LEXICAL REPRESENTATION AND SELECTION ON BILINGUAL SPEECH PRODUCTION

Mikel Santesteban Insausti

Doctoral Dissertation

Supervisor: Albert Costa Martínez

2006

Programa de Doctorat: Ciència Cognitiva i Llenguatge
Bienni 2001/2003

Departament de Psicologia Bàsica
Universitat de Barcelona

Cover design: Odon García Primo

A mi aita y a mi ama, de todo corazón

Nire aita eta amari, bihotz bihotzez

AGRADECIMIENTOS - ESKERRAK – ACKNOWLEDGMENTS

Desde que me embarqué en la realización de ésta tesis he conocido a gente que de una manera o de otra ha marcado mi camino en esta aventura. Han sido innumerables las ocasiones en las que he pensado que no debía olvidarme de añadir el nombre de estas personas en la lista de agradecimientos que algún día habría de escribir. Sin embargo, nunca dudé que los primeros nombres a añadir, y por eso los más importantes, en mi larga lista de agradecimientos debían ser los de mi ama y mi aita. A Daniel y a Nati, por apoyarme siempre en todos los pasos que he dado en esta vida, y por mostrarme siempre su cariño y afecto. Obviamente, tampoco puedo olvidarme de mis hermanos Xabier y Patxi, que al igual que mis padres, siempre han sido un punto de apoyo fundamental para mí. Esker aunitz, bihotz-bihotzez!

Obviamente, Itziar y Nuria no podían faltar en esta lista! Las clases de Itziar lograron que me apasionara y me fascinara definitivamente por el lenguaje y la lingüística. Después me guió hacia Barcelona, y, sobre todo, me presentó a Nuria, que me abrió las puertas de su grupo y me enseñó que la psicolingüística es mucho más de lo que nos enseñan en las carreras de filología. Aunque finalmente no haya sido ninguna de ellas la que haya dirigido mi tesis, siempre han estado presentes cuando necesitaba su ayuda o consejo. De hecho, sus ánimos han sido de más ayuda de lo que ellas puedan pensar. Eskerrik asko, Itziar! Moltes gràcies, Nuria!

Obviamente, no puedo dejar de nombrar a Albert Costa, que ha sido el que realmente ha hecho posible que la realización de esta tesis llegara a buen puerto. Durante los años que he trabajado con Albert, siempre se ha mostrado dispuesto a echarme una mano en todo, algo que nunca dejaré de agradecerle. Su ambición y su exigencia en ocasiones me han desbordado, pero, indudablemente, también ha conseguido contagiarme su entusiasmo y su pasión por la investigación. Creo que durante estos años de trabajo, además de conocer a un gran investigador, he conocido también a un gran amigo. Eso sí, un amigo que no ha dudado en machacarme en algunos partidos de squash, pero al que gané con toda justicia en el último enfrentamiento. Pero tranquilo, si quieres, tendrás opción de una revancha. Pues eso... ¡gracias por todo, Albert!

Bueno, y que queréis que os diga, la lista es todavía muy larga y no creo que logre acordarme de todos vosotros, pero lo intentaré (si alguno no aparece, seguramente no será porque no se lo merezca!). En primer lugar, gràcies al reducido grupo SPPB (luego ampliado y convertido en GRNC) por acogerme en su seno y enseñarme tantas cosas sobre psicolingüística, y, sobre todo, por brindarme vuestra amistad. Gracias a Nuria (de nuevo), Laura, Xavi (por tu paciencia), Àngels (por tus consejos y por acogerme en tu casa), Ruth y Ferrán. Ellos fueron las primeras personas a las que conocí en el departamento de Psicología, pero no las últimas. Gracias también a Jordi (en mi primera conversación contigo pensé "¿y este tío de que va?", pero ha merecido mucho la pena conocerte) y Juanma (que fue mi guía particular por la preciosa Colombia. Moltes gràcies, noi!). Gracias también a Rubén (¡Aupa rojillo!), Agnés, C., Agnés A., Begoña, Toni C., Cucu, Marta, Elena, Fátima, Bárbara, etc. Sin duda, debo agradecer también a Jin Nam Choi, Gabi Felhosi, e Iva Ivanova su ayuda en la pasación de algunos de los experimentos aquí reportados, y nuevamente a Iva por las innumerables correcciones ortográficas, estilísticas y de contenido que seguro han mejorado considerablemente la presente tesis. Blagodariá!! Mila esker ere Adam, Eider, Bea, Marijo eta HIMeko lagun guztiei (Aritz, Urtzi, Izaskun, Juncal, Julen, Ibon, etab.), Gasteizera egindako bisita guztietan hizkuntzalaritzaz horrenbeste gauza irakasteagatik! Eta bereziki Kepari, behar nuen guztietan gertu egoteagatik, eta lagun mina izateagatik! Finalmente, quiero agradecer especialmente a Edu el haber estado siempre ahí, dispuesto a escucharme cuando lo necesitaba. Ha sido todo un placer trabajar contigo y tener la oportunidad de disfrutar de todas esas largas conversaciones sobre trabajo, política, deporte, mujeres, música, etc. Por cierto, aún te debo un bacalao al ajoarriero!!

I would also like to thank Jacques Mehler and Judy Kroll for being so kind to receive me in their labs at SISSA and Penn State University, respectively. I would especially like to thank Judy and David for taking me from the streets of State College to her own home when I was homeless! :-) Thanks also to

Damir, Mohinish, Marcela and Ansgar for spending with me part of their time and making my stay in Trieste so nice! Thanks a lot to Steph, Susan, Kate, Carmen, Jared, Noriko, Maya, Chip, Giuli, Nuria, Pilar, etc. for all the interesting discussions on language production and comprehension, bilingualism, and various other, not psycholinguistics-related, issues. Thanks all for being so friendly to me and for contributing to the enriching experiences I had in Trieste and State College!

Bestalde, ezin dut atal honetan aipatu gabe utzi Bartzelonako Euskal Etxearen inguruan ezagutu ditudan lagun euskaldun zein katalanak. Zuekin hasi nintzen Bartzelona ezagutzen, eta zuek egin zenuten nire Bartzelonako hasierako abentura alaiagoa eta, batez ere, aberasgarriagoa: P-14 (Aitor O., Mikel, Agost, Moli, Eli), Lluis, Aitor K., Iban, Eñaut, les germanes Sureda (Susanna, Marta i Mont), etab. Com no, gràcies també a tota la gent de la Plataforma per Egunkaria (Aitor, Lis, Sergi, David, Itxaso, Ray, Ion, David N., Aitzol, Manel, Nora, Itziar, etab.) i a tots els altres que m'hagi oblidar d'anomenar. Bizitzak bide ezberdinetatik eraman gaitu, baina ez ditut inoiz ahaztuko zuekin bizi izandakoak!! Besarkada handi bat guztiontzat, eta ikusi arte! Eta, nola ez, besarkada berezi bat ez bizitzak, baizik eta epaileak Bartzelonatik (eta etxetik) urrun eraman duen lagunarentzat!! Laster izango dugu berriz ere zurekin parrandatxo bat egiteko aukera, hortaz, laster arte, Asier!

Gracias también a Elena y Sandra (y Julio), por acogerme "temporalmente" en su casa y hacérmelo pasar tan bien con ellas. Han sido unas compañeras de piso excelentes, y, sobre todo, ¡son unas grandes amigas! Bueno, y ¡qué decir del Combo (Juanma, Elena, Yolanda, Rubén, Fátima y... Marta)! ¡¡Esas grandes fiestas por L'H me las guardo para el recuerdo!!

Nire Barañaingo lagunek aipamen berezia merezi dute, hainbeste urtetan alde batetik bestera ibili arren, beti gertuago sentitu baitut euren laguntasuna! Barañainera itzultzen nintzen guztietan han zeuden Xabi, Odon (eta Kons), Iban, Axier, Aitor, Boni, eta Iparralde tabernako beste lagun guztiak. Asteburu zein oporraldi bikainak pasatu ditugu elkarrekin!! Mila esker!

Y por último, y no por eso la menos importante, muchas gracias a Elena, por acompañarme durante el último y más complicado trayecto de esta aventura vital e intelectual. Gracias por dedicarme tantos y tantos momentos inolvidables, y como no, gracias también por ayudarme a superar los abundantes momentos olvidables. ¡¡El viatge continua!!

En definitiva, gracias a todos y todas por vuestros "¿y la tesis, que, cuando la presentas?" Se ha hecho esperar, pero... aquí la tenéis.

Gràcies a tots! Ens veiem a la propera estació!

Ah!, y, ya sabéis, si necesitáis cualquier cosa...

The research reported in this thesis was supported by a grant from the Basque government (Eusko Jaurlaritza, PI-1999-18)

TABLE OF CONTENTS

0 Introduction

The main issue we will address along this dissertation could be summarized with the following question: how do bilingual speakers prevent massive interference from the non-response language during speech production? That is, the focus of research interest of this dissertation concerns two main topics: language production and bilingualism. From these starting points, we try to shed some light on the way speakers access proper words during the production of language. More specifically, we explore the attentional control mechanisms that allow bilingual speakers to achieve lexical access in the intended language while avoiding interference from the lexical items of the non-intended one.

Few people would disagree with the following statement: one of humans' most special ability is that of being capable of communicating to other humans any idea that comes to their minds through linguistic vocalizations (or hand signings). In fact, the human language faculty allows us to communicate information in ways that can not be matched by other communicative systems. So, language seems to be the ability that mostly differentiates us from all the other animal species. But, how do humans produce words in a way that conveys the intended meaning to their interlocutors? Which are the cognitive representations and processes that allow us to put thoughts into linguistic vocalizations? These are the main questions broached by researchers working on speech production.

In the past 30 years, an increasing amount of research has been devoted to the study of the architecture and functioning of the language production system. The research methods used for that purpose range from naturalistic observation (e.g. slips of the tongue, disfluencies, aphasic cases) to experimental techniques (reaction time registration of picture or word naming, lexical or syntactic structure priming paradigms, etc.). All this research has provided fundamental information for a better understanding of the way the cognitive machinery underlying speech production works. Moreover, this research has revealed that, despite the ease with which language production is conducted, the cognitive machinery involved in this ability is very complex and unfortunately still poorly understood.

Language production researchers agree that the production of fluent speech involves the use of pragmatic, semantic, syntactic, phonological and articulatory processes and representations. Hence, to achieve successful communication, different processing subsystems should be properly orchestrated by the language production system (e.g., Caramazza, 1997; Dell, 1986; Garrett, 1980; Levelt, 1989). The ability to produce language involves both retrieving information from the different linguistic levels of representation stored in memory and integrating all this information on the fly into utterances. In order to see how the production of an utterance is carried out, let us consider an example.

Imagine that you read a book by Paul Auster, and you want to recommend the book to a friend. In such a case, you have already made the first step through language use: you have selected the concept you want to communicate. Thereafter, you have to retrieve from your mental lexicon the words corresponding in meaning to the concept. For example, you select the words corresponding to the names of the author ("Paul Auster") and the book ("The New York Trilogy") you want to recommend. Additionally, you should also specify who must do what. That is, you have to retrieve from your mental lexicon words like: “Paul”, “New York”, “you”, “must”, “trilogy”, “Auster”, and “read”. Then, in order to construct a grammatical and understandable sentence, you should retrieve the syntactic information contained in those words and use it to generate the appropriate syntactic structure and the specific order in which these words need to be produced. For that purpose, you need to use the syntactic rules of the specific language you intend to produce, in this case, the rules of English. Thereafter, the phonological form and the information about the articulatory gestures to be performed must be retrieved. To do that, you have to access the phonemes of each of the selected words (e.g., /s/, /t/, /e/, /p/, /o/ and /r/), order them (e.g., /p/, /o/, /l/, /o/, /s/, /t/, /e/, /r/), and retrieve information about the articulatory gestures necessary to produce them (e.g., perform a formation and a rapid release of a complete closure at any point in the vocal tract from the glottis to the lips to produce the sound /p/, etc…). By such a way, the articulation of the name of the writer Paul Auster will be achieved. After the retrieval and assembly of all these different types of information have been orchestrated in real time, the speaker should be able to produce the following utterance: “You must read Paul Auster’s The New York Trilogy!”. So, the intended communicative intention would finish through the parsing of the sentence by your friend. Of course, there is no doubt that the decision to read the book would depend on your friend’s personal choice.

This example clearly illustrates the complexity of the mental machinery implicated in the ability to speak. Although clear advances have been made in the last decades (e.g., Bock & Levelt, 1994, Dell, 1986; Garrett, 1975, 1980; Levelt, 1989; Vigliocco & Hartsuiker, 2002), a lot of research should be done in order to fully understand the mechanisms engaged in speech production. An important hazard on the way towards finding a conclusive answer to these issues, however, is presented by the intrinsic difficulties in developing experimental paradigms to study the production of complex linguistic structures. Maybe for this reason, most of the research on language production has focused on the study of single word or, in some cases, small phrases production. One could argue that such studies do not provide relevant data to account for how utterances are produced. But, albeit their limitations, they have provided a great source of data from which rich information has been obtained to better understand how some syntactic aspects of language are retrieved (e.g., syntactic gender information, number agreement, etc.). Thus, we believe that the study of specific processes (e.g., lexical selection, phonological segment selection, gender retrieval, etc.) could be a valuable shortcut to get a better knowledge of the way the full machinery works.

One of the main characteristics of the human language production system could be summarized as follows: despite the complexity of the cognitive machinery involved in the production of language, this machinery is extremely efficient and accurate. Levelt (1989) estimated that a literate adult speaker has acquired a productive lexicon of about 30.000 words. All these words can be arranged in an incredibly large number of ways that, following the syntactic rules of the specific language, would create a large, maybe infinite number of sentences. Moreover, sentences are built in a rate of around one sentence per two seconds. However, in spontaneous language production, monolingual speakers make no more errors than once or twice every 1.000 words (Bock, 1991). In the case of bilingual speakers, it is estimated that highly-proficient bilinguals produce an average of 2 or 3 slip-of-the-tongue errors every 1000 words, in first (L1) and second (L2) language, respectively (Poulisse & Bongaerts, 1994; see also Poulisse, 1999). This may suggest the bilingual system is less accurate than the monolingual. But, if one assumes that bilinguals have at least two different labels for each of their lexicalized concepts (e.g. an English-Spanish bilingual should have acquired the words "table" and "mesa" for the conceptual representation of TABLE; e.g., Kroll & Stewart, 1994), it seems reasonable to admit that their system is in fact not so inaccurate. The question now arising is how the language production system works to attain those accuracy rates. This issue has been largely investigated in the language production literature. However, until now, most of this research has focused on the study of monolingual speakers, whereas unfortunately few researchers have addressed bilingualism.

The main aim of this dissertation is centred on the study of an important process involved in language production: lexical access. However, we explore the processes involved in lexical access from a bilingual perspective. This is because a better understanding of the way speech production is achieved by bilingual speakers is necessary. In contemporary society, around 50% of the world's population is bilingual. Given the current political and economic globalization and the emigration movements, one may suspect that bilingualism will become the rule rather than the exception. For example, in the European Union, according to a recently published public opinion pull (*Europeans and languages*. Special Eurobarometer 237-63.4), half of the citizens of the Member States assert that they can speak at least one other language than their mother tongue at the level of being able to have a conversation. Moreover, two interesting data suggesting that this percentage will increase in the following years are reported. First, the tendency to know other language(s) than the mother tongue diminishes with age. For example, 66% of the 15-24 year-olds claim to speak English as a second language, compared with 53% of the 25-39 year olds, 38% of the 40-54 year-olds and 18% of the over-55s. Second, 93% of the parents of children aged under 20 in Europe say it is important that their children learn other European languages. Hence, in order to better understand how the language production system works, we should look into lexical access not only from the perspective of monolingual speakers, but also from the perspective of bilinguals. In the case of bilingual speakers, to know how they achieve lexical access in the production of language is an important step towards the understanding of how they maintain their two linguistic systems apart. To give a satisfactory answer to this question is the main goal of this dissertation.

0.1 Main structure of the present dissertation

In the first section, the architecture of the language production system will be presented. Here, we will focus on the way lexical access is achieved by bilingual speakers. We will start presenting the two main assumptions adopted by current models of monolingual language production (multiple lexical activation and selection by competition), and discuss how these assumptions affect lexical access in bilingual speech production. In the second section, the two main models of bilingual lexical access, the Inhibitory Control (IC) and

Language-Specific Selection models, will be presented along with the main pieces of evidence supporting each of them. Third, we will put forward the main objective of this dissertation: to test whether bilingual speakers rely on inhibitory control mechanisms while producing speech. That is, we will test whether the IC model can account for bilinguals' language switching performance, and, by extension, the way bilinguals control language production. The main properties of the experimental paradigm used will be also presented: the language-switching paradigm. The main results of the reported experiments and their main implications for the bilingual language selection models will be reported in the Experimental Section and the General Discussion sections, respectively. Finally, an overall conclusion of our results will be drawn.

1 Lexical access in language production: The case of bilingual speakers

During speech production, speakers have to convert their communicative intention into linguistic form. Although there are different models of monolingual speech production accounting for this issue, all of them agree that there are at least three levels of representation involved in language production: the conceptual, the lexical[1] and the phonological level (Caramazza, 1997; Dell, 1986; Levelt, Roelofs, & Meyer, 1999).[2] Speakers have to decide which concept they want to communicate, select the proper lexical entry to express it, and retrieve the phonological content of the word to articulate it. That is, speakers have to access, at least, three types of representations: concepts, words and phonemes. To do that, speech production models widely embrace two main assumptions: 1) during the lexicalization process several lexical representations are activated; and 2) selection is achieved by competition processes among the activated lexical nodes. That is, according to

[1] There is an interesting debate in regard to the necessity of decomposing the lexical level into two different levels (lemma and lexeme). However, those questions do not fall within the scope of this dissertation. Interested readers are encouraged to see: Caramazza 1997; Miozzo & Caramazza, 1997; Levelt et al., 1999.

[2] Certainly, in order to account for how language is produced syntax is also needed. However, our research is only focused on single word production processes; thus, we will not discuss here how syntax is implemented in these language production models.

the former assumption, at the time of selecting the concept to be produced, related concepts are also activated to some degree. As a consequence, the intended lexical node is activated at the lexical level of representation. However, at the same time, related conceptual representations also activate their corresponding lexical nodes. Due to the multiple lexical activation, speakers should implement some sort of selection mechanism in charge of deciding which of all the activated lexical nodes correspond to the concept they want to produce. The characteristics of these two assumptions and their implications in bilingual speech production are more deeply described in the following section.

1.1 Does activation spread to bilinguals' non-response language?

The spreading activation principle assumes that any activated representation spreads a proportion of its activation to any other representation to which it is linked. Hence, activation will freely flow both within and between levels of representation. Speech production starts with the activation of conceptual representations at the semantic level. Then, by means of the spreading activation principle, during conceptual processing, not only the semantic representation of the intended concept but also those of semantically related concepts are activated to some degree. The main evidence in favour of the spreading activation account comes from naturally occurring and experimentally induced speech errors or slips of the tongue in both normal and aphasic speakers (e.g., Baars, Motley, & Mackay, 1975; Butterword, 1989; Dell, 1986; Dell, Schwartz, Martin, Saffran, & Gagnon, 1997) and from experimental paradigms such as the picture-word interference paradigm (see section 2.1). For example, evidence coming from speech error analyses has shown that errors caused by a misselection of lexical entries usually relate the target (e.g. "cat") in meaning (semantic error; e.g., "dog"), in sound (formal error; e.g., "mat" or "cap"), or in both meaning and sound (mixed error; "rat")[3] to other representations. The existence of such semantic errors suggests that speakers do not only activate the concept of the target (e.g., "table"), but also other semantically related concepts such "chair", "wardrobe", "desk", "bed", etc. Additionally, all these activated semantic representations spread activation down to the lexical level activating their corresponding lexical nodes. Thus, in addition to the target lexical node "table", others like "chair", "wardrobe", "desk", "bed", etc. are also activated. Because of this multiple activation, and to ensure the correct selection of the target lexical node "table" while avoiding production of any other activated lexical item, a lexical selection mechanism is required. A malfunctioning of such a mechanism may result in erroneous lexical selection, and the speaker may produce the word "chair" instead of "table". Before going further to explain how this selection mechanism works, it is important to comment how the spreading activation account affects bilingual speech production.

The models of bilingual language production assume the existence of a common semantic representation for the two languages of a bilingual at the conceptual non-linguistic level (Finkbeiner, Nicol, Nakamura & Greth, 2002; Li & Gleitman, 2002; Kroll & Stewart, 1994; Potter, So, Von Eckhardt, & Feldman, 1984). However, at the lexical level, different representations are proposed for each language. Therefore, for such models, the same concept, at least regarding concrete concepts, is associated with two translation equivalent lexical nodes in a bilingual mind. Thus, the bilingual should decide which of these lexical nodes correspond to the language she intends to speak. At this point, is worth noting an assumption widely assumed in bilingual language production models: selection of the response language precedes activation of

---

[3] These mixed errors have been interpreted as evidence of the existence of spreading activation from the lexical to the phonological levels of representation, and, additionally, to an interactive flow of the activation between these two levels of representation (e.g., Dell, 1986, 1988; Dell & O'Seaghdha, 1991, 1992; Dell & Reich, 1981; Dell, Schwartz, Martin, Saffran and Gagnon, 1997; Harley, 1984, 1993; MacKay, 1987; Stemberger, 1985). Moreover, these results challenge the assumption of no spreading activation from lexical to phonological levels (see Butterworth, 1989; Garrett, 1980, 1992; Kempen & Huijbers, 1983; Levelt, 1989, 1992; Levelt et al., 1991; Levelt et al. 1999; Roelofs, 1992, 1997; Schriefers, Meyer, & Levelt, 1990; for a review of these issues, see Rapp & Goldrick, 2000).

lexical nodes. In other words, it is at the conceptual level of representation where the decision of which language to produce is taken. This is because, it is the bilingual speaker who decides, based on the linguistic context in which she is involved (e.g. whether the interlocutor is a monolingual or a bilingual speaker, etc.), the language she wants to speak. Hence, an important question becomes relevant in order to implement the monolingual language production models into bilingual contexts: Does the semantic system activate the two lexicons of a bilingual? In other words, is the spreading activation principle functional across languages?

There is wide agreement in giving a positive answer to this question. Most models of lexical access assume that during the course of lexicalization in one language (e.g., L2), the lexical nodes of both languages of a bilingual receive activation from the semantic system (e.g., Colomé, 2001; Costa, Caramazza, & Sebastián-Gallés, 2000; Costa, Colomé, Gómez & Sebastián-Gallés, 2003; Costa & Santesteban, 2004a De Bot, 1992; Gollan & Kroll, 2001; Hermans, Bongaerts, De Bot & Schreuder, 1998; Poulisse, 1999). The most important evidence supporting this parallel activation assumption comes from studies proving that phonological representations of lexical nodes of the non-target language are activated when speaking in the target language. For example, in a series of phoneme-monitoring tasks, Colomé (2001) demonstrated that segmental units of information of the target-words' translations are also activated. This author asked Catalan-Spanish highly-proficient bilinguals to determine whether a predesignated phoneme (e.g. "t", "m" or "f") was present in the Catalan name of the target picture (e.g. "taula", table in Catalan) (see also Wheeldon and Levelt, 1995; and Costa, Sebastián-Gallés, Pallier and Colomé, 2001, for studies in which the phoneme monitoring paradigm has been used in speech production). Three types of trials were included: a trial that elicited positive answers (e.g., "t", a phoneme that was present in the Catalan name of the target picture), and two trials eliciting negative answers (e.g., "m" and "f", phonemes that were not present in the Catalan name of the target picture). The comparison of the two critical conditions requiring negative answers gave us the most important proof of the presence of phonological activation for non-target language words: In one condition the presented phoneme (e.g. "m") was not in the target word "taula", but appeared in its Spanish translation, “mesa”. In the other condition, the presented phoneme (e.g. “f”) appeared in neither the target language word (“taula”) nor the non-target language one (“mesa”). Crucially, the comparison of these two conditions showed that participants needed more time to reject phonemes belonging to the translation word than phonemes not present in either word (see also Hermans, 2000 for similar results, and Rodriguez-Fornells, Van der Lugt, Rotte, Britti, Heinze and Münte, 2005, for a replication of the data with ERP and fMRI techniques). These results were interpreted as revealing the simultaneous activation of bilinguals’ two languages up to sublexical levels (but see Costa, La Heij and Navarrete, 2006, for an alternative explanation of these results).

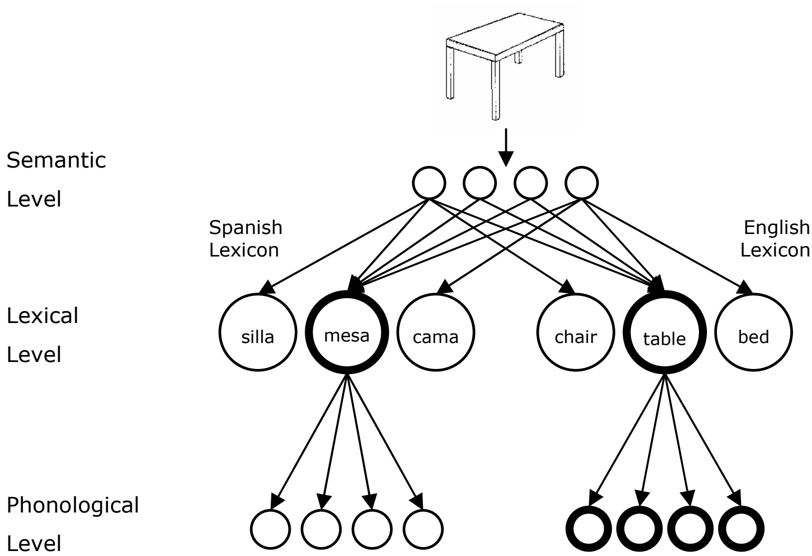


Figure 1. Schematic representation of the bilingual language production system. The arrows represent the flow of activation, and the thickness of the circles indicates the level of activation of the representations. Hence, in this example, the activation spreads to the two lexicons of the bilinguals. However, finally only the lexical node “table” is selected.

Consequently, whereas monolinguals have to face the problem of selecting the proper lexical entry (e.g., “table”) between all activated entries of the same language (e.g., “table”, “chair”, “desk”, “bed”, etc.), bilinguals have to face the same problem with the additional difficulty of having to select the target word among activated lexical nodes of their *two* languages (e.g. the English words “table”, “chair”, “desk”, “bed”, etc.; but also the Spanish words “mesa”, “silla”, “escritorio”, “cama”, etc., respectively) (see Figure 1). Hence, the main question in this context refers to the role of the lexical representations belonging to the non-response language. How do bilingual speakers solve the lexical selection problem?

1.2 Competition in lexical selection

The lexical selection mechanism is in charge of deciding which of the activated lexical items needs to be prioritized for further processing. It is widely accepted that the level of activation of lexical nodes is the critical variable for deciding which element is to be selected (e.g., Dell 1986, Levelt, 1989, 2001; Levelt, Roelofs, & Meyer, 1999; Roelofs, 1992, Starreveld & La Heij, 1995, 1996). Thus, in general, the lexical selection mechanism would pick out the word with the highest level of activation (e.g. “table”) which, in normal error-free production, corresponds to the intended meaning. However, in this process, not only the activation level of the target lexical node is considered, but also the activation level of all competing lexical nodes (“chair”, “desk”, “bed”, etc.). In other words, all the activated lexical nodes compete for selection. As a result, the time needed to select the target node could vary depending on the activation levels of the competing lexical nodes. If competing nodes are not highly activated, these would be weak competitors, and target selection would be easy. However, if competing nodes are highly activated, they would be strong competitors, and target selection would be hard and delayed in time.

The main evidence for the selection-by-competition assumption (as well as for spreading activation) comes from results observed with the picture-word interference paradigm. This paradigm is a Stroop-like task in which participants are presented with a target picture and a distractor word, and are asked to name the picture and ignore the word (see MacLeod, 1991, for a review of Stroop and Stroop-like paradigms). Picture naming latencies vary depending on the relationship between the two stimuli. For example, longer reaction times are found with categorically related picture-word pairs (e.g., "table-chair") than with unrelated ones (e.g., "table-dog") (e.g. Caramazza & Costa, 2000; Glaser & Düngelhoff, 1984; Glaser & Glaser, 1989; La Heij, 1988; Lupker, 1979; Meyer, 1996; Roelofs, 1992, 1993; Rosinski, 1977; Schriefers, Meyer, & Levelt, 1990; Starreveld & La Heij, 1995, 1996); and faster reaction times are found with phonologically related pairs (e.g., "table-tape") than with unrelated ones (e.g., Costa & Caramazza, 2002; Costa & Sebastián-Gallés, 1998; Damian & Martin, 1999; Lupker, 1982; Meyer & Schriefers, 1991; Navarrete & Costa, 2005). In the former case, it is broadly assumed that the semantic interference effect reflects competition between lexical nodes at the stage of lexical selection. That is, in the case the speaker is presented with the picture of a table with the superimposed word "chair", the distractor word would be highly activated. This is because, as the target word is "table", the speaker would activate its corresponding semantic representation, and that, due to the spreading activation assumption, would also activate the semantic representations of related concepts such as "chair", "desk", "bed", and so on. Such representations would activate their lexical counterparts to different degrees. As a result, the lexical node "chair" would receive activation from two sources: the picture and the distractor. In contrast, when the distractor word is an unrelated one (e.g., "dog"), such word would receive activation only from the distractor, but not from the picture. Consequently, as the competing word (the distractor) is activated to a greater extent in the "table-chair" picture-word pair than in the "table-dog" pair, the former distractor would be a stronger competitor, and would lead to larger response times. However, these semantic effects are not reported when picture-word stimuli are used in tasks that do not require overt naming responses. For example, Schriefers and collaborators did not observe semantic interference in a "button pressing" picture recognition task (Schriefers, Meyer and Levelt, 1990). That leads to the localization of the semantic interference effect at the lexical level, rather than at the conceptual one (but see Costa, Alario & Caramazza, 2005; Costa, Mahon, Savova & Caramazza, 2003; and Rosinski, 1977, for an alternative explanation). Consequently, semantic interference has been interpreted as a main source of evidence for a "lexical selection by competition" process.

Going back to the bilingual case, observe that for them almost every concept is associated with two lexical nodes. Hence, one may speculate that lexical access should be considerably more difficult for bilinguals than for monolinguals. This is because, while selecting the target word (e.g., "table") bilinguals have to select it between all the activated lexical nodes of their two languages (e.g. "table", "wardrobe", "chair", "mesa", "armario", "silla", etc.). In addition, it is reasonable to assume that, because it gets activated from the same conceptual representation, the translation word "mesa" should be a stronger competitor than any other semantically related lexical node, independently of whether it is of the response language. That is, when presented with a picture of a table in a picture naming experiment, the lexical representations "table" and "mesa" should become activated to roughly equal levels, as it happens with synonyms in monolingual production (Peterson & Savoy, 1998; and, especially Jescheniak & Schriefers, 1998). Subsequently, it should be very difficult to select the target lexical node.

Given that situation, the central issue that needs to be addressed in order to implement monolingual lexical selection mechanisms to bilingual contexts is whether the lexical nodes of the non-response language (the language not intended for production) act as competitors. Resulting directly from the assumption of the "selection by competition" lexical access, bilingual speakers should find some way to solve the selection problem. In the second section of this dissertation, we will review the two main models that have been proposed to account for this lexical selection problem in bilinguals.

2 How do bilinguals select lexical nodes in the response language?

As mentioned above, the lexical selection problem in language production arises because of the spreading activation principle. That is, if we assume that activation flows freely between representations, multiple lexical nodes will be activated, and a lexical selection mechanism is necessary to select the intended word. If, moreover, we assume that the spreading activation principle is also functional across languages, we must agree that the selection process should be even harder in the case of bilingual speakers. Thus, the question that becomes relevant is the following: how does the bilingual select the word in the intended language while preventing massive interference from the non-response language? The two main models accounting for such issues will be presented in the following lines.

The first model assumes that the *lexical selection mechanism is language-specific* (Costa & Caramazza, 1999; Costa, Miozzo, & Caramazza, 1999; Roelofs, 1998), in the sense that it only considers the activation-level of words in the intended language. According to this idea, lexical intrusions from the non-target language would be prevented since these words would not be included in the pool of possible candidates for production, and therefore they would not be able to compete with target language lexical nodes during lexical access. That is, this model assumes that the "selection by competition" account is only applied within languages, but not across languages. Consequently, according to this proposal, there would be no competition at all between lexical items of different languages. In contrast, the second model of bilingual lexical selection assumes that *the lexical selection mechanism is insensitive to the language in which the speaker intends to express her ideas*, and would consider for selection all activated lexical nodes, irrespective of the language to which they belong. However, although lexical nodes of both languages would compete for selection, in this model, the successful selection of the proper lexical node (i.e., in the correct language) is ensured by creating a differential level of activation for the two lexicons of a bilingual.[4] The most

---

[4] However, some researchers apparently suggest that the language selection problem is solved at the semantic level of representation. These researchers propose that an activation imbalance between the two lexicons of a bilingual is achieved assuming that the semantic system activates to a larger extent words in the response language than words in the non-response language (Paradis, 1997, 2004; Poulisse & Bongaerts, 1994). In a recent proposal, La Heij (2005) suggests that the language selection problem of the bilingual speakers is not that problematic after all. He begins by suggesting that in the case of monolingual speakers, the lexical node corresponding to the intended message receives much more activation than unintended near synonyms or related words. Thus, the level of activation of the non-target lexical nodes would not be enough to compete with the activation level of the target node. In such a way, La Heij apparently suggests a shift of the locus of selection from the lexical level to the level of semantics (see, Bloem and La Heij, 2003; and Bloem, Van Den Boogaard, and La Heij, 2004, for data on monolingual speakers leading to such a proposal). Moreover, assuming that the preverbal message includes some kind of language tag, La Heij (2005) argues that the same argument is applied to bilingual speakers. That is, when an English-Spanish bilingual intends to produce the name of a table in Spanish ("mesa") she will specify at the conceptual level the intended language, Spanish. Thus, the Spanish language will be more strongly activated than the English one, and, because the semantic system activates the lexical nodes of the response to a substantially higher level than lexical nodes in the non-response language, the lexical node "mesa" will be selected.
However, in order to explain the semantic interference effect, La Heij is forced to assume that more than one lexical node is activated at the lexical level of representation. Consequently, although selection might be facilitated by means of the activation imbalance created at the conceptual level of representation, one might think that selection really occurs at the lexical level of representation. Thus, it is not clear what is the difference between this proposal and those assuming multiple lexical activation. In both approaches, it seems that selection should happen at the lexical level of representation (see Kroll, Bobb, & Wodniecka, 2006, for a discussion on the existence of different loci of bilingual language selection).

articulated proposal that achieves this imbalance postulates that lexical access in bilingual speakers entails the reactive inhibition of lexical items belonging to the non-response language (Green, 1986, 1998; Hermans et al., 1998).

In the following section we will present these two models in detail and we will discuss the available experimental evidence that has been used to argue in favour and against them.

2.1 Language-Specific Selection Model (Costa et al., 1999)

In a work published in 1999, Costa and collaborators proposed a lexical selection mechanism in which the bilingual only considers the activation-level of the words in the language she wants to speak. Accordingly, this model should be considered, in terms of the lexical selection mechanism, a language-specific model. This is because the model postulates that only the words tagged for the proper language are considered for selection, whereas those words having an incorrect tag do not enter into competitive processes of selection. Costa and collaborators embrace the assumption that lexical nodes are specified for language in terms of language tags. Therefore, bilinguals are able to identify L1 and L2 words and subsequently specify which lexical entries will be considered during lexical selection.

The language-specific selection model makes the following main assumptions. First, at least for highly-proficient bilinguals, lexical nodes of both languages receive the same amount of activation from the conceptual level. That is, both lexicons are activated in parallel. Second, although all lexical nodes are activated, *"only"* those lexical nodes in the lexicon that are part of the language the speaker wants to produce are considered for selection. Consequently, the model assumes that those lexical nodes that are part of the non-response language lexicon ***cannot compete*** for selection (see Figure 2). In that respect, the authors note that the notion of a lexical selection process sensitive to specific properties of the lexical nodes has already been postulated in monolingual contexts. For example, Dell (1986) proposed that the lexical selection mechanism is sensitive to the grammatical class of the lexical items. That is, if the speaker wants to produce a noun, the selection mechanism will consider only the lexical items corresponding to nouns (see Mahon, Costa, Shapiro, & Caramazza, 2001; Pechmann, & Zerbst, 2002, for evidence supporting such an assumption; but see Vigliocco, Vinson, & Siri, 2005).

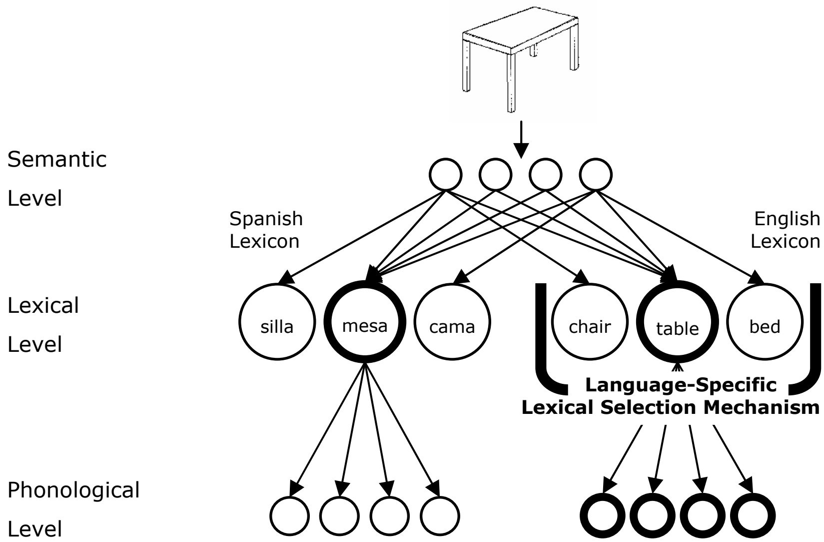


Figure 2. The Language-Specific Selection model (Costa et al., 1999). In this example, a Spanish-English bilingual intends to produce the target word ("table") in his L2 (English). As could be noted, both Spanish and English lexicons are activated. However, according to this account, the lexical selection mechanism only considers for selection those lexical representations belonging to the response language (L2, English). The lexical nodes of the non-response language (L1, Spanish) are not considered for selection.

2.1.1 Evidence supporting the Language-Specific Selection model

Support of this model is based on results from a bilingual version of the picture-word interference paradigm (Costa et al., 1999). In this work, Costa and collaborators studied whether there is lexical competition across languages. To do that, they tested how identity, semantic and phonological relationship between the names of target pictures and distractor words affect naming response latencies of highly-proficient Catalan-Spanish early bilinguals, both within and across languages. In a series of experiments, participants were asked to name pictures in Catalan while ignoring printed distractor words. These distractor words were presented both in Catalan and in Spanish. The main results showed semantic interference and phonological facilitation effects for both Catalan and Spanish distractors. However, the crucial result supporting a language-specific selection model is the facilitatory identity effect found for both same- and different-language distractors. That is, shorter reaction times were found when participants had to name the picture of a table in Catalan ("taula") both when presented with an identical distractor word in the same language ("taula"), *and* with its translation in Spanish ("mesa"), than when paired with an unrelated word such as "gos" or "perro" (dog in Catalan and Spanish, respectively).

The finding that identical pairs facilitate the naming task cross-linguistically supports the notion of language-specific selection processes in bilingual speech production. Moreover, it challenges those models that assume cross-language competition processes (e.g., Green, 1986, 1998), because in such a scenario, for a bilingual intending to produce the word "taula" (table in Catalan), one must expect that the strongest possible competitor would be its translation word "mesa" (table in Spanish). That is, translation words should be even stronger competitors than semantically related words. But this it is clearly not the case. Therefore, the authors proposed a language-specific selection model in which the cross-language identity effect is explained as follows: assuming that a distractor activates not only its corresponding lexical representation but also its translation, when the distractor is the translation of the target picture name, the latter will receive extra activation from the former. That is, the target name "taula" will receive activation not only from the target picture itself (table), but also from the distractor word ("mesa"). Cruciallly, because only lexical representations of the target language are considered for selection, the Spanish lexical representation "mesa" cannot interfere with the selection of the Catalan target word, "taula". Thus, the production of the target word is facilitated relative to the presentation of a neutral distractor (e.g. “perro”; dog in Spanish).[5]

2.2 The Inhibitory Control model (Green, 1986; 1998)

The most articulated model assuming that bilingual lexical selection is achieved through language non-specific mechanisms is the Inhibitory Control model proposed by David Green (1986, 1993, 1998). Norman & Shallice (1986) put forward an action control model in which they assumed that the performance of actions is linked to task-schemas determining the way those actions will be performed. Based on this model, Green proposed the existence of language task-schemas that control language production. Such task-schemas refer to mental networks that individuals may construct in order to achieve a specific task. In the case of language production, task-schemas refer to actions like “speak-in-L1” or “speak-in-L2”. When the individual’s goal is to speak in L2, the appropriate language task-schema would be retrieved from memory to regulate and ensure the L2 production process. In this case, the “speak-in-L2” task schema would regulate the activation levels of the representations within the lexico-semantic system by activating representations belonging to L2 and ***inhibiting*** those of the non-intended language, L1. Moreover, as the language task-schemas could compete to control output, a supervisory attentional system (SAS) is proposed. In the IC model, the role of the SAS is to modulate the activity of task-schemas and monitor the performance of these schemas in relation to task goals. That is,

[5] This cross-language identity facilitation effect has been replicated with bilinguals of different languages: Dutch-English (Hermans, 2000, 2004); Spanish-English and English-Spanish bilinguals (Costa & Caramazza, 1999). In the latter case, Costa and Caramazza found the effect both when subjects named pictures in their L1 and in their L2. This favours the interpretation that the language-specific selection model is active both when speaking in L1 and when speaking in L2. Moreover, although the two bilingual populations tested by Costa and Caramazza were highly-proficient in their L2, they were unbalanced bilinguals that were more fluent in their native language. They started learning their L2 late in life (after the age of 9). Thus, they were from a different population as that of the highly-proficient early bilinguals tested by Costa et al. (1999).

the SAS transmits to the task-schemas which is the language required to achieve the communicative intention. The corresponding language task-schema controls the output from the lexico-semantic system by regulating the activation levels of lexical representations and inhibiting other task-schemas from the system. At the same time, conceptual information is also transmitted to the lexico-semantic system from the language-independent conceptualizer. However, with such conceptual information, the intention to produce a word in a specific language (e.g. "say 'table' in L2, English" for a Spanish-English bilingual speaker) must be specified. Green assumes that lexical nodes are specified in terms of language tags that are also part of the lexical ("lemma") representation of the word. However, this tag is just one feature of the lexical representation. Then, in order to ensure the production of a word in the

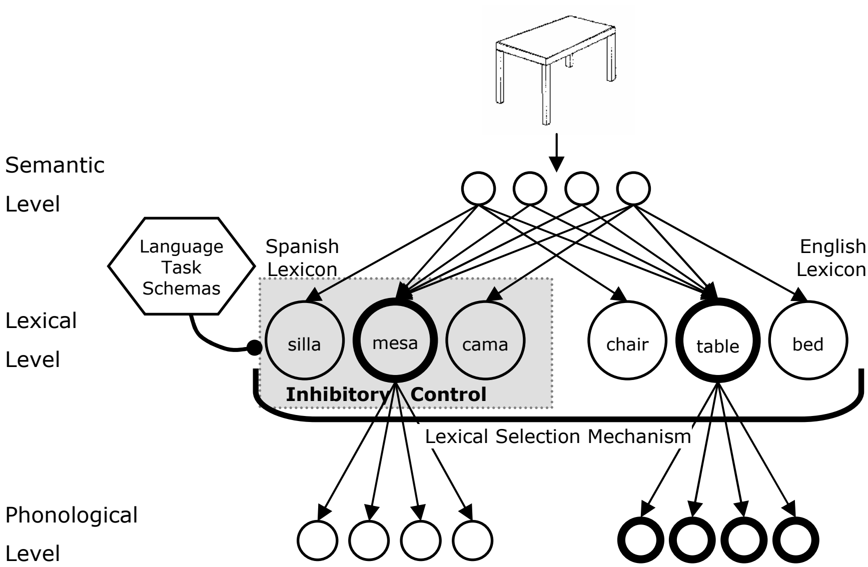


Figure 3. A simplified version of the Inhibitory Control model proposed by Green (1998). In this example, a Spanish-English bilingual intends to produce the target word ("table") in his L2 (English). As could be noted, both Spanish and English lexicons are initially activated, and both are considered for selection by the lexical selection mechanism. However, the language task schemas through their inhibitory connections suppress the non-response language's lexicon (L1, Spanish).The shaded box indicates the inhibition applied over the lexicon of the non-response language.

intended language, convergent information has to arrive to the lexico-semantic system both from the language-task-schemas ("speak in L2") and from the conceptualizer ("say 'table' in English"). It is precisely at this point where the *inhibitory control mechanism of language selection enters into play*. To ensure that the correct output word is produced, the IC model assumes that the activation of the lexical nodes of the non-response language is suppressed (see Figure 3). Next, evidence supporting the IC model will be presented.

2.2.1 Evidence supporting the IC model

There are two sets of results that have been argued to support the assumptions made by the IC model. For the first one, the picture-word interference paradigm was used, while a language-switching paradigm was used for the second one. The former supported the notion of the existence of competition across languages. The latter revealed the use of inhibitory control processes in bilingual language production.

Hermans and collaborators (1998) showed that the lexical nodes of the non-response language do compete for lexical selection. This was shown by means of what has been called the phono-translation interference effect. In a series of picture-word interference tasks, they asked Dutch-English unbalanced bilinguals to name pictures in their L2 (English) while ignoring auditorily presented distractor words in L2 (English) or in L1 (Dutch). The critical condition of this study was the phono-translation condition in which the distractor word was phonologically related to the target's translation. So, when participants were asked to name the picture of a mountain in English, the distractor was a Dutch word (e.g., "berm"; verge in English) phonologically related to the target's translation in Dutch (e.g., "berg"). The results indicated that it took longer to say "mountain" with the Dutch distractor "berm", than with the unrelated distractor "kaars" (candle in English). To interpret this interference, Hermans and collaborators argued that the phonologically related distractor "berm" activates the target's translation, "berg". In this case, as the Dutch lexical node "berg" (mountain in English) receives activation both from the picture's semantic representation and the distractor word, its activation would be enhanced. Hence, during the lexical selection of the English node "mountain", in the phono-translation condition, the translation of the target word ("berg") would become a strong competitor. Thus, Hermans and collaborators explain the phono-translation interference effect by assuming that the words of the non-response language enter into competition during lexical selection (see also Hermans, 2004).

However, Costa, Colomé, Gómez, & Sebastián-Gallés (2003) proposed an alternative interpretation of these results. In this study they replicated the phono-translation interference effect in highly-proficient Spanish-Catalan bilingual speakers. But, in contrast to the explanation given by Hermans et al. (1998), Costa and collaborators argued that the phono-translation effect can be accounted for without appealing to cross-language lexical competition. They suggested that a language-specific selection mechanism could account for the phono-translation effect assuming that the phonological properties of the target's translation are activated and affect the ease with which the target's phonological properties are retrieved. Consequently, according to these researchers, the phono-translation effect would be the result of phonological interference during the selection of the target's phonological content, rather than the result of interference at the lexical level.

The second result that has been quoted to support the IC model comes from a study carried out by Meuter & Allport (1999). These authors conducted a language switching experiment in which unbalanced bilingual speakers were asked to name aloud series of lists containing Arabic digits (from 1 to 9) either in L1 or in L2. The language in which a given number had to be named was determined by the background color of the screen (i.e., if blue name the digit in L1; if red name the digit in L2). Experimental trials were divided into switch and non-switch trials. A non-switch trial required a response in the same language as the immediately preceding trial, while a switch trial required a response in a different language. Since responses were given in L1 and L2, there were four different types of trials: Switch to L1, Switch to L2, Non-Switch in L1, Non-Switch in L2. As expected, naming latencies on switch trials were slower than on non-switch trials, revealing that switching between tasks (name in language X, name in language Y) incurred a time cost. However, the magnitude of the switching cost was larger for L1 than for L2. That is, the switching costs were asymmetrical: to switch from L2 to L1 was more costly than vice versa (see also Janssen, 1999). The asymmetrical switching cost, which at first glance seems paradoxical, finds a ready explanation in the framework of the IC model and in the Task Set Inertia hypothesis (e.g., Allport, Styles, & Hsieh, 1994; Allport & Wyllie, 1999). Specifically, these results supported two main assumptions of the IC model that are crucial for our purposes:

1) According to the first assumption, *inhibition is reactive and proportional to the level of activation of the words that are to be suppressed*. The term reactive means that inhibition is only applied after the lexical nodes of the non-response language are activated from the semantic system. Importantly, the amount of inhibition applied to one language depends on the proficiency level with which that language is spoken. Specifically, when speaking in L1, not much inhibition is required for the less dominant language (L2) because it is assumed that the baseline level of activation of L2 lexical items is lower than that of L1 lexical items. However, when speaking in the less dominant language (L2), L1 representations need to be strongly inhibited in order to ensure that L2 lexical items are selected.

2) The second assumption suggests that *the time required to overcome inhibition positively correlates with the amount of inhibition applied over a given language*. That is, it is assumed that the suppression (or inhibition) of the activation of a given language may exert an influence on subsequent production events in which words from the suppressed lexicon need to be retrieved (see Allport, Styles, & Hsieh, 1994; reviewed later on in section 3.1.1.). Accordingly, retrieving words from a lexicon that has just been inhibited will be relatively difficult, since it will take time for that inhibition to be overcome. Hence, the more inhibition is applied to a given lexicon, the harder it will be to overcome it on a subsequent trial (see Tipper, 2001; for an explanation of negative priming).

Thus, to explain the paradoxical asymmetrical switching costs, Meuter & Allport (1999) argued that the amount of inhibition applied to L1 when speaking in L2 must be greater than vice versa (assumption 1 of the IC model). That is, the relative strength of the two tasks at hand (naming in L1 or in L2) would have an effect on the strength with which each of the two languages is inhibited. The authors further assume that the inhibition exerted on one language has effects on the subsequent trial. As a consequence, to retrieve L1 words on a switch trial will be relatively hard because the system has to overcome the large inhibition that was applied to that lexicon on the immediately preceding trial (assumption 2 of the IC model). However, to retrieve L2 words on a switch trial will be relatively less difficult, since the L2 lexicon was not as strongly suppressed on the preceding trial (see also Lee & Williams, 2001; but see Finkbeiner, Almeida, Janssen, & Caramazza, in press, for an alternative interpretation).

Evidence converging on the assumption that access to L2 representations involves the active suppression (or inhibition) of L1 was reported by Jackson, Swainson, Cunnington, & Jackson (2001) who recorded low-proficient bilinguals' event-related electrical potentials (ERP) in a language-switching task. Switch trials were associated with an enhanced negative deflection in the ERP at frontal sites compared to non-switch trials. Interestingly, this negativity was larger when switching from L1 into L2 than vice versa. Given that this component seems to index the presence of response suppression (e.g., Jackson, Jackson, & Roberts, 1999), the authors interpreted its asymmetrical presence in the switching task as revealing the larger suppression applied over L1 when speaking in L2 than vice versa (see also Hernandez, Dapretto, Mazziotta, & Bookheimer, 2001; Hernandez, Martinez, & Kohnert, 2000; Meuter, Humphreys, & Rumiati, 2002; and Price, Green, & Von Studnitz, 1999, for studies exploring the neural basis of language switching).

Further post-hoc analyses conducted by Meuter & Allport (1999) supported the notion that the asymmetrical switching costs stem from differences in the L2-L1 proficiency levels. In particular, the asymmetrical switching costs were somewhat dependent on the bilinguals' L2 proficiency:

the higher the L2 proficiency, the smaller the asymmetry. Although such differences among groups did not turn out to be significant, the trend was in the direction predicted by the IC model. In view of these data, the authors speculated that the asymmetrical switching cost may disappear for highly-proficient bilinguals. This is because, for these bilinguals, the difference in proficiency levels between the two languages would be minimal, and therefore the amount of inhibition applied to them would be similar too (see Monsell, Yeung, & Azuma, 2000; for a discussion of the conditions in which asymmetrical switching costs are observed). We will extensively investigate this specific account in the present dissertation.

2.3 Main differences between the models of Language-Specific Selection and Inhibitory Control

The two models presented above assume that the two languages of a bilingual become activated while producing speech. However, two main characteristics differentiate the IC and the Language-Specific Selection models. The first refers to the assumption of competitive selection processes between lexical items of the two languages of a bilingual. On the one hand, according to the IC model, the lexical nodes of both the response and non-response language enter into lexical competition. On the other hand, the Language-Specific Selection model assumes that, although the lexical nodes of the non-response language receive activation from the semantic level, they do not enter into lexical competition. The second main difference refers to the assumption of the use of inhibitory control mechanisms by bilingual speakers. In that case, in order to avoid interference from the non-response language, the IC model postulates that the corresponding lexical nodes are inhibited. However, the Language-Specific Selection model postulates that bilingual speakers do not need to use inhibitory control mechanisms to properly select words.

The main evidence supporting both the Language-Specific Selection and the IC model has been summarized above. However, it is worth noting that the data supporting each of these two models have some limitations.

2.4 Limitations of the data supporting the Language-Specific Selection and IC models

The evidence in favour of the two models presented above has, at least, two main limitations. On the one hand, the main data supporting the IC model's assumption that bilinguals rely on inhibitory processes comes from studies in which the performance of unbalanced, low-proficient bilinguals (e.g., Meuter & Allport, 1999; see also, Lee & Williams, 2001) was tested. On the other hand, seemingly contradictory results have been reported regarding whether lexical access involves cross-language competition processes (e.g., Costa et al., 1999; Costa & Caramazza, 1999; Hermans, 2000; 2004).[6] In the former case, the problem would be solved by systematically studying the language-switching performance of different types of bilinguals. In fact, this is the main objective of this dissertation.

In order to achieve a better understanding of the attentional control mechanisms used by bilingual speakers in the production of language, a further step towards a better description of bilinguals' language-switching performance will be done in the present dissertation. More specifically, we will

[6] On the issue of whether lexical access involves cross-language competition, a challenge to the crucial assumption of the Language-Specific Selection model arises. This is because, on the one hand, the phono-translation interference effect in the picture-word interference paradigm seems to suggest that words from the non-response language are activated and compete for selection (e.g., Hermans et al., 1998). However, on the other hand, the between-language identity facilitation effect suggests that there are no cross-language competitive selection processes (e.g., Costa et al., 1999).
In an effort to account for the phono-translation interference effects within a Language-Specific Selection model, an alternative interpretation has been put forward (Costa et al., 2003; see above). But, at the same time, Hermans (2004) argued that the between-language identity facilitation effects could be easily accounted for by both language-specific and language-nonspecific (e.g. the IC model) models of lexical selection. Hence, at this point, there are no satisfactory explanations of these contrasting effects obtained by means of the picture-word interference paradigm.

carefully test one of the main assumptions of the IC model: the use of inhibitory control mechanisms during lexical access. To do that, a systematic exploration of the production performance of different types of bilingual speakers in different linguistic contexts will be performed.

3 Main objectives and overview of the experiments

The main objective of this dissertation is to better understand the cognitive mechanisms that allow bilingual speakers to prevent massive interference from the non-response language during speech production. That is, we will investigate which the control mechanisms are allowing bilinguals to perform successful lexical selection during speech production. For this purpose, we will put to test the assumptions of the IC model. In order to do that, we will make use of the language-switching paradigm previously used by Meuter & Allport (1999).

3.1 Implementing the main objective: a systematic exploration of the language-switching production performance of bilinguals

We will adopt the explanation given by Meuter & Allport (1999) of asymmetrical language-switching costs as reflecting inhibitory control processes. Specifically, we will make a systematic exploration of the language-switching production performance of highly- and low-proficient bilingual speakers. The performance of these groups of bilinguals will be tested in different linguistic contexts. In such a way, we will be able to put to test the predictions derived from the IC model. Thus, we will try to replicate the observations of Meuter and Allport with low-proficient bilingual speakers and extend it to different linguistic contexts. More importantly, we will further explore the language-switching performance of highly-proficient bilinguals. The main theoretical question then is *whether the IC model can account for bilinguals' language switching performance, and by extension, the way bilinguals control language production*.

Hence, in order to achieve a better understanding of the type of cognitive mechanisms bilinguals use to select words in the intended language, an exhaustive characterization of their switching performance will be presented. For this purpose, we have established the following objectives:

(1) To establish the role *language proficiency* plays in the use of cognitive control mechanisms. For this purpose, the switching performance of highly- and low-proficient bilinguals will be tested and compared.

(2) To explore the role *age of acquisition* and *language similarity* play in cognitive control mechanisms. To do that, the switching performance of different groups of highly-proficient bilinguals (early bilinguals of typologically similar and dissimilar languages, and late bilinguals) will be tested.

(3) To investigate the role *the cognate status of the words* plays in bilingual cognitive control mechanisms. Both highly- and low-proficient bilingual speakers will be tested while performing the language-switching task with cognate and non-cognate words.

(4) To explore the role proficiency differences between the languages involved in the switching tasks have in the cognitive control mechanisms of highly-proficient bilinguals. For this purpose, we will observe the switching performance of highly-proficient bilinguals while switching between their strong L1 and L2, and their strong L1 or L2 and weak L3.

(5) To investigate the type of cognitive control processes used by bilinguals while managing the production of words of a language for which they are at the first stages of acquisition. To do that, the switching performance of highly-proficient bilinguals while switching between their weak L3 and their very weak L4 will be tested. Finally, the performance of monolinguals and highly-proficient bilinguals while switching between their L1 and a recently learned new-language will be also tested.

Before introducing the experimental section, it is worth describing in a more exhaustive fashion the paradigm that will be used thorough this dissertation. Next, the way the task-switching paradigm has been used to investigate issues related to general attentional control mechanisms and language control will be presented. Finally, the rationale followed by Meuter & Allport (1999) in the interpretation of language-switching data will be presented in more detail.

3.1.1 On the Language-Switching Paradigm

The task-switching paradigm has been mainly used to study the mechanisms of executive function. To shift between different cognitive tasks is one of the most common acts we do, and intensive work has been done to better understand which attentional, executive control mechanisms are used to organize and select these different tasks (e.g., Monsell & Driver, 2000; Monsell, 2003). "To type a text", "to read an e-mail", "to answer the telephone", "to type a text" again, etc. could be an example of how we are continuously performing different tasks. Task switching requires the use of some sort of attentional control mechanism to select and link the intention of what a person wants to do to the proper mental task-schema. To study these attentional control mechanisms, task-switching is an experimental paradigm that has been extensively used in the last decades. This paradigm was initially developed by Jersild (1927) to compare the time needed by subjects to perform different tasks and to measure the cost of switching between them. In his work, Jersild compared the total time needed by subjects to complete a block in which they had to perform two different tasks depending on the presented trial (e.g., add 3 vs. subtract 3 to a number) with the time needed to complete a block in which the same task had to be performed on all trials (e.g., add 3 to a number). A larger time was needed to complete the alternating trial blocks than to complete the pure blocks. This difference was used to calculate the switch cost that was taken to be an index of the effort associated with reconfigurating task-schemas.

Following this line of research, Allport and collaborators (1994) ran a series of experiments using Jersild's switching paradigm. However, instead of measuring total list completion times, each trial's response latencies were registered. In this version of the paradigm, two types of trials were presented: switch trials (those on which a task different from that performed on the previous trial had to be performed) and non-switch trials (those on which the same task as on the previous trial had to be performed). Thus, switching costs were measured comparing the naming latencies of switch and non-switch trials. In such experiments, participants were asked to switch between a pair of tasks with different levels of difficulty. For example, in one experiment, participants were required to switch between a color-naming and a word-reading task with Stroop color-word stimuli (e.g., the word "RED" printed in green ink). It is well known that incongruency between the name of a word and the color in which this word is displayed interferes much more with the naming of the color than with the naming of the word (Stroop, 1935; see MacLeod, 1991 for a review of Stroop and Stroop-like paradigms). Using such Stroop stimuli, they found a surprising counterintuitive result: switching to the stronger word-reading task led to larger switching costs than switching to the weaker color-naming task. In order to account for these asymmetric task-switching costs, Allport and collaborators put forward the so-called Task Set Inertia hypothesis. This hypothesis proposes that extra inhibition must be applied to the stronger task-schema to enable performance of the weaker task-schema. This inhibition is carried over to the next trial, and, consequently, overcoming it prolongs response selection. Hence, the apparently counterintuitive asymmetrical switching costs are explained as follows: To enable a correct performance of the weaker color-naming task, the competing stronger task of word-reading must be actively suppressed. However, to perform the word-reading task does not require such strong suppression of the competing color-naming weaker task (or maybe does not require any suppression at all). The inhibition applied in one task is assumed to have effects on subsequent trials, and consequently, as the time needed to overcome this inhibition is proportional to the amount of applied inhibition, larger switching costs are found for a switch to a word-reading trial than for a switch to a color-naming trial (see also Allport & Wylie, 1999, 2000; Yeung & Monsell, 2003).

In the case of language control, Macnamara, Krauthammer, & Bolgar (1968) were the first to use the task-switching paradigm to investigate the costs of language-switching in the production of language. In this work, Macnamara and collaborators used a similar paradigm as that initially developed by Jersild (1927). They asked French-English bilinguals to name Arabic numerals in their L1 or L2 from a list in which switching between both languages was required. Numerals appeared in the center of a circle or a triangle that was used as a language-cue (e.g., if the numeral appears in the center of a circle, name it in French; if it appears in the center of a triangle, name it in English). Blocked lists were also included, and total list completion times were measured. More time was required to complete the language-switching lists than the blocked lists, showing a clear switching cost.

It is not until recently that the language-switching task has been used again in order to investigate the attentional control mechanisms implicated in language production. This was the above mentioned work by Meuter & Allport (1999). Here, replicating Allport et al.'s (1994) results, larger switching costs when switching from the harder task (name in L2) to the easier task (name to L1) were found than vice versa. Hence, the authors embraced the main idea of the Task Set Inertia hypothesis, and related it to Green's IC model of bilingual language production to explain the asymmetrical language-switching costs.

Note, however, that the above explanation of the existence of asymmetrical language-switching costs is a bit more complex, since there are at least two components behind such costs. The first is the time it takes for the speaker to implement the new task goal, or in Green's IC model, to select the right "language schema" (Green, 1998; see also Allport & Wylie, 2000; Meiran, 2000; Ruthruff, Remington, & Johnston, 2001; Sohn & Anderson, 2001 for similar arguments in general task-switching models). This component is common for both directions of switching (from L1 to L2 and vice versa), and reflects the intrinsic time it takes for speakers to reset their experimental goal in switch trials (from naming in language X to naming in language Y). This switching cost is common to many other switching tasks, and is supposed to reflect processes outside of the lexical system (e.g., Von Studnitz & Green, 2002). Thus, bilingual speakers would experience an overall switching cost when changing the "language-schema" (e.g., when switching), regardless of their language proficiency (see also Kohnert, Bates, & Hernandez, 1999; for effects of switching languages across the life-span of bilingual speakers). The second component consists in the differential inhibition applied to the lexical representations of the languages involved in the switching task. According to Green's IC model (e.g., Green, 1998), the successful selection of a given lexical representation in the appropriate language requires the reactive inhibition of lexical representations belonging to the other language. In Green's proposal this inhibitory mechanism is sensitive to the different levels of activation of the two languages of a bilingual, in such a way that the amount of inhibition applied to the more readily-available (i.e., dominant) language would be larger than that applied to the less available language. This differential amount of inhibition and its effects on subsequent trials would account for the existence of asymmetrical switching costs when the two languages involved in the switching task differ in their strength (availability). Thus, while the first component of the switching cost accounts for the presence of switching costs per se, the second component accounts for the presence of asymmetrical costs.

The experiments presented in this dissertation have a main goal: to investigate which are the control mechanisms used by bilingual speakers to achieve lexical access in the intended language while avoiding interference from the non-intended one. That is, we will investigate which are the control mechanisms allowing bilinguals to perform successful language selection in speech production. To do that, we will first replicate the observations of

Meuter & Allport (1999). Second, and more importantly, we will further explore the language-switching performance of highly-proficient bilinguals. This would allow us to establish whether Meuter and Allport's explanation of asymmetrical language-switching costs as reflecting inhibitory-control processes could be generalized to all bilingual populations (e.g., highly-proficient bilinguals).[7]

It is worth noting that the specific properties of the design used by Meuter & Allport (1999) have some potential limitations when drawing conclusions about the performance of bilingual speakers in other contexts (e.g., the large number of repetitions of items). However, to be able to compare both studies, we have kept our experimental design, in the relevant dimensions (e.g., percentage of switching trials, percentage of responses in L1 and L2, unpredictability of the language switch, etc.) as similar as possible to theirs. There are, however, several important modifications. First, the populations tested in each of our experiments are homogeneous (regarding the languages of the speakers), while the population tested in Meuter and Allport's experiment was not (French–English, German–English, etc.). Second, the number of trials, and the number of repetitions of the experimental stimuli, is smaller in our study (from 2000 trials to 950). Third, in order to better control the phonological similarity (i.e., cognate status) of the words in the languages involved in the task, we used pictures of common objects rather than Arabic digits as experimental stimuli.

[7] Note, however, that the aim of our investigation is not to explore issues related to task-switching per se, but rather to explore how experiments of this sort can inform us about the way in which bilingual speakers produce fluent speech. Although the use of the switching paradigm has been useful for developing theoretical hypotheses about the processes involved in bilingual speech production (see, for example, Meuter, 2005; but see Finkbeiner et al., in press), it is always an open question whether the results obtained with a specific experimental paradigm (e.g., task-switching, picture-word interference, picture naming, etc.) can be generalized to other naming contexts. We believe that one way to explore whether this paradigm (or any other) is sensitive to issues related to language processing in bilingual speakers is to assess whether it is sensitive to the linguistic particularities of the speakers performing the task.

3.1.2 Overview of the experiments

In Experiment 1 we aimed to replicate the asymmetrical switching costs reported by Meuter and Allport. Here we investigated the switching performance of two different low-proficient, L2 learner populations (Spanish learners of Catalan and Korean learners of Spanish). In Experiment 2, we analyzed the performance of highly-proficient Spanish–Catalan bilinguals when switching between their two dominant languages (Spanish and Catalan). Experiments 1 and 2, then, allowed us to achieve our Objective 1 (section 3.1). In experiments 3 and 4 we further explored how the variables of language similarity and age of L2 acquisition may affect the language-switching performance of highly-proficient bilinguals (Objective 2). We did so by testing Spanish-Basque early bilinguals (Experiment 3) and Spanish-English late bilinguals (Experiment 4). Whether the cognate status of the words affects the language switching performance of L2 learners and highly-proficient bilinguals was tested in Experiment 5 (Objective 3). In Experiments 6 and 7, we explored the origin of a surprising language effect (faster L2 than L1 responses) showed by highly-proficient bilinguals in Experiments 2, 3, 4 and 5. Subsequently, in Experiments 8 and 9 the switching performance of highly-proficient Spanish–Catalan bilinguals when the task involved switching between two languages on which they had different proficiency levels was tested. In Experiments 8 and 9 participants were asked to perform the task in their dominant language (L1: Spanish; or L2: Catalan; respectively) and their much weaker language (L3: English). Hence, Experiments 8 and 9 allowed us to achieve our Objective 4. In Experiment 10, the switching performance of Spanish-Catalan bilinguals switching between their weak L3 (English) and their much weaker L4 (French) was tested. Finally, in Experiment 11 we explored and compared the performance of Spanish monolinguals and Spanish-Catalan highly-proficient bilinguals when the task required switching between their L1 and a language for which they were at very early stages of word learning (Objective 5).

4 EXPERIMENTAL SECTION [8]

4.1 Experiment 1: Replicating the asymmetrical switching costs in L2 learners

This experiment aims at replicating the asymmetrical switching costs reported by Meuter & Allport (1999) for low-proficient bilinguals. We do so by exploring the performance of two groups of speakers who have been exposed to their L2 relatively late in life and who can be considered L2 learners. The languages of the speakers in the two groups were different. In Group 1, we tested Spanish-Catalan participants and in Group 2, Korean-Spanish participants. Given the results of Meuter & Allport (1999), we expect the switching cost in L1 to be larger than in L2, for both groups of participants.

[8] Part of this research is published in two journal articles. Experiments 1, 2, 6, 7 and 8 are reported on Costa, A., & Santesteban, M, (2004b). Lexical access in bilingual speech production: Evidence from language switching in highly proficient bilinguals and L2 learners. *Journal of Memory and Language, 50*, 491-511. Experiments 3, 4, 9, 10 and 11 are reported on Costa, A., Santesteban, M, & Ivanova, I. (in press). How do highly proficient bilinguals control their lexicalization process? Inhibitory and Language-Specific Selection mechanisms are both functional. *Journal of Experimental Psychology: Learning, Memory and Cognition.*

Method

Participants

Twenty-four participants took part in the experiment. Participants in Group 1 were native speakers of Spanish that were learning Catalan for an average of 1.5 years. These participants were receiving formal training in Catalan as a second language. Participants in Group 2 were native speakers of Korean that were learning Spanish for an average of 4 years. All participants were living in Barcelona at the time of testing, being, therefore, exposed regularly to Catalan and Spanish. Participants in both groups were considered L2 learners (see language proficiency self-assessment and history in Appendix A).

Materials

The materials used for both groups of participants were similar. For Group 1, ten pictures of common objects with non-cognate names were selected. For Group 2, we used 8 out of the 10 pictures plus two new ones (see Appendix B for a description). All pictures' names were non-cognates.

Participants were instructed to choose the language of the response according to the color of the picture (red or blue). The assignment of color cue to response language was counterbalanced across participants. Half of the participants were instructed that "red" indicated "respond in Spanish" (or Korean for Group 2) and "blue" indicated "respond in Catalan" (or Spanish for Group 2), and the other half received the reverse assignments. Pictures were presented in short sequences ("lists") ranging in length unpredictably from 5 to 14 trials. There were two types of trials: (a) trials in which the language of the response (either L1 or L2) was the same as the trial immediately before (non-switch trials); (b) trials in which the language of the response (either L1 or L2) was different from that used on the preceding trial (switch trials).

The lists varied in the number of switch trials (from 0 to 4 switch trials). To prevent participants from developing strategies, some lists did not include switch trials at all. A total of 400 such lists were constructed. These lists varied in the specific sequence of: (a) L1 and L2 responses; and (b) switch and non-switch trials. Each participant was presented with 100 of such lists that varied in length (from 5 to 14 trials). In total, each participant was presented with 950 trials (70% non-switch and 30% switch). In half of the non-switch trials, participants were asked to name the picture in L1 (333 trials) and in the other half in L2 (333 trials). The same applied for the switch trials. Therefore, participants used their L1 and L2 the same number of times during the course of the experiment (475 responses in each language). For each subject, 50 of the 100 lists started with a picture to be named in L1 and 50 with a picture to be named in L2.

Each picture was presented 95 times during the experiment. The assignment of each specific picture to each trial was left random, but varied for each participant. That is, a given picture could be named more often in L1 than in L2 and could appear more often on a switch trial than on a non-switch trial for one participant. However, for another participant this distribution changed, given that the assignment of the pictures to the different trial types varied randomly across participants. In lists of 10 trials or fewer, no picture could appear twice, and in lists from 11 to 14 items, the same picture could appear no more than twice. There were at least two different items between the first and second appearance of the same picture.

Procedure

Participants were tested individually in a soundproof room. They were asked to name the pictures as fast as possible while trying to avoid errors. They were informed that the language in which a given picture had to be named was determined by the color in which the picture appeared, and that, in a given list of trials, pictures with different colors could be presented. Before the experiment proper, participants were familiarized with the names of the pictures in the two languages. A list of trials had the following structure: (1) a blue or red circle along with the word CATALÀ (Catalan) or ESPAÑOL (Spanish) written below was presented for 2000 ms (the words were Spanish or Korean for Group 2). This circle (and the word) indicated the language in which the first picture of the list had to be named, and therefore we can consider the first trial of a list as non-switch trial; (2) the first picture of a list appeared and remained on the screen for 2000 ms or until participants responded; (3) a blank interval of 1150 ms; (4) the next picture was presented, and the cycle was repeated until the end of the list; (5) after the presentation of the last picture of the list an asterisk was presented for 1000 ms signaling the end of the list; and the next list started. The experiment started with the presentation of 6 training lists.

Data Analysis

Two main variables were considered in the statistical analyses: "Response Language" (L1 or L2), and "Type of Trial" (Switch vs. Non-switch). Error rates and naming latencies were submitted to two analyses of variance (ANOVAs). The analyses were conducted for each Group of participants separately. Although analyses by items are not usually reported in this sort of experiments (Meuter & Allport, 1999), for the sake of completeness we present them here. However, given the small number of items, and that we assigned them randomly to each condition, caution has to be exercised when interpreting the item analyses.

Two types of responses were scored as errors: (a) verbal disfluencies (stuttering, utterance repairs, production of nonverbal sounds that triggered the voice key); (b) recording failures. Also, naming latencies exceeding 3 SD from a given participant's mean and trials on which participants produced a different name from that designated by the experimenter were discarded from the analyses.

Results

Group 1: Spanish learners of Catalan

Following the criteria presented above, 5.8% of the trials (errors: 4.5%; outliers: 1.3%) were excluded from the analyses. No significant effects were observed in the error analyses.

In the analysis of naming latencies, the main effects of "Response Language" ($F1$ (1, 11) = 7.04; MSE = 2143.20; p = .022; $F2$ (1, 9) = 5.9; MSE = 1928.12; p = .038) and "Type of Trial" ($F1$ (1, 11) = 53.8; MSE = 631.47; p = .001; $F2$ (1, 9) = 221.45; MSE = 130.45; p = .001) were

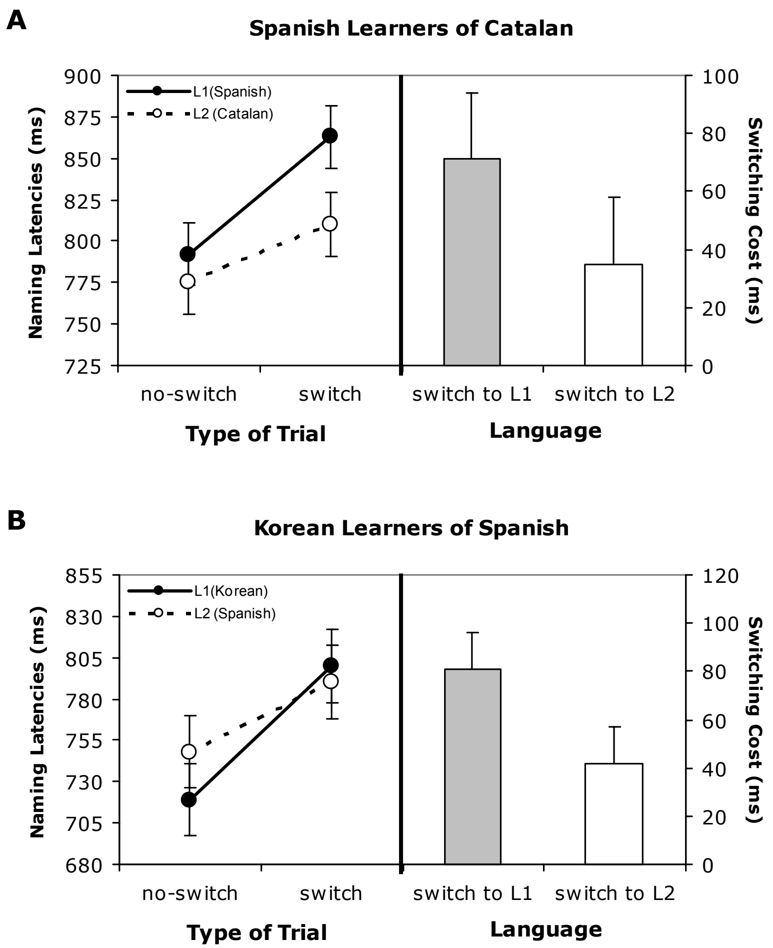


Figure 1. (A) Switching performance of native Spanish speakers learners of Catalan (left panel), and the magnitude of the switching cost for each language showed by the interaction plot (right panel). (B) Switching performance of native Korean speakers learners of Spanish (left panel), and the magnitude of the switching cost for each language showed by the interaction plot (right panel) (Experiment 1).

significant. Participants showed faster reaction times in L2 than in L1 (792 and 828 ms, respectively) and were faster naming non-switch (783 ms) than switch trials (836 ms). More importantly, the interaction between the two variables was also significant (*F1* (1, 11) = 8.83; *MSE* = 437.97; *p* = .014; *F2* (1, 9) = 15.39; *MSE* = 213.94; *p* = .003), revealing that the magnitude of the switching cost was different for the two languages (L1: 71 ms; L2: 35 ms).

Nevertheless, the switching cost was significant for both languages (two tailed t tests; L1: t (11) = 6.38; p = .001; L2: t (11) = 4.78; p = .001) (see Figure 1A) (see Appendix H for tables with the results of all experiments reported in this dissertation).

Group 2: Korean learners of Spanish

We discarded 6.8% (errors: 5.2%; outliers: 1.6%) of the data points. No significant effects were observed in the error analyses.

In the analysis of naming latencies, the only significant main effect was that of the variable "Type of Trial" (*F1* (1, 11) = 38.4; *MSE* = 1184.99; p = .001; *F2* (1, 9) = 51.01; *MSE* = 590.82; p = .001). Participants showed faster reaction times naming non-switch (733 ms) than switch trials (795 ms). Importantly, the interaction between the variables "Type of Trial" and "Response Language" was significant (*F1* (1, 11) = 17.46; *MSE* = 261.27; p = .002; *F2* (1, 9) = 9.76; *MSE* = 288.9; p = .012), revealing that the magnitude of the switching cost was different for the two languages (L1: 81 ms; L2: 42 ms). However, once again, the switching cost was significant for both languages (two tailed t tests; L1: t (11) = 7.01; p = .001; L2: t (11) = 4.07; p = .002) (see Figure 1B).

Post hoc analyses combining the results of both groups of participants revealed that the crucial interaction reflecting asymmetrical switching costs (''Type of Trial'' X ''Response Language'') did not interact with the factor ''Group of Participants'' (both *F*s < 1), indicating that the magnitude of the asymmetrical switching cost was not different in the two groups.

Discussion

Two main results were obtained in this experiment: (a) significant switching costs for both the L1 and the L2, and (b) the magnitude of the switching cost was larger for L1 than for L2. That is, there was an asymmetrical switching cost, replicating Meuter & Allport's (1999) observation. Although this asymmetrical switching cost was observed for both groups of participants, the shape of the interaction was somewhat different. While in

Group 1 responses for non-switch trials were somewhat faster (but non-significantly faster) for L2 than for L1, the opposite was true for Group 2. Interestingly, both types of interaction have already been observed in similar studies. For example, while the shape of the interaction for Group 1 resembles that observed by Janssen (1999), the performance of participants in Group 2 resembles that reported by Meuter & Allport (1999). A third type of interaction has been found by Jackson and collaborators (2001) in which naming latencies were faster for L1 than for L2 on the non-switch trials and no difference among languages was found on the switch trials. At present, the source of the variation across studies is unclear (see Jackson et al., 2001; Yeung and Monsell, 2003; for a discussion of this issue). What is important in the present context, however, is that in all these studies the magnitude of the switching cost was larger for L1 than for L2.

Having established the reliability of the asymmetrical switching cost and its reproducibility with another naming task (picture naming rather than Arabic digit naming), we proceed to assess whether the presence of such an asymmetry is related to the different degree with which the two languages of a bilingual are inhibited. Specifically, does the extent to which a language is inhibited depend on the L2 proficiency level? Recall that, according to Meuter & Allport (1999), the difference in the magnitude of the switching cost is due to the larger inhibition applied to L1 in comparison to that applied to L2. This difference in the amount of inhibition reflects the difference in the proficiency levels between L1 and L2. There is a clear prediction that one can derive from this assumption: when the difference between L1 and L2 proficiency levels is small (as in the case of highly-proficient bilinguals), then a similar degree of inhibition should be applied to the two languages and, therefore, the magnitude of the switching cost should be similar in both directions.

4.2 Experiment 2: Language-switching costs in highly-proficient bilinguals

The goal of this experiment is to assess whether a reduction of the difference between the L1 and L2 proficiency levels leads to a reduction in the magnitude of the asymmetrical switching cost. If the interpretation given to this asymmetrical switching cost by Meuter & Allport (1999) is correct, then we should expect a reduction (or even an elimination) of such an asymmetry when highly-proficient Spanish-Catalan bilinguals perform the task in their L1 and L2. That is, to switch from L2 to L1 should be as difficult as to switch from L1 to L2.

Method

Participants

Twelve native speakers of Spanish who were highly-proficient speakers of Catalan took part in the experiment. They had learned Catalan at school at a mean age of 4. All participants has received education in both Spanish and Catalan, and claimed to be very fluent in the two languages (see Appendix A). All participants were living in Barcelona at the time of testing, and were, therefore, exposed to the two languages. They were all undergraduate students at the University of Barcelona.

Materials and procedure

The same materials and procedure used in Experiment 1 (for Group 1) were employed here.

Results

Following the same criteria as in Experiment 1, 4.9% (errors: 3.1%; outliers: 1.8%) of the trials were excluded from the analyses. The only significant effect in the error analysis was that of "Type of Trial" ($F1$ (1, 11) = 8.97; MSE = 6.18; p = .012; $F2$ (1, 9) = 9.07; MSE = 1.8; p = .015). Switch trials (5.7%) led to more errors than non-switch trials (4.5%).

In the analysis of naming latencies, the main effects of "Response Language" ($F1$ (1, 11) = 6.95; MSE = 650.40; p = .023; $F2$ (1, 9) = 4.47; MSE = 854.35; p = .064) and "Type of Trial" ($F1$ (1, 11) = 134.27; MSE = 199.52; p = .001; $F2$ (1, 9) = 132.37; MSE = 173.69; p = .001) were significant. Participants showed faster reaction times in L2 than in L1 (720 and 740 ms, respectively) and were faster naming non-switch (706 ms) than switch trials (754 ms). The interaction between the two variables was not significant (both *F*s < 1; switch to L1: 47 ms; switch to L2: 47 ms) (see Figure 2).

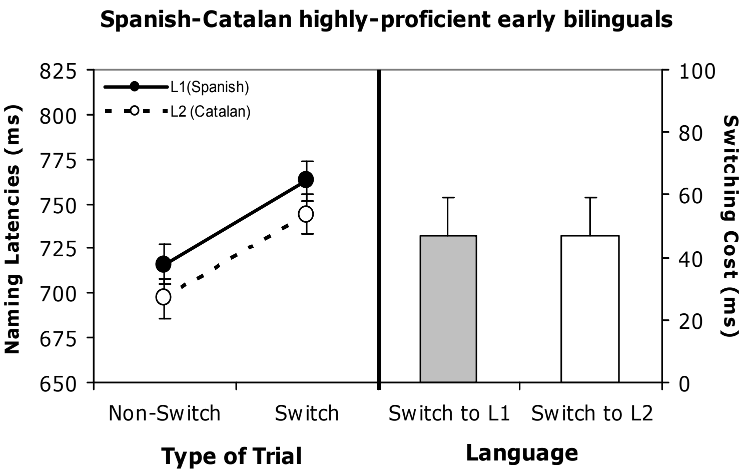


Figure 2: Switching performance of Spanish-Catalan highly-proficient bilinguals in their two dominant languages (left panel), and the magnitude of the switching cost for each language showed by the interaction plot (right panel) (Experiment 2).

The results of this experiment showed that highly-proficient bilinguals suffered the same switching cost in L1 and L2. These results contrast sharply with those reported in Experiment 1 for L2 learners, for whom switching into L1 was harder than switching into L2. Given that we use the same materials and languages in Experiments 1 (Group 1) and 2, we conducted a joint analysis to determine whether this difference between groups was statistically significant.

In this analysis, the main effects of the variables: "Response Language" (*F1* (1, 22) = 12.93; *MSE* = 1396.80; *p* = .002; *F2* (1, 9) = 5.53; *MSE* = 2567.83; *p* = .043); "Type of Trial" (*F1* (1, 22) = 145.73; *MSE* = 415.49; *p* =

.001; *F2* (1, 9) = 231.89; *MSE* = 223; *p* = .001); and "Group of Participants" (*F1* (1, 22) = 4.46; *MSE* = 34190.90; *p* = .046; *F2* (1, 9) = 740.13; *MSE* = 177.95; *p* = .001), were significant. Only one two-way interaction was significant: "Response Language" X "Type of Trial" (*F1* (1, 22) = 6.35; *MSE* = 304.32; *p* = .019; *F2* (1, 9) = 11.15; *MSE* = 129.5; *p* = .009). Crucial for our purposes here, the three-way interaction was significant ("Response Language" X "Type of Trial" X "Group of Participants"; [*F1* (1, 22) = 6.35; *MSE* = 304.32; *p* = .019; *F2* (1, 9) = 9.91; *MSE* = 187.89; *p* = .012]). This interaction reflects the existence of an asymmetrical switching cost for one group of participants (L2 learners [Group 1 in Experiment 1]) but not for the other (highly-proficient bilinguals in Experiment 2).

Discussion

Three main results were obtained in this experiment: (a) significant switching costs for both L1 and L2; (b) the same magnitude of switching cost for L1 and for L2; and (c) naming latencies were faster for L2 than for L1.

These results are consistent with the notion that the asymmetrical switching cost is related to the different degree with which the two languages of a bilingual are inhibited, and that the extent to which a language is inhibited depends on the L2 proficiency level. Thus, when the difference in proficiency between the two languages of a bilingual is large (L2 learners), more inhibition is applied to L1 than to L2, resulting in an asymmetrical switching cost. When the difference in proficiency is small (highly-proficient bilinguals), a similar degree of inhibition is applied to the two languages and symmetrical switching costs are observed.[9]

---

[9] With regard to the highly-proficient bilinguals' language switching performance, one could argue that the lack of an asymmetrical switching cost in this experiment is not very informative since it stems from a null result (e.g., the lack of interaction between "Type of Trial" and "Response Language"). However, it is important to keep in mind that this lack of an interaction is observed in the context of two main effects ("Type of Trial" and "Response Language") and in the context of other experiments in which such an interaction is present (Experiment 1 for Groups 1 and 2). Therefore, it is unlikely that the absence of an interaction in the present experiment is due to insufficient power in our experimental design, and that we are actually

However, there is one result in this Experiment that came about as a surprise: highly-proficient bilinguals named the pictures in their L1 more slowly than in their L2. If the amount of inhibition applied to L1 and L2 is similar, as suggested by the symmetrical switching costs, one should expect similar naming latencies in the two languages or, if anything, faster naming latencies in the more dominant L1. We do not have a ready explanation for such a surprising language effect. However, considering that we are interested in the asymmetrical language-switching pattern of the bilingual speakers, we will defer further discussion of this issue to the discussion section of Experiment 5 and to the General Discussion section.

The naming performance of highly-proficient bilinguals is consistent with the notion that language switching entails inhibition of the non-response language, and that the amount of inhibition applied to a given language depends on the difference in L1–L2 proficiency. In this framework, asymmetrical switching costs are a function of the different proficiency levels of the two languages involved in the switching task. Consequently, when L2 proficiency is almost as high as that of L1, the asymmetrical switching cost disappears. In summary, the present pattern of results is consistent with the notion that when a bilingual achieves a similar performance level in her two languages, the amount of inhibition applied to L1 and L2 is also similar. Thus, from these results we can extract the following empirical generalization: "highly-proficient bilinguals do not show asymmetrical switching costs, whereas low proficient bilinguals do."

However, caution needs to be exercised when attributing this different performance to the proficiency level attained in L2. First, the individuals in the L2 learner and highly-proficient bilingual groups differed not only in their attained L2 proficiency level but also in the age at which they learned their L2. Therefore, their differential performance could be due to either of these two factors. Second, the symmetrical switching pattern has been observed for a

---

committing a type II statistical error. Indeed, the IC model predicts the absence of such an interaction.

group of highly-proficient bilinguals of two very similar languages: Spanish and Catalan. These two languages are Romance languages with many similarities at the lexical (about 70% of the words are cognates [translations that are orthographically and phonologically similar]) and grammatical levels. It is possible that symmetrical switching costs are only present when the two languages are very similar. If that were to be the case, we would have to limit our claims about the presence of a symmetrical pattern of switching costs to specific (and relatively small) bilingual populations (e.g., early bilingual speakers of typologically similar languages). Importantly, such a conclusion would leave out from our characterization of the language-switching phenomena a large number of bilingual populations differing in some relevant aspects that may have an effect on the way they carry out their lexicalization processes (e.g., late bilinguals, bilinguals of typologically different languages: French-Arabic, English-Spanish, Chinese-English, Spanish-Basque, English-French, etc.).

In the following two experiments, in order to better characterize the performance of highly-proficient bilinguals in language-switching tasks, the role of language similarity (Experiment 3) and age of L2 acquisition (Experiment 4) in the symmetrical switching cost pattern will be explored.

4.3 Experiment 3: Does language similarity affect the language switching performance of highly-proficient bilinguals?

The similarity between the two languages of a bilingual may have an effect in the way bilingual speakers control their lexicalization processes. There are at least two reasons of why this could be the case. First, there are reasons to believe that the more similar the two languages of a bilingual are, the more likely it is they interfere with each other. In some sense, bilingual lexical access is a situation in which conflict between two potential responses needs to be resolved (bilinguals need to attend to some representations while ignoring others). The ease with which such a conflict is resolved may depend, to some extent, on the similarity between the ignored and attended representations. The greater the similarity between them, the more difficult conflict resolution and eventual target selection are. Support for the notion that similarity between representations may tax the attentional system comes from various cognitive domains. For example, in visual categorization, increasing the similarity between the representations that need to be categorized into two sets also increases the amount of attentional control involved in the task (e.g., Sigala & Logothetis, 2002). In the language production domain, we can also find several situations in which the amount of competition between potential responses depends on their similarity. Perhaps the clearest example is the semantic interference effect in the picture-word interference paradigm. In this task, participants' naming latencies are slower when naming a target picture while ignoring the presentation of a categorically related than unrelated distractor word (see section 1.2).

In light of these results it is possible that the attentional system responsible for keeping the two languages apart may be more taxed when the two languages are very similar than when they are dissimilar. As a consequence, and to solve this complex situation, bilinguals of two similar languages may have developed a different attentional control mechanism than that of bilinguals with two very different languages.

Second, language similarity affects the sociolinguistic use of two languages. This is because the more similar the two languages are, the more likely people will understand both, even if they cannot speak one of them (as, for example, passive bilinguals that do not speak, but do understand, a second language). In such a scenario, bilinguals may use their two languages at will, in almost any communicative occasion, thereby enhancing the chances for bilingual conversations. The highly-proficient Spanish-Catalan bilinguals tested in our previous study are placed in precisely this sociolinguistic context. Spanish and Catalan are understood by at least 97% (and spoken by 85%) of the population of Catalonia (Vila i Moreno, 2004). Therefore, a speaker can reasonably use both languages in any conversation. In a sense, these bilinguals are "language-switching masters" as they are continuously exposed to their two languages in the same contexts. This situation is rather different when the two languages are very different since, in general, the chances for using the two languages in the same conversation are reduced.

Thus, the present experiment aims at assessing the extent to which the similarity between the two languages of a bilingual affects the control mechanisms developed by highly-proficient bilinguals. We do so by comparing the language-switching performance of the highly-proficient Spanish-Catalan bilinguals tested in Experiment 2 with that of highly-proficient bilinguals of two very dissimilar languages (Spanish and Basque; a description of the major differences between Basque and Spanish, and also about the sociolinguistic context in which these two languages are spoken, is given in Appendix G). This comparison will inform us about the extent to which the presence of symmetrical switching costs depends on the similarity of the two languages of a highly-proficient bilingual.

Participants

Eleven native speakers of Spanish and highly-proficient speakers of Basque took part in the experiment. All participants were undergraduate students at the University of the Basque Country, learned Basque at school at a mean age of 3, had received education in Basque, but also some courses in Spanish, and claimed to be very fluent in the two languages. They were living in the Basque Country at the time of testing, being therefore exposed to both languages. This sample is in the relevant variables (education, age of L2 acquisition, years of L2 use) fully comparable to that of the Spanish-Catalan bilinguals tested in Experiment 2 (see Appendix A).

Materials and procedure

The materials, design and procedure were almost identical to those of Experiment 2. Ten pictures of common objects with non-cognate names were selected (8 pictures were the same as those used in Experiment 2) (see Appendix B for a description). Participants were instructed to name the pictures in Spanish or Basque based on the color of the picture (red or blue). The assignment of color cue to response language was counterbalanced across participants. Half of the participants were instructed that "red" indicated "respond in Spanish" and "blue" indicated "respond in Basque", and the other half received the reverse assignments.

Results

Following the criteria presented above, 5.7% of the trials (errors: 4.1%; outliers: 1.6%) were excluded from the analyses. Participants made more errors in their L1 (6.9%) than in their L2 (5%) ($F1$ (1, 10) = 5.78; MSE = 6.99; p = .037; $F2$ (1, 9) = 6.78; MSE = 4.96; p = .028), and on the switch trials than on the non-switch trials (6.6% and 5.4%, respectively) ($F1$ (1, 10) = 5.96; MSE = 2.14; p = .035; $F2$ (1, 9) = 2.6; MSE = 4.99; p = .141). The interaction of these two factors was not significant (both Fs < 1).

Faster naming latencies were observed for L2 (703 ms) than for L1 trials (776 ms) ($F1$ (1, 10) = 30.32; MSE = 1943.01; p < .001; $F2$ (1, 9) = 20.57; MSE = 2665.02; p = .001). Switch trials (752 ms) led to longer naming

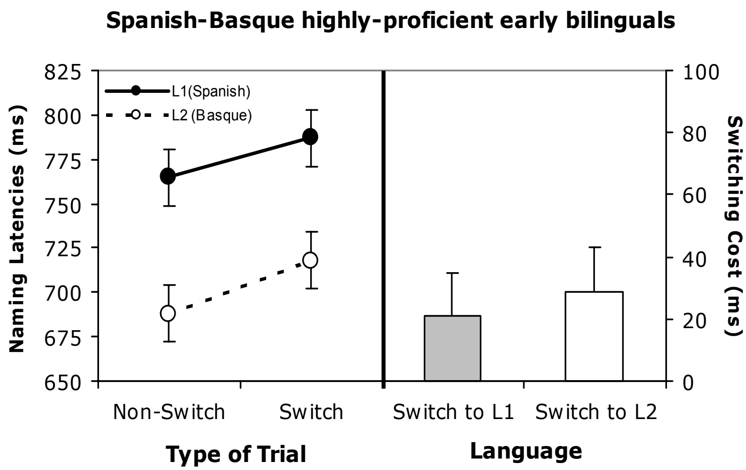


Figure 3: Switching performance of Spanish-Basque early learners and highly-proficient bilinguals in their two dominant languages (left panel), and the magnitude of the switching cost for each language showed by the interaction plot (right panel) (Experiment 3).

latencies than non-switch trials (727 ms) ($F1$ (1, 10) = 27.94; MSE = 253.2; p < .001; $F2$ (1, 9) = 33.3; MSE = 222.95; p < .001). More importantly, the interaction between the two variables was not significant (both Fs < 1), revealing that the magnitude of the switching cost was comparable for the two languages (L1: 21 ms; L2: 29 ms) (see Figure 3).

Discussion

The results of the Spanish-Basque bilinguals fully replicate the pattern of results obtained with Spanish-Catalan bilinguals: (a) the magnitude of the switching cost was the same regardless of the direction of the switch, and (b) naming latencies were faster for L2 than for L1. In fact, when considering together the results of the Spanish-Basque bilinguals with those observed with Spanish-Catalan bilinguals, the crucial interaction between "Response Language" (L1 vs. L2), "Type of Trial" (Switch vs. Non-Switch) and "Group of Participants" (Spanish-Basque vs. Spanish-Catalan) was not significant (all Fs < 1), revealing that the pattern of switching costs was similar for both populations.

These results reveal that the similarity between the two languages of a bilingual does not affect the way in which highly-proficient bilinguals perform the language-switching task: highly-proficient bilinguals showed symmetrical switching costs regardless of the similarities between their two languages. Thus, we can safely conclude that the similarity between the two languages of a bilingual (and the associated extensive use of the two languages in the same contexts) does not affect the way bilingual speakers control their lexicalization process, at least as indexed by the language-switching task.

In the following experiment, we turn to the second issue presented above and explore whether the age at which the L2 is acquired affects the language-switching performance of highly-proficient bilinguals.

4.4 Experiment 4: Does L2 Age of Acquisition affect the language switching performance of highly-proficient bilinguals?

This experiment aims at exploring the extent to which the language switching performance of highly-proficient bilinguals is affected by the age at which L2 has been acquired. As discussed above, we argued that the differential performance of highly-proficient bilinguals and L2 learners in the language-switching tasks (the former group showing symmetrical switching costs and the latter asymmetrical switching costs), as predicted by the IC model, was related to the different L2 proficiency levels of these speakers. However, both groups also differed in the age at which the L2 was acquired, this being earlier in the case of the highly-proficient bilinguals. Thus, at present, we do not have a clear understanding of the potential contribution of the L2 age of acquisition to this contrasting pattern of results.

The age at which L2 is acquired has important and pervasive effects in many bilingual domains (Birdsong, 1999; Birdsong & Molis, 2001; Flege, 1999; Flege, Yeni-Komshiam, & Liu, 1999; Newport, 1990, 1991; Sebastián-Gallés & Bosch, 2002; Sebastián-Gallés, Echeverría, & Bosch, 2005; Sebastián-Gallés & Soto-Faraco, 1999; Weber-Fox & Neville, 1996, 1999; see Sebastián-Gallés & Kroll, 2003, for a review). This variable affects not only the acquisition of representations, such as phonological representations, but also the mastering of processing mechanisms, such as syntactic and morphological processing. In fact, in a recent study, Wartenburger, Heekeren, Abutalebi et al. (2003) argued that different linguistic components are affected by proficiency and age of acquisition to different extents: proficiency seems to play a greater role for semantic information, while age of acquisition affects grammatical knowledge. Furthermore, early acquisition of an L2 has consequences outside of the linguistic domain (as in the development of theory of mind; Goetz, 2003). Of special interest are the benefits that early bilingualism exerts in the development of executive control functions in children and in adults (Bialystok, 1999, 2005). Given these considerations, it is appropriate to explore the role of L2 age of acquisition in the attentional mechanisms involved in bilingual production.

To gather such knowledge, we asked highly-proficient bilinguals who acquired their L2 (English) late in life to perform the language-switching task. They had grown in a Spanish monolingual context (outside of Catalonia), and they started acquiring the L2 relatively late in life. Furthermore, they learned English in the classroom and did not start using English more or less regularly until the age of 15 (for more details, see Appendix A). Nevertheless, they attained a high proficiency level in English, since they kept studying it at university, and were enrolled in translation and interpretation programs, becoming professional interpreters and translators.[10] All participants had received university education and were living in Barcelona at the time of testing.

Participants

Twelve Spanish-English highly-proficient bilinguals were tested in this experiment. All of them were late L2 learners that were exposed to L2 at a mean age of 10 years. These speakers were highly fluent in the two languages, as is reported in the participants' self-assessed proficiency scores in which they reported a mean L1 proficiency level of 4 and a mean L2 proficiency level of 3.71 on a 4 point scale in which the index of speech comprehension, speech production, reading and writing abilities were averaged (see Appendix A). All participants had received university education, and were living in Barcelona at the time of testing.

Materials and procedure

The same materials, design and procedure used in Experiment 2 were

[10] The reason for choosing this particular population is the large negative correlation between the age at which L2 is acquired and language proficiency. That is, in general, the earlier a speaker learns an L2, the higher her proficiency level is. So, in order to ensure as much as possible that the late learners were as proficient as the early learners in their L2, we followed the same strategy already used in other bilingual studies in which the contribution of proficiency and age of acquisition to language processing has been explored (Perani, Paulesu, Sebastián-Gallés et al., 1998; see nevertheless Christoffels & De Groot, 2004). Thus, arguably, we chose those late bilinguals with the highest proficiency level that one could find.

employed here. All the pictures had non-cognate names (see Appendix B). The only difference was that participants were asked to perform the task in their L1 (Spanish) and L2 (English).

Results

Following the criteria presented above, 6.1% of the trials (errors: 4.5%; outliers: 1.6%) were excluded from the analyses. The error analysis showed significant effects of "Response Language" ($F1$ (1, 11) = 8.29; MSE = 5.81; p = .015; $F2$ (1, 9) = 5.49; MSE = 7.53; p = .044) and "Type of Trial" ($F1$ (1, 11) = 17.74; MSE = 2.22; p = .001; $F2$ (1, 9) = 11.56; MSE = 2.79; p = .008). Participants made more errors in their L1 (6.9%) than in their L2 (5.2%) and on the switch trials than on the non-switch trials (7.3% and 5.5%, respectively). The interaction of these two factors was not significant.

In the analysis of naming latencies, the main effects of ''Response Language'' ($F1$ (1, 11) = 7.14; MSE = 1198.33; p = .022; $F2$ (1, 9) = 9.38; MSE = 832.35; p = .013) and ''Type of Trial'' ($F1$ (1, 11) = 44.71; MSE = 432.05; p = .001; $F2$ (1, 9) = 207.81; MSE = 77.95; p = .001) were significant. Participants were faster naming pictures in L2 (693 ms) than in L1 (720 ms). The reaction times were also faster for non-switch than switch trials (686 and 727 ms, respectively). More importantly, the interaction between the two variables was not significant ($F1$ < 1; $F2$ (1, 9) = 2.43; MSE = 92.84; p =.153), revealing that the magnitude of the switching cost was comparable for the two languages (L1: 43 ms; L2: 37 ms) (see Figure 4).

Discussion

The results of the Spanish-English highly-proficient late bilinguals fully replicate the pattern of results obtained with Spanish-Catalan early bilinguals: (a) the magnitude of the switching cost was the same regardless of the direction of the switch, and (b) naming latencies were faster for L2 than for L1. In fact, when considering together the results of the Spanish-English late bilinguals with those observed with Spanish-Catalan early bilinguals, the crucial interaction between "Response Language" (L1 vs. L2), "Type of Trial"

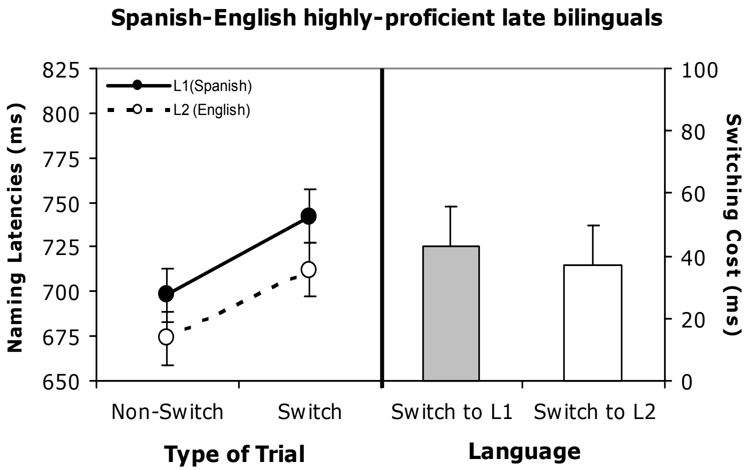


Figure 4: Switching performance of Spanish-English late learners and highly-proficient bilinguals in their two dominant languages (left panel), and the magnitude of the switching cost for each language showed by the interaction plot (right panel) (Experiment 4).

(Switch vs. Non-Switch) and "Group of Participants" (Spanish-English vs. Spanish-Catalan) was not significant (all *F*s < 1), revealing that the pattern of switching costs was similar in both populations.

These results reveal that the age at which the L2 of highly-proficient bilinguals has been acquired does not affect the way in which they perform the language-switching task: highly-proficient bilinguals showed symmetrical switching costs regardless of the age of L2 acquisition. Hence, the differential pattern of switching performance between L2 learners and highly-proficient bilinguals cannot be due to the age at which L2 has been acquired. As a consequence, we could conclude that the factor behind the absence of asymmetrical switching costs is the level of proficiency attained in L2, regardless of the L2 age of acquisition.[11]

---

[11] Additional support of this proposal comes from the results reported by Hernandez & Kohnert (1999). In their study, Spanish–English bilinguals that learned their L2 before the age of 8 were tested. However, and despite Spanish being the first language of the participants, their dominant language was English. For example, in a blocked naming condition, responses in

The results of Experiments 1, 2, 3 and 4 are consistent with the hypotheses derived from the IC model proposed by Green (1998). According to this view, asymmetrical switching costs should be present when the difference in the proficiency levels of the languages involved in the switching task is large (Experiment 1). But whenever such proficiency difference is small, the asymmetry should disappear (Experiments 2, 3 and 4). Thus, up to now, we have replicated and extended Meuter and Allport's results exploring the language-switching performance of low-proficient and highly-proficient bilingual populations. At this point, the results allow us to extend the generalization presented above in the following terms: "highly-proficient bilinguals do not show asymmetrical switching costs, *regardless of the age at which the L2 was learned and regardless of the typological similarities of their two languages*, whereas low-proficient bilinguals do."

Nevertheless, in order to be able to make a complete characterization of the language-switching performance of bilinguals, there is an additional factor that should be controlled: the cognate status of the words. Cognates are those translation words with phonologically and/or orthographically similar lexical representations (e.g. "guitarra" and "guitar", in Spanish and English,

---

English were faster than in Spanish. Thus, because of their extensive and intensive exposure to English (they were living in the United States), their second language became the more dominant one, revealing a dissociation between L1/L2 relative dominance. The results of this experiment showed a larger switching cost in the dominant language (English) than in the less dominant language (Spanish), replicating the asymmetrical switching cost observed in Experiment 1. If we compare these results with those observed for the Spanish–Catalan bilinguals tested in Experiment 2, we might tentatively conclude that proficiency rather than age of L2 acquisition is at the basis of the different performance between the bilingual groups. This is because both groups behave differently despite the fact that they were exposed to their two languages early in life. Thus, such differential performance must be guided by the different degrees of proficiency between their two languages

At any rate, the comparison between these two studies needs to be taken cautiously for various reasons. First, it is unclear what consequences a change in the linguistic dominance of the participants may have had when performing the switching task. Second, the designs and procedures used by Hernandez & Kohnert (1999) and those used in our study were very different. For example, our experiments included 950 trials while only 60 trials were included in their study.

respectively), whereas non-cognates have dissimilar lexical representations in the bilinguals' two languages. In the case of non-cognate words, there is wide agreement assuming that bilinguals have two different and independent lexical representations referring to the same concept, one for each of the speakers' two languages (Finkbeiner et al., 2002; Kroll & Stewart, 1994; Li & Gleitman, 2002; Potter et al. 1984). However, there is less agreement regarding the way cognate words are lexically represented. This is because, for cognate words, some researchers propose that the bilinguals' two languages share a unique lexical representation referring to the same concept (Kirsner, Lalor, & Hird, 1993). In all the experiments presented above, participants were required to name pictures with non-cognate instead of cognate names. Thus, for the sake of completeness, we decided to test the language switching performance of bilingual speakers producing cognate words. Next, we briefly present the main proposals regarding the lexical representation of cognate words. Their main predictions regarding the way the cognate status of the words may affect bilinguals' language-switching performance will be also discussed.

Language switching and the cognate status of words

The cognate status of a word has pervasive effects in the performance of bilinguals. For example, cognate words are faster to learn and more resistant to forgetting (e.g., De Groot & Keijzer, 2000; Lotto & De Groot, 1998;), less likely to fall in tip of the tongue states (Gollan & Acenas, 2004), faster to produce (Costa, Caramazza & Sebastián-Gallés, 2000), more sensitive to cross-linguistic priming (De Groot & Nas, 1991; Van Hell & De Groot, 1998), more resistant to anomic states (Roberts & Deslauriers, 1999) and show more language transfer in rehabilitation (Kohnert, 2004). In short, those translation words that are formally similar across languages enjoy a benefit in the course of speech production. Despite this general impact of a word's cognate status in lexicalization, the origin of these effects is under dispute.

There are three main hypotheses about the origin of the cognate facilitation effect that we can label with the terms *semantic*, *lexical* and *phonological hypotheses*, according to the different levels of representation at which they assume the effect to arise from. Importantly, according to the claims these hypotheses made regarding the lexical organization of the bilingual system, these could be divided into two groups: those assuming that both cognate and non-cognate words are lexically represented in the same way, and those assuming that cognate words are lexically represented in a different way than non-cognate ones. The semantic and phonological hypotheses belong to the former group, while the lexical hypothesis belongs to the later one.

On the one hand, the *semantic hypothesis* assumes that the cognate facilitation effect arises as a consequence of the different semantic overlap between translation words: cognate translations share more semantic features than non-cognate translations. As Van Hell & De Groot (1998) argued: *"Differences obtained between cognates and noncognates (…) may originate from similar differences in conceptual overlap: cognates may share more conceptual units than noncognates (…)"* (pp. 207). In this scenario, the cognate facilitation effect, for example in picture naming, may arise either because the retrieval of semantic representations shared across languages is easier than that of non-shared representations (since they are retrieved more often), or because access to lexical representations from a shared semantic representation is faster than from non-shared ones. However, the *phonological hypothesis* claims that a word's cognate status affects the processes involved in the retrieval of phonological information (Costa et al., 2000; Gollan & Acenas, 2004). Accordingly, the cognate facilitation effect arises because the retrieval of the phonemes belonging to cognate words is facilitated by the concurrent activation of the corresponding translations. That is, the phonological content of a cognate word would receive activation from its corresponding lexical representation and, given the phonological overlap, also from that of its translation. In contrast, the phonological representation of a non-cognate word would receive activation only from the corresponding lexical representation. Thus, assuming that the ease with which phonological representations are retrieved depends on their corresponding level of activation, retrieval will be faster for cognate than for non-cognate words (e.g., Costa et al., 2000; see Roelofs & Verhoef, 2006, for a simulation of the cognate facilitation effects reported by Costa et al. (2000), by implementing the assumptions of the phonological hypothesis). Thus, although these two proposals allocate the origin of the cognate effect at different levels of representation, both of them assume that cognate and non-cognate words are lexically represented in the same way.

On the other hand, the *lexical hypothesis* claims that the cognate facilitation effect reveals the structure/organization of lexical items in the bilingual lexicon: cognate translations are supposed to share a single lexical representation, while non-cognate translations are represented by two different lexical entries (Kirsner, Lalor, & Hird, 1993; Sánchez-Casas & García-Albea, 2005). Thus, the retrieval of a cognate word entails the retrieval of the same lexical representation in L1 and L2, while the retrieval of a non-cognate word entails the retrieval of distinct lexical entries. In this context, Kirsner and collaborators explain the cognate facilitation effect by assuming that the frequency value of the lexical representations corresponding to cognate words is higher than that of non-cognate words. This is because, for cognate words, the same lexical representations are retrieved when speaking in L1 and in L2, while different representations are retrieved in the case of non-cognate words. In other terms, the lexical representation of an L2 cognate word inherits the frequency of its L1 translation.

Important for our purposes, different predictions arise from these three hypotheses regarding the way the cognate status of the words would affect bilingual speakers language-switching patterns. The differences arise from whether these hypotheses assume cognate and non-cognate words are lexically represented in a different way. On the one hand, for those hypotheses assuming both the cognate and non-cognate words are lexically represented in the same way (both are represented by two different lexical entries), no different switching cost patterns may be expected for cognates and non-cognates. This is the case of the semantic and phonological hypotheses. However, according to the lexical hypothesis, the pattern of language-switching costs will be affected by cognate status.

First, the language-switching cost may be smaller for cognate than for non-cognate words. This is because, for cognate words, the lexical representations that are being selected when speaking in L1 and in L2 are the same. Consequently, the only cost associated with switching will be that corresponding to shifting between tasks, but not that of inhibiting the lexical representations of the non-response language. Consider the following case in which a Spanish native speaker and learner of English is naming a picture in English (e.g., house). To achieve her goal, the lexical representations of her Spanish lexicon need to be inhibited (e.g., “barco” [ship], “casa” [house], “manzana” [apple], etc.). However, while the lexical entries corresponding to Spanish non-cognate words will be inhibited without problem (they belong only to Spanish), the lexical entries of Spanish cognates will not be inhibited (“tren” [train], “hotel” [hotel], “pera” [pear]), given that they also belong to the response language (English) -they are shared between languages-. Thus, if in the next trial a non-cognate word (e.g., “manzana” [apple]) needs to be produced in Spanish (a switch trial from English into Spanish), the bilingual would need to overcome the inhibition applied to such representations. In contrast, if such a switch involves the production of a cognate word (“pera” [pear]), the bilingual will not need to overcome such inhibition. In short, smaller switching costs for cognates than for non-cognates are expected because the lexical representations of the former are not inhibited while those of the latter are.

Following this rationale, we can derive another prediction: asymmetrical switching costs for L2 learners may disappear for cognate words. The asymmetrical switching costs are supposed to stem from the differential amount of inhibition applied to the lexical representations of the two languages. However, for those lexical representations that are shared across languages, the amount of inhibition (if any) should be the same no matter the language being spoken, and, therefore, the asymmetrical switching costs should be absent for cognate words.

Summarising, the lexical hypothesis of the origin of the cognate facilitation effect makes two interesting predictions for the performance of bilinguals in the language-switching task: a) the magnitude of the switching cost will be smaller for cognates than for non-cognates for both L2 learners and highly-proficient bilinguals, and b) for L2 learners, asymmetrical switching costs will be present for non-cognates but not for cognates.

4.5 Experiment 5: Does words' cognate status affect the language switching performance of bilinguals?

The aim of this experiment is to explore whether the cognate status of words affects in any way bilinguals' language switching performance. For this purpose, the language switching performance of a group of L2 learners and a group of highly-proficient bilingual speakers will be explored in a language-switching task in which pictures with cognate and non-cognate names are presented. The language-switching patterns of these bilinguals will be compared while naming cognate and non-cognate words.

Method

Participants

Forty-eight native speakers of Spanish took part in the experiment. Twenty-four participants were learners of Catalan from the same population as in Experiment 1 (Group 1). They were native speakers of Spanish that had been taking formal training in Catalan as a second language for an average of 1 year. They had been living in Barcelona for an average of 2.5 years before the time of testing. This is to say that, at the moment of testing, they were regularly exposed to Catalan and Spanish. All of them were low-proficient bilinguals and, thus they were considered to be L2 learners. The other twenty-four participants were highly-proficient Spanish-Catalan bilinguals taken from the same population as in Experiment 2 (see Appendix A for a more detailed language history profile of participants). L2 learners were assigned to Group 1, while Spanish-Catalan bilinguals to Group 2.

Materials and procedure

Twenty pictures of common objects, half with non-cognate and half with cognate names were selected. The pictures with non-cognate names were the same used in Experiment 2. Regarding the pictures with cognate names, care was taken to select pictures for which the phonological form of the Spanish and Catalan names differed in at least one phoneme. For example, cognates differing in two phonemes (e.g. "árbol" and "arbre", [tree] in Spanish and Catalan, respectively), or cognates differing in only one phoneme, were selected (e.g., "luna" and "lluna", [moon] in Spanish and Catalan, respectively) (see Appendix C for a description). The same materials were used for both groups of participants.

The same lists used in the previous experiments were used here. As a consequence, the same specific sequence of L1 and L2, and switch and non-switch trials was used. However, mixing cognates and non-cognates and switch and non-switch trials in the same experiment required controlling for the cognate status of the picture's name preceding any given trial. This is because it is possible that the naming latencies for a given trial depend, to some extent, on the cognate status of the preceding word. For example, it is possible that when a response is given relatively fast, more resources are left for giving a response on the following trial. Thus, if there was to be a cognate effect in our experiments, we should make sure that the same number of switch and non-switch, L1 and L2, and cognate and non-cognate target trials were preceded by the same number of cognate and non-cognate trials. However, if we were to manipulate all these properties for each participant, the number of trials per condition would be relatively small. Thus, we decided to control for the cognate status of the preceding trial in a different manner. For half of the participants in each group, cognate and non-cognate target items were preceded by trials of the same type. That is, a cognate target trial was always preceded by another cognate trial, and a non-cognate target trial was always preceded by a non-cognate trial. Those trials in which there was a change in the cognate status were regarded as fillers. For the other half of the participants, the reverse situation was constructed. That is, a cognate target trial was always preceded by a non-cognate trial, and a non-cognate target trial was always preceded by a cognate trial. The other trials in which there was a repetition of cognate status were regarded as fillers. This design allowed us to: a) control for the possible effects of the cognate status of the preceding trial on the target trial, b) minimize the development of expectancy strategies on the cognate status of following trials. However, given that we do not have any prediction about how the cognate status of the preceding trial may affect the language-switching performance on target trials, the results from all participants will be reported together.

Consequently, for each group, there were 8 experimental conditions as a result of crossing the following variables: "Cognate Status" (Non-cognate vs. Cognate); "Type of Trial" (Non-switch vs. Switch); and "Response Language" (L1 vs. L2). Each experimental condition had 71 trials. Thus, there were 284 non-switch trials and 284 switch trials (divided in 4 experimental conditions: L1 and L2 cognate and L1 and L2 non-cognate conditions). The remaining 382 trials of the non-switch conditions were left as filler trials. Cognates and non-cognates were represented evenly for the filler trials.

Each picture was presented 47 or 48 times. No picture could appear twice in a list, and there were at least two different items between the first and second appearance of the same picture across lists. As in previous experiments, the assignment of each specific picture to each trial was left random, but varied for each participant. That is, a given picture could be named more often in L1 than in L2 and could appear more often on a switch trial than on a non-switch trial for one participant. However, for another participant, this distribution changed, given that the assignment of the pictures to the different trial types varied randomly across participants.

Data Analysis

Three main variables were considered in the statistical analyses: "Response Language" (L1 or L2), "Type of Trial" (Non-Switch vs. Switch), and "Cognate Status" (Non-cognate vs. Cognate).

Results

Group 1: Spanish learners of Catalan

Erroneous responses (5.8% of the trials) were excluded from the analyses. The error analyses revealed that the main effect of the variable "Type of Trial" approached significance in the analysis by subjects and it was significant in the analysis by items (*F1* (1, 23) = 3.22; MSE = 15.66; *p* =

.085; *F2* (1, 18) = 5.6; *MSE* = 3.23; *p* = .029), revealing that switch trials (6.3%) were more prone to errors than non-switch trials (5.3%). Moreover, a significant "Type of Trial" X "Response Language" interaction was found (*F1* (1, 23) = 5.65; *MSE* = 6.14; *p* = .026; *F2* (1, 18) = 10.14; *MSE* = 1.43; *p* = .005). No more significant results were observed.

In the analysis of naming latencies, the main effects of "Cognate Status" (*F1* (1, 23) = 164.76; *MSE* = 1751.18; *p* < .001; *F2* (1, 18) = 42.16; *MSE* = 2950.65; *p* < .001), "Type of Trial" (*F1* (1, 23) = 291.16; *MSE* = 855.85; *p* < .001; *F2* (1, 18) = 498.39; *MSE* = 208.17; *p* < .001) and "Response Language" (*F1* (1, 23) = 16.19; *MSE* = 3092.45; *p* = .001; *F2* (1, 18) = 11.57; *MSE* = 1678.95; *p* = .003) were significant. Participants were faster naming cognate (735 ms) than non-cognate words (812 ms), non-switch (737 ms) than switch trials (809 ms), and L2 than L1 words (757 and 790 ms, respectively). The interaction between "Cognate Status" and "Response Language" was significant in the analysis by subjects, but not by items (*F1* (1, 23) = 9.23; *MSE* = 1084.46; *p* = .006; *F2* (1, 18) = 2.24; *MSE* = 3767.51; *p* = .151). Importantly, the interaction between "Type of Trial" X "Response Language" was significant (*F1* (1, 23) = 15.54; *MSE* = 581.02; *p* = .001; *F2* (1, 18) = 11.26; *MSE* = 341.76; *p* = .004), indicating that to switch into L1 was harder than to switch into L2 (the mean switching cost was 86 and 58 ms for L1 and L2, respectively). No other interactions were significant. The magnitude of the switching cost for cognates and non-cognates was very similar (68 vs. 75 ms, respectively) (see Figure 5A).

Group 2: Spanish-Catalan highly-proficient bilinguals

Erroneous responses (3.5% of the trials) were excluded from the analyses. In the error analyses, the three main effects were significant: "Cognate Status" (*F1* (1, 23) = 8.85; *MSE* = 5.54; *p* = .007; *F2* (1, 18) = 4.42; *MSE* = 4.52; *p* = .05); "Type of Trial" (*F1* (1, 23) = 23.63; *MSE* = 5.19; *p* < .001; *F2* (1, 18) = 31.47; *MSE* = 1.5; *p* < .001); and "Response Language" (*F1* (1, 23) = 10; *MSE* = 5.79; *p* = .004; *F2* (1, 18) = 6.19; *MSE* = 3.91; *p* = .023). Participants made more errors with non-cognate (4.1%) than cognate words (3.1%), on switch (4.4%) than non-switch trials (2.8%), and in

L1 than in L2 (4.1 and 3.0%, respectively). No significant interaction was present.

In the analysis of naming latencies, the three main effects were significant: "Cognate Status" (*F1* (1, 23) = 238.29; *MSE* = 802.11; *p* < .001; *F2* (1, 18) = 31.19; *MSE* = 2532.29; *p* < .001); "Type of Trial" (*F1* (1, 23) =

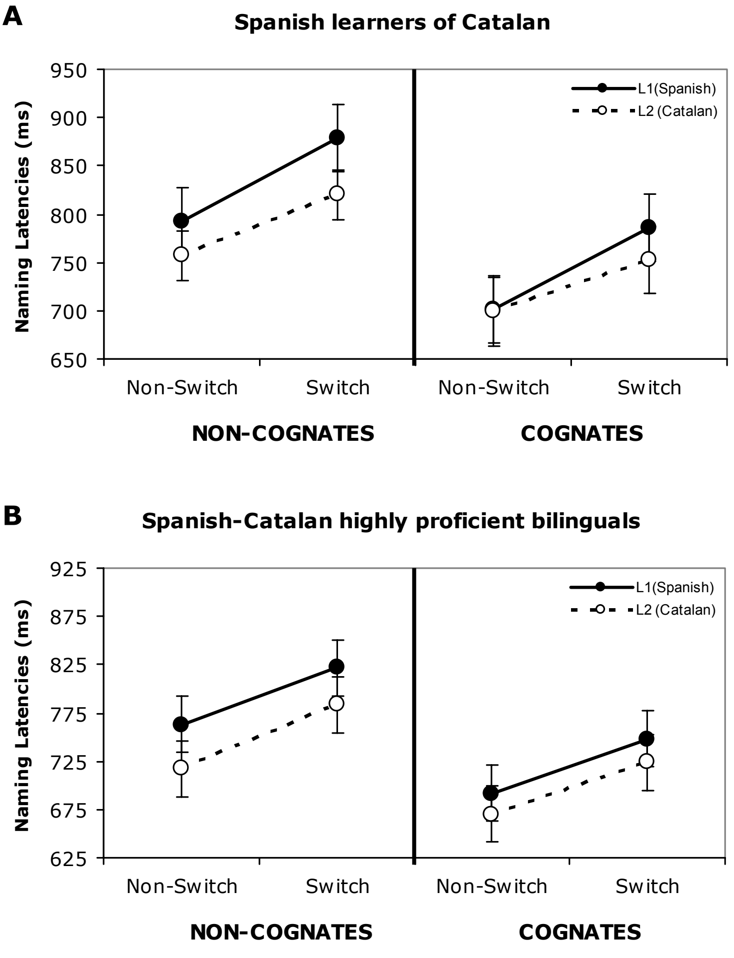


Figure 5: (A) Switching performance of native Spanish speakers learners of Catalan with both non-cognate and cognate words. (B) Switching performance of Spanish-Catalan highly-proficient bilinguals with both non-cognate and cognate words (right panel) (Experiment 5).

145.44; *MSE* = 1142.3; $p < .001$; *F2* (1, 18) = 450.27; *MSE* = 153.3; $p < .001$); and "Response Language" (*F1* (1, 23) = 10.56; *MSE* = 3790.16; $p = .004$; *F2* (1, 18) = 14.36; *MSE* = 1591.17; $p = .001$). Participants were faster naming cognate (708 ms) than non-cognate words (772 ms), non-switch (711 ms) than switch trials (769 ms), and L2 than L1 words (724 and 756 ms, respectively). Importantly, no significant interactions were present. To switch into L1 and into L2 was equally costly (57 and 60 ms, respectively), and the magnitude of the switching cost for cognates and non-cognates was very similar (55 vs. 63 ms, respectively) (see Figure 5B).

Finally, in order to establish whether the different language-switching patterns showed by highly-proficient bilinguals and L2 learners were statistically significant, a post-hoc analysis combining the results of these two groups was done. Importantly, the crucial triple-interaction of the variables ''Type of Trial'', ''Response Language'' and ''Group of Participants'' was highly significant (*F1* (1, 46) = 9.8; *MSE* = 5696.46; $p = .003$; *F2* (1, 18) = 5.91; *MSE* = 2227.55; $p = .026$). Hence, this experiment replicates the different pattern of language-switching costs showed by L2 learners and highly-proficient bilinguals while performing the language-switching task only with non-cognate words.

Discussion

The results from this experiment were clear: (a) A main cognate facilitation effect was found for both the L2 learner and highly-proficient bilingual groups; (b) the same pattern of switching costs was observed for the two groups of bilinguals naming both cognates and non-cognates: asymmetry for the L2 learners (larger switching costs for the L1 than for the L2); and symmetry for the highly-proficient bilinguals (the same costs when switching into L1 and L2); (c) both types of bilinguals showed the same overall amount of switching costs for cognates and non-cognates; and, finally (d) both types of bilinguals showed to be faster naming words in L2 than in L1, regardless of the cognate status of the words.

The main purpose of Experiment 5 was to assess whether the cognate status of the words affects bilinguals' language switching performance. The results reveal that the cognate status of words does *not* affect bilinguals' language switching performance. Here, the main cognate facilitation effect was replicated in the language-switching task, evidencing that cognates (735 ms and 708 ms) are named faster than non-cognates (812 ms and 772 ms for L2 learners and highly-proficient bilinguals, respectively). Additionally, while L2 learners showed clear asymmetrical switching cost patterns for both cognate and non-cognate words, symmetrical ones were observed with highly-proficient bilinguals (see Figure 6). Finally, on average, both groups of bilinguals showed the same amount of switching costs when producing cognate and non-cognate words.

Consequently, we could safely conclude that the cognate status of words does not have any impact on bilinguals' language selection processes. This is because our results demonstrate that there is no interaction between the language-switching cost and the cognate status of the picture names. As we argued above, a possible prediction derived from the lexical hypothesis of the origin of the cognate effect is that the cost associated with language switching

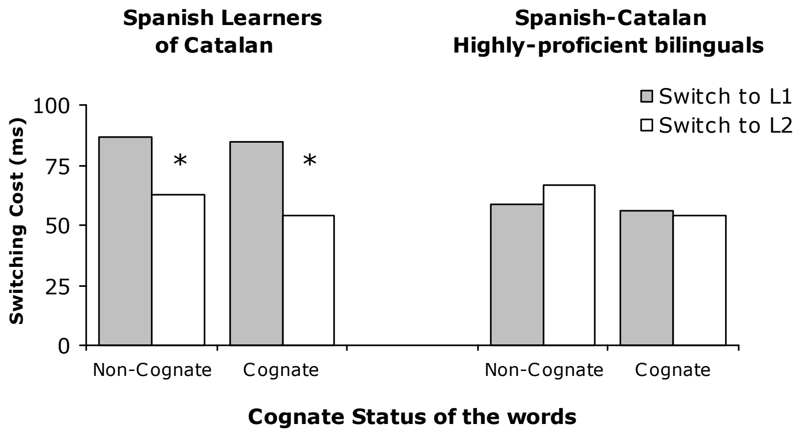


*Figure 6: The magnitude of the switching costs for both non-cognate and cognate words for the L2 learners of Catalan and the highly-proficient bilinguals broken by the direction of the switch (Experiment 5). Significant difference (p<.01) in the magnitude of the switching costs for the two languages involved in the switching task are marked with an *.*

would be smaller for pictures with cognate names than for pictures with non-cognate names. This prediction is derived from the assumption that part of the switching cost reveals the processes of accessing the lexical representations of the response language while avoiding interference from the non-response language. The results of the present experiment are not consistent with such a prediction (further discussion of the way the different types of words are lexically represented in the bilingual mind will be deferred to the General Discussion section).

The data reported in Experiment 5 allow us to extend the main empirical generalization based on bilinguals' language-switching performance in the following terms: "highly-proficient bilinguals do not show asymmetrical switching costs, whereas low-proficient bilinguals do, *regardless of the cognate status of the words*". Importantly, in relation to the type of language-selection mechanisms bilinguals use to select the intended language words in language production, this generalization is in complete agreement with the IC model.

Now, before continuing to study bilinguals' language-switching performance in different linguistic contexts, it is worth discussing the possible origins of a result that has been systematically found in highly-proficient bilingual speakers, both when naming cognate and non-cognate words: the counterintuitive L2-over-L1 advantage effect.

On the nature of the L2 advantage over L1

In all the language switching experiments reported until now, highly-proficient bilinguals showed an unexpected L2-over-L1 advantage effect (Experiments 2, 3, 4 and 5). Due to the impact that such an intriguing and new effect could have in future research on bilingualism, before trying to identify the origin of the phenomenon, its reliability will be tested. Since the phenomenon has been observed in bilinguals of different pairs of languages such as Spanish-Catalan (Experiments 2 and 5), Spanish-Basque (Experiment 3) and Spanish-English (Experiment 4), it is improbable that the effect arises from the specific properties of the words used in a given experiment. However, in all these experiments Spanish was the dominant language of the bilinguals and a small set of stimuli (10 pictures) was used. Thus, in order to assess the reliability of the effect in language-switching tasks and to test whether the difference between L1 and L2 naming latencies stems from poor selection of experimental materials, we decided to run a control experiment. Two main changes were introduced here: First, in this experiment, a larger set of stimuli was used (40 rather than 10 pictures). Second, and more importantly, the L1 and L2 naming performance of Spanish-Catalan highly-proficient bilinguals was tested in two different contexts: a language-switching task that required participants to be in the so-called bilingual mode (Grosjean, 2001); and a simple picture naming task in which participants had to name pictures either in their L1 or in their L2. Hence, participants were set in the so-called monolingual mode.

4.6 Experiment 6: The L2 advantage: A consequence of the bilingual mode-setting?

In this experiment, we further explore the L2-over-L1 advantage showed by highly-proficient bilinguals in the language-switching tasks and its relationship to the language mode-setting established by the speakers to perform each specific task. We do so by asking three groups of Spanish-Catalan highly-proficient bilinguals to perform three different tasks. The first group was asked to perform the same switching task as in the previous experiments, whereas the remaining two groups were asked to perform a monolingual simple picture naming task, asking participants to name pictures in either their L1 (Spanish: Group 2) or in their L2 (Catalan: Group 3). However, in this experiment, 40 rather than 10 pictures were used in order to avoid massive repetition of the same pictures, and to avoid any unexpected effect induced by the selection of a small set of stimuli. The following results are expected in this experiment: 1) larger naming latencies for L1 than for L2 for the participants required to set their language mode at the bilingual end; and 2) faster response latencies for the group performing the simple naming task in L1 (Group 2) than for the group naming pictures in L2 (Group 3).

Hence, the main goal of this experiment is to replicate the L2-over-L1 advantage effect in the switching task, and to confirm that such an effect is a consequence of the type of task bilinguals are required to perform.

Method

Participants

Thirty-six participants from the same population as in Experiments 2 and 5 (Group 2) took part in the experiment. We randomly assigned them to one of the three groups, in a manner that each participant was only tested in one of the three tasks described above. In such a way, we enlarged the possibility of putting bilinguals into the language mode (bilingual or monolingual) that was most appropriate for performing the respective tasks, either the language-switching task or the simple picture naming task in L1 or L2. None of them had participated in previous experiments.

Materials and procedure

Forty pictures with non-cognate names were selected (the 10 pictures used in Experiment 2 plus 30 new pictures. See Appendix D). For the language-switching task, the same design and procedure as in Experiment 2 were used here. However, unlike in Experiment 2, each picture appeared only once per list, and a given picture was repeated across lists with a minimal interval of 5 pictures. Each picture appeared 23 or 24 times. All the other details were identical to those of Experiment 2.

For the simple picture naming tasks, the same 40 pictures were presented. The procedure was maintained as similar as possible to that of the language-switching task. Before the experiment proper, participants were familiarized with the names of the pictures in the corresponding language (L1 or L2). Three blocks containing the 40 pictures were constructed in a random way. The blocks were divided in three lists of 13 or 14 trials each. All these lists were presented to each participant, therefore requiring of each participant to name the same picture three times. A minimal interval of 10 pictures was established between the appearance of a given picture and his subsequent presentation across sub-blocks. The pictures were presented following the same procedure as that of the language-switching experiments with the exception that no language cue was presented.

Results

Group 1: Bilingual-mode naming: Language-Switching task

We excluded 5.6% of the trials from the analyses (errors: 4.1%; outliers: 1.5%). In the error analysis, the main effect of the variable "Type of Trial" was significant (*F1* (1, 11) = 6.45; *MSE* = 1.84; *p* = .027; *F2* (1, 39) = 4.67; *MSE* = 9.99; *p* = .037), revealing that participants made more errors on switch (6.3%) than on non-switch (5.3%) trials. Neither the main effect of "Response Language" nor the interaction between "Type of Trial" and "Response Language" were significant (all *F*s < 1).

In the analysis of naming latencies, the main effects of "Type of Trial" (*F1* (1, 11) = 30.72; *MSE* = 1757.35; *p* = .001; *F2* (1, 39) = 238.17; *MSE* = 686.83; *p* = .001) and "Response Language" (*F1* (1, 11) = 21.19; *MSE* = 4543.17; *p* = .002; *F2* (1, 39) = 81.13; *MSE* = 3817.88; *p* = .001) were significant. Participants were faster naming pictures in L2 than in L1 (792 and

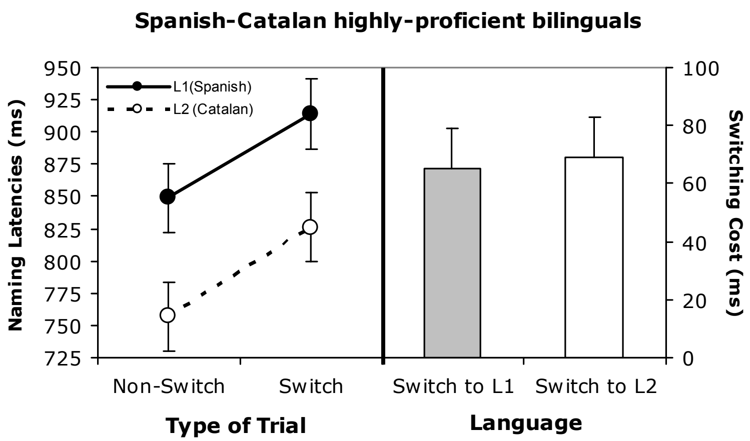


Figure 7: Switching performance of Spanish-Catalan highly-proficient bilinguals in their two dominant languages (left panel), and the magnitude of the switching cost for each language showed by the interaction plot (right panel) (Experiment 6).

881 ms, respectively) and showed faster reaction times on non-switch (803 ms) than on switch trials (870 ms). The interaction between the two variables was not significant (both *F*s < 1). The switching cost for both languages was very similar (L1: 65 ms; L2: 69 ms) (see Figure 7).

Groups 2 and 3: Monolingual mode: Simple picture naming task in L1 and L2.

4.8% (errors: 3.2%; outliers: 1.6%) of the trials were discarded from the data of participants performing the task in their L1 (Group 2), whereas 5.2% (errors: 3.2%; outliers: 2%) of the trials were discarded from the data of the participants performing the task in their L2 (Group 3). No significant results were found in the errors analysis (all *F*s < 1). However, naming latencies in L1 were faster (Group 2: 607 ms) than in L2 (Group 3: 645 ms). Perhaps, because of the reduced number of participants, this difference only reached significant values in the item analyses ($F1$ (1, 22) = 1.88; MSE = 4721.28; p = .184; $F2$ (1, 39) = 51.65; MSE = 562.77; $p < .001$). However, a closer look at the results revealed that participants named 36 out of the 40 pictures faster in their L1 than in their L2.

Discussion

The results of this experiment were clear: (1) for the participants from Group 1, doing the language-switching task, (a) symmetrical switching costs were found (to switch from L1 to L2 takes the same amount of time as to switch from L2 to L1), and (b) slower L1 than L2 naming latencies were observed. These results fully replicate those obtained in Experiment 2. However, (2) for the participants of Groups 2 and 3 performing the monolingual-mode picture-naming tasks, faster

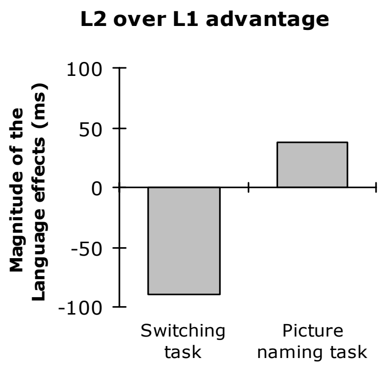


Figure 8: The magnitude of the overall L2-over-L1 advantage as a function of the type of task performed by bilingual speakers (Experiment 6).

L1 than L2 naming responses were observed (see Figure 8). Thus, the results of Group 1 serve us to extend the observations made in Experiments 2 and 5 to naming contexts in which the response set is larger and the number of item repetitions is smaller. Additionally, the faster L1 than L2 naming latencies showed by the participants in the monolingual-mode picture-naming task serve us to conclude that the L2-over-L1 advantage effect stems from the type of task bilingual speakers have to perform, and probably to the language mode they set themselves in to perform each specific task.[12] Consequently, our more important goal now is that of trying to identify the origin of the L2-over-L1 advantage. Where does such an effect come from?

One possible source of this surprising language effect is that participants may bias the lexicalization process towards their weak language. That is, on some percentage of the trials, participants may have triggered the lexicalization process in the weak language irrespective of the language cue (the color of the picture). When the language cue is processed triggering the proper language schema, and that corresponds to the weak language, the lexicalization process that has already started proceeds with no problems. However, if the language cue corresponds to the dominant language (L1), speakers need to stop the lexicalization process in their L2 and start it from scratch in the appropriate language. In this scenario, the advantage of L2 over L1 could stem from: (a) the head start in the lexicalization process of L2, and (b) the "hidden language-switch" involved when naming has to be performed in L1. Note that this account would correctly predict that the difference between L1 and L2 would be independent of the participants' proficiency in the second language, and that such a difference would be present both on switch and non-switch trials. In Experiment 7, we try to shed light on the validity of this explanation.

[12] Further evidence suggesting that this effect is reliable and it is not due to the specific properties of the experimental design we used comes from results obtained in a different laboratory (Janssen, 1999; see also Kroll, Dijkstra, Janssen, and Schriefers, 2000). In those cases, the advantage of L2 over L1 was observed with a cued picture-naming language-switching task in which bilinguals with a different pair of languages were tested: Dutch-English bilinguals.

4.7 Experiment 7: The L2 advantage: A matter of lexicalization bias?

In this experiment we assess whether the difference in naming latencies between the dominant and the non-dominant languages is due to a bias in the naming process that prioritizes the start of lexicalization in the non-dominant language. One property of the design used in the previous experiments may have been critical for establishing such a bias: the simultaneous presentation of the language cue and the target picture. Given this simultaneous presentation, participants may have started encoding the name of the picture and processing the language cue simultaneously, favoring lexicalization in the less dominant language. One way to discourage such a bias is to reduce the uncertainty regarding the language in which a given picture will be named. If participants know in advance the language in which the picture has to be named, there would be no need to bias selection towards the non-dominant language. Thus, if naming latencies in the non-dominant language are faster than in the dominant language because of the bias in the lexicalization process, then a reduction of such a bias by informing participants about the language in which a picture has to be named would result in a reduction of the difference in naming latencies between L1 and L2. Furthermore, as other studies have shown, reducing the uncertainty in a switching task also reduces the magnitude of the switching cost (De Jong, 1995; Meiran, 1996; Rogers and Monsell, 1995).

We tested this hypothesis by presenting a cue that indicated the language in which a given picture had to be named before the actual presentation of the picture: each picture was preceded by a colored circle indicating the language in which the picture had to be produced (see Kroll et al., 2000 for a similar design). We used two different stimulus onset asynchronies (SOA) between the presentation of the language cue and the target picture. Participants saw the language cue either 500 ms (Group 1) or 800 ms (Group 2) before the target picture.

Method

Participants

Twenty-four participants from the same population as in Experiment 2 (see Appendix A) were randomly assigned to two groups, corresponding to the two SOAs.

Materials and procedure

The same materials used in Experiment 2 were employed here (see Appendix B). The procedure was very similar to that of Experiment 2. There were, however, two main differences. First, each picture was preceded by the presentation of a language cue (a red or blue circle) that was displayed for 300 ms. Second, for Group 1, the picture appeared 500 ms after the language cue onset, while for Group 2, each picture appeared 800 ms after the language cue onset.

Data Analysis

Given that the crucial issue addressed here was whether advancing the presentation of a language cue eliminates the difference between naming latencies for L1 and L2, we compared the results obtained when the language cue was presented before the picture (SOA: 500, SOA: 800) with those obtained when both stimuli were presented simultaneously (Experiment 2; SOA: 0). Thus, in the following analyses we declared three variables: "Type of Trial" (Switch vs. Non Switch), "Response Language" (L1 vs. L2), and SOA (SOA 0 [results from Experiment 2], SOA 500, SOA 800).

Results

Following the same criteria as in the previous experiments, 4.9% (errors: 3.4%; outliers: 1.5%) and 5.5% (errors: 3.9%; outliers: 1.6%) of the data points were excluded from the analyses for SOA 500 and SOA 800, respectively. In the analysis of error rates, the only significant effect was that of "Type of Trial" ($F1$ (1, 33) = 21.05; MSE = 2.37; p = .001; $F2$ (1, 9) = 16.62; MSE = 2.39; p = .003), reflecting the presence of more errors on switch trials (5.8%) than on non-switch trials (4.7%).

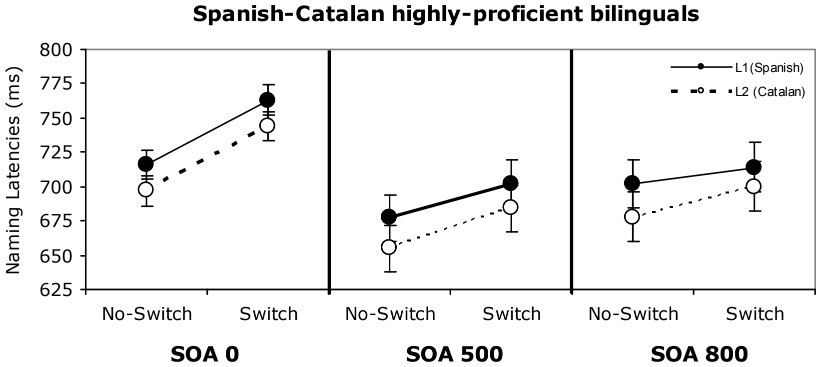


Figure 9: Switching performance of Spanish-Catalan highly-proficient bilinguals in their two dominant languages as a function of the SOA between the language cue and the target picture (Experiment 7).

In the analysis of naming latencies, two main effects were significant: "Type of Trial" (*F1* (1, 33) = 53.55; *MSE* = 628.79; *p* = .001; *F2* (1, 9) = 105.36; *MSE* = 273.63; *p* = .001), and "Response Language" (*F1* (1, 33) = 10.33; *MSE* = 1291.92; *p* = .003; *F2* (1, 9) = 4.2; *MSE* = 2618.2; *p* = .07). Importantly, the magnitude of the switching cost was modulated by the SOA, as reflected by the significant interaction between the variables "Type of Trial" and "SOA" (*F1* (2, 33) = 4.43; *MSE* = 628.79; *p* = .020; *F2* (1, 9) = 30.67; *MSE* = 140.88; *p* = .001). Despite this modulation, the difference in naming latencies between L1 and L2 remained stable across SOAs (SOA 0: 19; SOA 500: 20 ms; SOA 800: 19 ms) as revealed by the non-significant interaction between "Response Language" and "SOA" (both *F*s < 1). None of the remaining interactions were significant (see Figures 9 and 10).

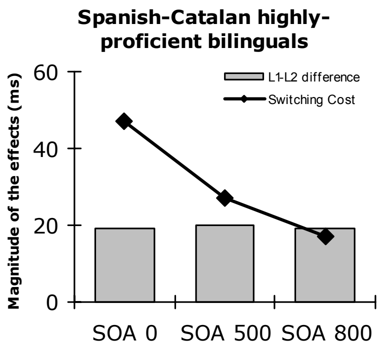


Figure 10: The magnitude of the overall switching cost and the L2-over-L1 advantage as a function of the SOA between the language cue and the target picture (Experiment 7).

A further analysis of the interaction between "Type of Trial" and "SOA" revealed that the switching cost ("Type of Trial") was significant for the three SOAs (SOA 0 [from Experiment 2]: $F1$ (1, 11) = 134.27; MSE = 199.52; p = .001; $F2$ (1, 9) = 132.37; MSE = 173.69; p = .001; SOA 500: $F1$ (1, 11) = 9.88; MSE = 896.19; p = .009; $F2$ (1, 9) = 26.76; MSE = 262.38; p = .001; and SOA 800: $F1$ (1, 11) = 4.56; MSE = 790.65; p = .05; $F2$ (1, 9) = 44.1; MSE = 78.02; p = .001). However, the magnitude of the switching cost decreased as the SOA increased (SOA 0: 47; SOA 500: 27; SOA 800: 17). The interaction between "Response language" and "Type of Trial" was not present at any SOA.

Discussion

The goal of this experiment was to assess one account of the difference in naming latencies between L1 and L2 observed in all previous experiments. We argued that such a difference may be reflecting a bias to start lexicalization in L2, and that one way to reduce such a bias, and hence the difference in naming latencies, is to inform participants about the language in which the target picture will be named some time before the presentation of the picture.

The results of the experiment did not support this prediction. Instead, the difference between L1 and L2 naming latencies was unaffected by the time given to participants to prepare the response language. Importantly, the failure to modulate this difference cannot be attributed to participants ignoring the language cue, since the magnitude of the overall switching cost was diminished when the language cue was presented before the target picture (see Yeung and Monsell, 2003, for a discussion of this issue). Thus, it seems that a bias in the triggering of the lexicalization process is not at the basis of the L2 advantage in the language-switching task. In the General Discussion, we put forward a tentative explanation of this difference in the context of the other effects reported in this dissertation.

Interim summary

Until now, we have explored the language-switching performance of different types of L2 learners and highly-proficient bilinguals performing the task with different types of words. In Experiment 1, the results of Meuter and Allport were replicated, and asymmetrical language-switching costs were found for two different groups of L2 learners: Spanish learners of Catalan and Korean learners of Spanish. In Experiments 2, 3 and 4, the performance of highly-proficient bilinguals was tested. However, in all three experiments, highly-proficient bilinguals did not show asymmetrical switching costs. That is, symmetrical rather than asymmetrical switching costs were observed when the switching task involved two typologically very similar languages (Experiment 2: Spanish-Catalan), when it involved two very dissimilar languages (Experiment 3: Spanish-Basque), and when the L2 had been acquired early in life but also when it had been acquired late (Experiments 2 and 4, respectively). Moreover, in Experiment 5, we have shown that the cognate status of words does not affect the switching performance of L2 learners or highly-proficient bilinguals.

As already noted, all these results are fully compatible with the hypothesis derived from the IC model (Green, 1998). This model postulates that the amount of inhibition applied to a language depends on the level of proficiency achieved in it (the higher the level of proficiency, the larger the applied inhibition). Consequently, if we consider that the amount of switching cost is proportional to the amount of inhibition applied to that language, the IC model would predict exactly what we have reported here. Asymmetrical switching costs for L2 learners having an imbalance between the proficiency levels of their two languages; and symmetrical switching costs for highly-proficient bilinguals having a similar level of proficiency between their two languages. However, the symmetrical language-switching pattern does not necessarily demonstrate the existence of inhibitory control in highly-proficient bilinguals. In fact, these results could be interpreted as reflecting either that the two languages of a highly-proficient bilingual are inhibited to the same extent, or that the language-switching task is achieved without inhibitory processing in these bilinguals. That is, it is possible that highly-proficient bilinguals have developed a different sort of selection mechanism that does not require inhibition of the non-response language for successful selection of words in the intended language. If this were to be the case, switching from L1 to L2 should be as costly as switching from L2 to L1. In other words, the results reported up to now, although consistent with the IC model, can also be explained without appealing to inhibition.

Thus, a question that remains unanswered is whether highly-proficient bilinguals really make use of reactive inhibitory mechanisms to perform the switching task. A possible way to answer this question is to explore whether highly-proficient bilinguals show asymmetrical switching costs when performing the switching task in a similar situation to that in which low-proficient bilinguals show such a pattern. That is, a situation in which bilinguals perform the task with two languages for which they have different levels of proficiency. To assess this issue, we need to test highly-proficient bilinguals that are learners of another language (L3), in a switching task involving L1 and L3. If inhibitory control is at the root of the switching performance of highly-proficient bilinguals, we should expect asymmetrical switching costs when they perform the task in L1 and L3. In fact, the pattern of results in this case should resemble that observed for L2 learners in Experiment 1.

4.8 Experiment 8: Do highly-proficient bilinguals rely on Inhibitory Control mechanisms? Highly-proficient bilinguals switching between L1 and L3

The main goal of this experiment is to explore whether highly-proficient bilinguals show asymmetrical switching costs when asked to perform a switching task in their L1 and in their much weaker L3.

We assessed this issue by testing in a language-switching task highly-proficient Spanish–Catalan bilinguals who were learning English (L3). Crucially, the L2 (Catalan) proficiency level of these speakers is very different from their L3 (English) proficiency level. In addition, the participants tested in this experiment were selected from the same population as those who participated in Experiment 2. Therefore, they had a similar level of L2 proficiency as in that experiment (see Appendix A).

Method

Participants

Twelve participants took part in the experiment. All participants had taken English courses for at least 6 years (1-hour lessons, twice a week), and were currently attending English courses as a foreign language. They scarcely used English for usual communication. As the language proficiency self-assessment shows, these subjects' L3 proficiency levels and the proficiency levels of the L2 learners group of Experiment 1 were very similar.[13] Consequently, participants in this group can be considered to be L3 learners. None of the participants had taken part in the previous experiments.

Materials and procedure

The same materials and procedure used in Experiments 1 (Group 1), 2 and 4 were employed here. The only difference is that participants, instead of naming pictures in their L1 and L2, were asked to perform the task in their L1 and L3 (Spanish-English).

---

[13] The fact that the L3 learners in this experiment and the L2 learners (Group 1) in Experiment 1 reported similar degrees of proficiency in their L3 and L2, respectively, may come as a surprise, given the differential amount of exposure to these languages. The Spanish native speakers that were learning Catalan had less exposure to it (in number of years) than the Spanish–Catalan bilingual learners of English had had formal training in English. However, when evaluating this information, one should consider the similarities between Spanish and Catalan, on the one hand, and Spanish and English, on the other. The first two languages are very similar in respect to lexical items (about 70% of words are cognates in the two languages), while the difference between Spanish and English is much larger. This is also true for other linguistic features such as grammatical gender, verbal inflections, word order, and so on. When considering the differences among the languages it is then not so surprising that a relatively short, but intense, exposure to Catalan, and a somewhat less intense, but longer, exposure to English, leads to similar self-assessment of proficiency.

Results

We excluded 6.1% of the trials from the analyses (errors: 4.4%; outliers: 1.7%). Participants made slightly more errors on switch (8.2%) than on non-switch trials (6.7%) ("Type of Trial", *F1* (1, 11) = 3.88; *MSE* = 6.79; *p* = .074; *F2* (1, 9) = 9.89; *MSE* = 2.29; *p* = .012).

In the analysis of naming latencies, two main effects were significant: "Type of Trial" (*F1* (1, 11) = 30.73; *MSE* = 880.90; *p* = .001; *F2* (1, 9) = 105.87; *MSE* = 223.55; *p* = .001), and "Response Language" (*F1* (1, 11) = 12.84; *MSE* = 1325.06; *p* = .004; *F2* (1, 9) = 12.87; *MSE* = 1060.58; *p* = .006). Faster reaction times were shown in L3 than in L1 (689 and 726 ms, respectively) and on non-switch (684 ms) than on switch trials (731 ms). Importantly, the interaction between the two variables was not significant (both *F*s < 1). The magnitude of the switching cost was practically identical for the two languages (L1:47 ms; L2: 48 ms) (see Figure 11).

These results resemble those observed for the same population when performing the task in the two dominant languages, L1 and L2, in the sense

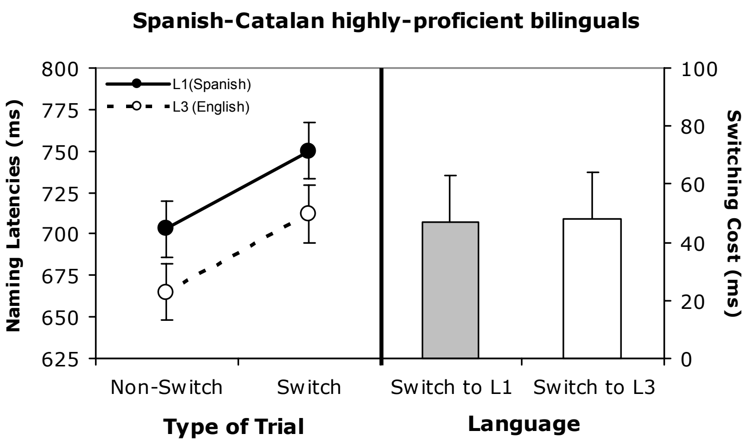


Figure 11: Switching performance of Spanish-Catalan early learners and highly proficient bilinguals in their dominant L1, Spanish, and their weak L3, English (left panel), and the magnitude of the switching cost for each language showed by the interaction plot (right panel) (Experiment 9).

that the magnitude of the switching cost was not modulated by the language of the response. To assess whether the performance of Spanish-Catalan highly-proficient bilinguals when performing the task in their L1-L2 or in their L1-L3 is comparable, we ran a joint analysis of the naming latencies obtained for highly-proficient bilinguals in Experiment 2 and in the present experiment. The main effects of "Type of Trial" and "Response Language" were significant ($F1$ (1, 22) = 99.71, MSE = 540.21; p = .001; $F2$ (1, 9) = 152.32, MSE = 306.3; p = .001; and $F1$ (1, 22) = 19.79; MSE = 987.73; p = .001; $F2$ (1, 9) = 10.12, MSE = 1577.13; p = .011; respectively). Crucially, none of the interactions was significant. Thus, Spanish-Catalan highly-proficient bilinguals performed the switching task similarly, regardless of whether it involved their two dominant languages (Spanish-Catalan) or their dominant language (Spanish) and a much weaker language (English-L3).[14] We also explored whether the performance of the bilinguals tested in this experiment differed from that of the L2 learners tested in Experiment 1 (Group 1). Recall that the proficiency level in the non-dominant language used in the experiments for the two groups of participants was comparable. In this analysis, the three-way interaction between "Type of Trial", "Response Language" and "Group of Participants" was significant ($F1$ (1, 22) = 5.45; MSE = 368.24; p = .029; $F2$ (1, 9) = 15.14; MSE = 113; p = .004), indicating that the magnitude of the asymmetrical switching cost was different for the two groups (L2 Learners: 36 ms; L3 Learners: -1 ms).

Another way to assess whether the magnitude of the switching cost in L1 is linked to bilinguals' proficiency levels in their weaker languages is to explore whether naming latencies in the weaker language predict the difficulty of switching into L1. In this analysis, we took the naming latencies in the L2 (or L3) non-switch trials of highly-proficient bilinguals in Experiments 2 and 8 as

[14] The joint analysis of the naming latencies obtained for the Spanish–English highly-proficient bilinguals in Experiment 4 and in the present experiment, revealed significant main effects of "Type of Trial" and "Response Language" ($F1$ (1, 22) = 70.17, MSE = 656.48; p < .001; $F2$ (1, 9) = 353.54, MSE = 111.77; p < .001; and $F1$ (1, 22) = 19.7; MSE = 1261.7; p < .001; $F2$ (1, 9) = 13.46, MSE = 1564.27; p = .005; respectively). However, once again, none of the interactions was significant.

an indicator of participants' L2 (or L3) proficiency level, and we evaluated whether this variable was able to correctly predict the magnitude of the L1 switching cost. The correlation between the two variables was very low (.16) and accounts for a very small part of the variance (.026), supporting the notion that the level of proficiency of the less dominant language involved in the switching task does not affect the ease with which switching into L1 is achieved.

Discussion

The results of this experiment are clear: highly-proficient bilinguals do not show asymmetrical switching costs when performing the switching task in their L1 and in their much weaker L3. This result is at odds with the account of the asymmetrical switching cost in terms of an imbalance between the proficiency levels of the two languages of a bilingual, which in turn leads to stronger inhibition of the more dominant language. Consequently, it appears that the difference in proficiency levels between the languages involved in the switching task does not predict the presence of asymmetrical switching costs.[15]

Given the important implications that this surprising result might have for our understanding of the processes involved in the attentional control mechanisms used by highly-proficient bilinguals in language switching, in Experiment 9 we aim at replicating and extending this observation.

[15] The similarity between the pattern of results in Experiments 2 and 8 also extends to the overall difference in naming latencies between L1 and L3. Surprisingly, in Experiment 8, naming latencies for L1 were also slower than for L3, replicating the results of previous experiments. However, as the main objective of this experiment was to explore whether highly-proficient bilinguals make use of reactive inhibitory mechanisms to perform the switching task, further discussion of the possible origins of the L2/ L3 naming latencies' advantage over L1 will be postponed.

4.9 Experiment 9: Highly-proficient bilinguals switching between L2 and L3

The purpose of this experiment is to assess the language-switching performance of highly-proficient bilinguals in a language-switching task that involves a strong language (L2) and a much weaker language (L3). In Experiment 8, we found that Spanish-Catalan highly-proficient bilinguals showed symmetrical switching costs when asked to switch between their L1 and their much weaker L3. Here, we aim at replicating and extending this result by asking the same type of bilinguals to switch between their L2 (Catalan) and their much weaker L3 (English). This is an interesting and novel condition, given that up to now all experiments of language switching have always included bilinguals' first language. Thus, the results of this experiment will also provide us with relevant information on the role played by the presence of L1 in the language-switching task.

If the proficiency difference between the two languages involved in the switching task is at the basis of asymmetrical switching costs, then we should find similar asymmetrical switching costs in this experiment. Alternatively, if highly-proficient bilinguals do not make use of the same inhibitory mechanism as that used by L2 learners when performing the language-switching task, then we should find symmetrical switching costs.

Method

Participants

Twelve participants from the same population as in Experiment 8 took part in the experiment. All of them were native speakers of Spanish who were also highly-proficient speakers of Catalan (see Appendix A). All participants had taken English courses for at least 8 years (1-hour classes, twice a week), as part of their high-school curriculum. However, only one of them reported having subsequently enrolled in an English course, only two reported having been to an English-speaking country (for a period not longer than two weeks), and all except four claimed they did not use English at all at the time of testing. As the language proficiency self-assessment shows, these subjects' L3 proficiency levels are even lower than (very similar to) those of the L2 learner groups tested in Experiment 1. Consequently, participants in this group can be considered to be L3 learners (people with some L3 experience but not very high proficiency).

Materials and procedure

The materials, design and procedure were identical to that of Experiment 8 (see Appendix B for a description). The only difference was that, in this case, participants were instructed to name pictures in their L2 (Catalan) or L3 (English).

Results

Following the same criteria as in previous experiments, 5.6% (errors: 4.2%; outliers: 1.4%) of the trials were excluded from the analyses. The only significant effect in the error analysis was that of "Type of Trial" ($F1$ (1, 11) = 24.79; MSE = 2.99; p < .001; $F2$ (1, 9) = 21.31; MSE = 3.12; p = .001). Switch trials (7.4%) led to more errors than non-switch trials (4.9%).

In the analysis of naming latencies, the main effect of "Type of Trial" was significant ($F1$ (1, 11) = 59.33; MSE = 613.62; p < .001; $F2$ (1, 9) = 29.1; MSE = 1052.55; p < .001), showing that reaction times were faster for non-switch than for switch trials (864 ms and 919 ms, respectively). The main effect of "Response Language" was also significant by subjects, but not by items ($F1$ (1, 11) = 7.34; MSE = 2849.02; p = .02; $F2$ (1, 9) = 3.02; MSE = 5178.35; p = .116). The analysis of the naming latencies indicated that participants were faster naming pictures in L3 (871 ms) than in L2 (913 ms). Interestingly, the interaction between the two variables was not significant (both Fs < 1; switch to L2: 57 ms; switch to L3: 53 ms) (see Figure 12).

To assess whether the results of Spanish-Catalan highly-proficient bilinguals when performing the task in their L2-L3 is comparable to their performance when doing the task in L1-L2 or in L1-L3, we ran two joint analyses of the naming latencies obtained for highly-proficient bilinguals in the

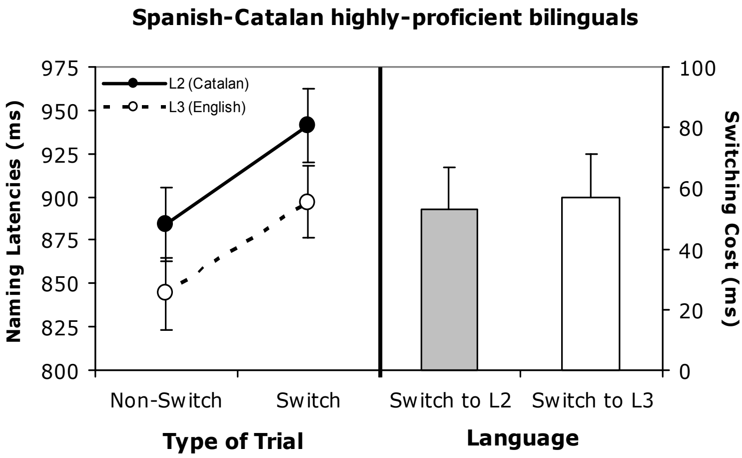


Figure 12: Switching performance of Spanish-Catalan early learners and highly-proficient bilinguals in their dominant L2, Catalan, and their weak L3, English (left panel), and the magnitude of the switching cost for each language showed by the interaction plot (right panel) (Experiment 9).

present experiment with those obtained in Experiments 2 and 8. However, none of the two "Type of Trial" X "Response Language" X "Group of Participants" interactions was significant (all *F*s < 1). These results revealed that Spanish-Catalan highly-proficient bilinguals showed exactly the same pattern of switching costs regardless of whether the task involved their two dominant languages (Spanish-Catalan) or one of their two dominant languages (Spanish or Catalan) and a much weaker one (English-L3): (a) the magnitude of the switching cost was the same regardless of the direction of the switch, and (b) naming latencies were slower for the dominant L2 than for the non-dominant L3.

Discussion

The results of this experiment are clear: when highly-proficient bilinguals are asked to switch between their strong L2 and their much weaker L3, symmetrical switching costs are observed. This pattern of results replicates and extends those observed in Experiment 8, when participants performed the task in L1 and L3. Together, these observations reveal that differences in the proficiency levels between the two languages involved in the switching task do not lead to asymmetrical switching costs for highly-proficient bilinguals. Thus, these results allow us to draw the following empirical generalization: *The crucial factor for the presence of asymmetrical switching costs is whether participants are highly-proficient bilinguals in any given pair of languages*. That is, a difference in dominance between the languages involved in the switching task results in asymmetrical switching costs for L2 learners but not for highly-proficient bilinguals.

Consequently, these observations cast some doubt on whether the "selection through inhibition" explanation given to the switching performance of L2 learners can account for the performance of highly-proficient bilinguals. More importantly, the issue arises of why a difference in the proficiency levels of the two languages involved in the switching task leads to asymmetrical switching costs for L2 learners but not for highly-proficient bilinguals.

Why is the switching performance of highly-proficient bilinguals and L2 learners different? The role of L2 proficiency in the shift of language control mechanisms

The difference in performance between highly-proficient bilinguals and L2 learners could be explained in terms of the different degrees with which these two populations master the switching task. It is possible that, by virtue of having practiced language-switching more often, the inhibitory control system of highly-proficient bilinguals works in a different way from that of L2 learners. For instance, one could argue that while the inhibitory system of L2 learners takes into account the different strengths of the languages involved in the switching task, such a variable is irrelevant for the inhibitory system of highly-proficient bilinguals. That is, while L2 learners would inhibit their L1 more than their L2, highly-proficient bilinguals/learners of an L3 would inhibit all of their languages (either their strong L1 and L2 or their weak L3) to the same degree, irrespective of the strength (or availability) of the specific languages involved in the switching task. In this view, to become a highly-proficient bilingual would, among other things, entail the development of an inhibitory mechanism that is not reactive; that is, a mechanism that does not depend on the relative strength of the two languages involved in the switching task (but see section 5.4 of the General Discussion for problems with this view when trying to account for the difference in naming latencies between L1/L2).

However, given the striking difference between the switching performance of highly-proficient bilinguals and that of L2 learners, one could seek an explanation in terms of different lexical selection mechanisms for the two populations rather than in terms of the degree with which they inhibit their different languages. That is, it is possible that the difference in the ways these two populations perform the switching task is not quantitative (e.g., amount of inhibition applied to the languages) but qualitative (e.g., the way in which lexical selection is achieved). As advanced in the Introduction, there are at least two views about how lexical selection proceeds in bilingual speakers. According to one of these explanations, lexical selection in the intended language is achieved by means of the active suppression of the lexical items belonging to the non-response language (Green, 1998). Alternatively, the language-specific selection hypothesis assumes that lexical access does not require inhibitory control (Costa et al., 1999). In this framework, a bilingual speaker has developed a lexical selection mechanism that is only sensitive to the activation levels of the words belonging to the intended language. Thus, the activated words belonging to the non-response language would not act as competitors at the level at which lexical selection is achieved, and therefore, there will be no need to suppress their activation.

In this scenario, one could put forward the following tentative explanation: the degree with which lexical selection in bilingual speakers entails inhibitory control depends on whether they have achieved a high proficiency level in any pair of languages. If the bilingual has not achieved comparable performance levels in her two languages, then lexical selection would make use of inhibitory control to ensure selection in the intended language. However, an increase in the proficiency level of the bilingual speaker would lead to a shift in the “type” of processes responsible for focusing on one language. The shift would be from reliance on inhibitory control to reliance on a language-specific selection mechanism during lexical selection. Importantly, when this language-specific selection mechanism has been developed, it will be applied to any language, regardless of the proficiency level of the speaker in that language. That is, the specific selection mechanism would be functional in the dominant L2, and in the weak L3. In other words, if speakers are able to focus their lexical selection on the strong L2 without suppressing L1, they will also be able to do so in the much weaker L3. In this view, given that reactive inhibition is only present for L2 learners, the asymmetrical switching cost would be present only for this group of speakers. Consequently, highly-proficient bilinguals would not show such an asymmetrical switching cost regardless of the difference in proficiency levels between the languages involved in the switching task (although they will suffer overall switching costs).

However, there is a context where the language-specific selection mechanism would be not functional: this is a context where the bilingual produces a language in which its lexical representations are not well established. This is because, such a mechanism is assumed to guarantee lexical selection in the intended language by inspecting the activation of only those representations belonging to the language that has been chosen for production. Thus, if the lexical representations of the response language are integrated in a lexicon, then the lexical selection mechanism can focus on that lexicon, and avoid interference from the lexical representations of the other language without the need of inhibiting them. That is, the lexical selection mechanism can only be sensitive to those representations that are integrated into a lexicon. When this criterion is not met, as presumably is the case at early stages of word learning, it would be impossible for the selection mechanism to perform restricted search over sparse lexical representations that do not belong to a specific lexicon. In other words, the language-specific selection mechanism could only be functional when there actually is a language specific lexicon to focus on. Hence, if this is true, in those contexts in which such a mechanism is not functional, highly-proficient bilinguals might need to rely on inhibitory control processes. In the following two experiments, we further test this possibility in two different linguistic contexts.

In Experiment 10, highly-proficient Catalan-Spanish bilinguals will perform a switching task involving two languages for which they have low proficiency levels (their L3-English and L4–French). This is an interesting condition not only because it is the first time a language-switching task involves two weak languages, but also because of the following reason. Research with multilingual speakers has shown that trilingual speakers with low L3 proficiency often show signs of interference from their L2 but not from their dominant L1 (De Angelis and Selinker, 2001; Williams and Hammarberg, 1998; Ringbom, 2001). It is like bilingual speakers can control very efficiently the potential interference from their dominant language(s), but they have more difficulties to do so with a weak language. Hence, this observation seems to reveal the difficulty of their lexical selection mechanism of focusing on the weaker language's lexical representations, while avoiding interference from their other languages. If this observation actually reveals the limits of the functionality of the language-specific selection mechanism, perhaps highly-proficient bilinguals performing the task in two weak languages (their L3 and L4) need to rely on the use of inhibitory control mechanisms. Hence, in such a case, asymmetrical language switching costs would be expected.

4.10 Experiment 10: Further exploring the language switching performance of highly-proficient bilinguals: Switching between L3 and L4

This experiment aims at exploring the language-switching performance of highly-proficient bilinguals in a language-switching task involving two languages in which the participants are not very proficient. This is, to our knowledge, the first time that a language-switching task involves two weak languages.

Method

Participants

Twelve native speakers of Spanish who were highly-proficient speakers of Catalan took part in the experiment (see Appendix A). All participants had studied English for a minimum of 8 years as part of their high-school curriculum at the time of testing. All subjects had studied French for at least a year, with the exception of one who reported having studied it for 70 hours, without specifying the time period over which this took place. All participants clearly reported to have a lower level in these two languages than in their dominant languages. None of the participants had taken part in the previous experiments.

Materials and procedure

A new set of 10 pictures was selected. The names of these pictures were non-cognates in all the four languages of the participants (see Appendix E). The design and procedure were the same as in previous experiments, although in this case participants were instructed to name pictures in English (L3) or French (L4).

Results

Following the same criteria presented above, 6.3% (errors: 5.1%; outliers: 1.2%) of the trials were excluded from the analyses. In the error analysis, the "Type of Trial" main effect approached significance in the subject analysis, and was significant in the item analysis (*F1* (1, 11) = 3.66; *MSE* = 4.45; p = .082; *F2* (1, 9) = 11.11; *MSE* = 1.06; p = .009). The "Response Language" main effect was significant in both analyses (*F1* (1, 11) = 22.03; *MSE* = 8.85; p = .001; *F2* (1, 9) = 14.16; *MSE* = 12.2; p = .004). Switch trials (7.2%) led to more errors than non-switch trials (6%), and more errors were committed when naming in L4 (8.7%) than when naming in L3 (4.4%).

In the analysis of naming latencies, the main effects of "Type of Trial" (*F1* (1, 11) = 28.96; *MSE* = 690.69; $p < .001$; *F2* (1, 9) = 52.19; *MSE* = 326.78; $p < .001$) and "Response Language" were significant (*F1* (1, 11) = 38.78; *MSE* = 4145.65; $p < .001$; *F2* (1, 9) = 24.34; *MSE* = 5450.62; p = .001). Naming latencies were faster for L3 (885 ms) than for L4 (926 ms). Non-switch trials were faster than switch trials (847 ms and 963 ms, respectively). The interaction between the two variables was also significant (*F1* (1, 11) = 27.35; *MSE* = 238.87; $p < .001$; *F2* (1, 9) = 19.92; *MSE* = 256.37; p = .002; switch

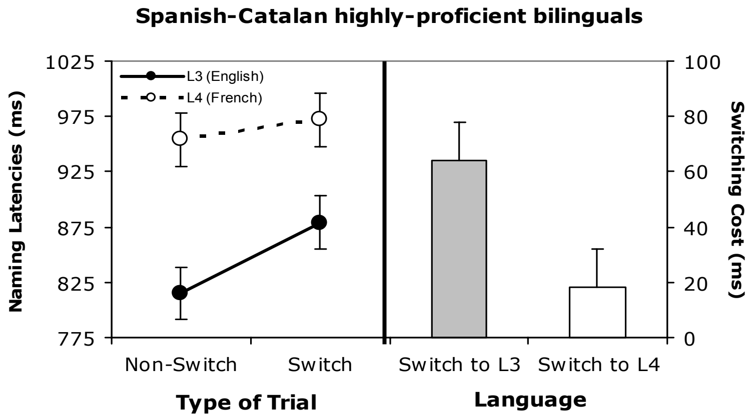


Figure 13: Switching performance of Spanish-Catalan early learners and highly-proficient bilinguals in their weak L3, English, and their even weaker L4, French (left panel), and the magnitude of the switching cost for each language showed by the interaction plot (right panel) (Experiment 10).

to L3: 64 ms; switch to L4: 16 ms) (see Figure 13).

Discussion

The results of this experiment are clear: the magnitude of the switching cost was four times larger for L3 than for L4. That is, when highly-proficient bilinguals are asked to perform the language-switching task in two languages in which their proficiency is relatively low, the magnitude of the switching cost is larger for the stronger language of the two. In the light of the results reported in Experiments 8 and 9, this observation reveals the limitations of the functionality of the language-specific selection mechanism developed by highly-proficient bilinguals. Recall that in these experiments highly-proficient bilinguals showed symmetrical switching costs when switching between a strong language (L1 or L2) and a weak language (L3), while in the present experiment asymmetrical switching costs were observed when the task involved two weak languages (L3 and L4).

According with the language-specific selection mechanism, highly-proficient bilinguals should not show asymmetrical switching costs while switching between any pair of languages. But, in those special contexts in which two weak languages are being used, they do. This observation reveals that, in those contexts, highly-proficient bilinguals rely on inhibitory control mechanisms in order to allow them to switch back and forth between languages. Consequently, these results seem to reflect the limitation of the cognitive flexibility of the bilinguals' switching mechanism. Indeed, they suggest that the language-specific selection mechanism is not available when the switching task involves a very weak language in which the bilingual has not well established its lexical representations yet.

In the following experiment, we will further test the limits of the functioning of the language-specific selection mechanism in a different experimental context. We will do so by exploring bilinguals' performance when asked to switch between their L1 and a recently learned set of words belonging to a new language.

4.11 Experiment 11: Controlling speech production in the first stages of word learning: The role of Inhibitory Control

In this experiment, we explore the language-switching performance of two groups of participants: Spanish monolingual and Spanish-Catalan highly-proficient bilingual speakers. Before the language-switching task, participants were asked to learn 10 words from a new language ("New-Language"). They were presented with the 10 experimental pictures and with their corresponding names from the new language (see procedure). After this learning phase, participants were asked to perform a language-switching task between their L1 and the "New-Language". If the limits of the functionality of the language-specific selection mechanism developed by highly-proficient bilinguals depends on whether the bilingual produces a language in which its lexical representations are not well established, no matter the level of proficiency of the other language involved in the switching task, then this type of bilinguals should also show asymmetrical switching when one of their strong languages is implicated in the task. That is, in such a case, asymmetrical language-switching costs are expected for both monolinguals (L2 learners) and highly-proficient bilinguals.

Method

Participants

Twenty-four participants took part in the experiment. Twelve participants were Spanish monolingual university students with little knowledge of another language (Group 1). All of them were from Pamplona (Navarre), and had grown in a Spanish monolingual context.[16] Although they had formally learnt English or French at school as a foreign language, none of them reported to use L2 on an everyday basis, or having high proficiency in that language. This group could in fact be considered L2 learners, but for the sake of clarity we will refer to them as Spanish monolinguals. Note, however, that whether or not they have little knowledge of another language is irrelevant for the hypothesis of the present experiment. The other twelve participants (Group 2) were recruited from the same population as the one reported in Experiment 2. All of them were highly-proficient Spanish-Catalan early bilinguals, students of Psychology at the University of Barcelona (see Appendix A). Participants in both groups were comparable in age and education.

Materials and procedure

The same method, materials and procedure as in Experiment 2 were used here for the language-switching task. However, before the main task, participants were required to learn 10 words that corresponded to each of the 10 pictures constructed by ourselves and not pertaining to any natural language (for more details about, see Appendix F). The learning phase had three parts. First, all pictures were presented 5 times with the corresponding name in the “New-Language” written under them and played through

[16] The population of Basque speakers in Navarre is rather small (only 10% of the population is bilingual; Basque Government, 2004). None of the participants had been exposed to Basque at school, and reported to have no knowledge of that language.

headphones. In this part, participants were asked to listen and repeat the name. Second, pictures were presented three times with their names written below, and participants were asked to produce the name of each picture. Third, pictures were presented separately and participants were asked to name them. In these three phases, the pictures were presented in randomly ordered sets. After this learning phase the language-switching task started.

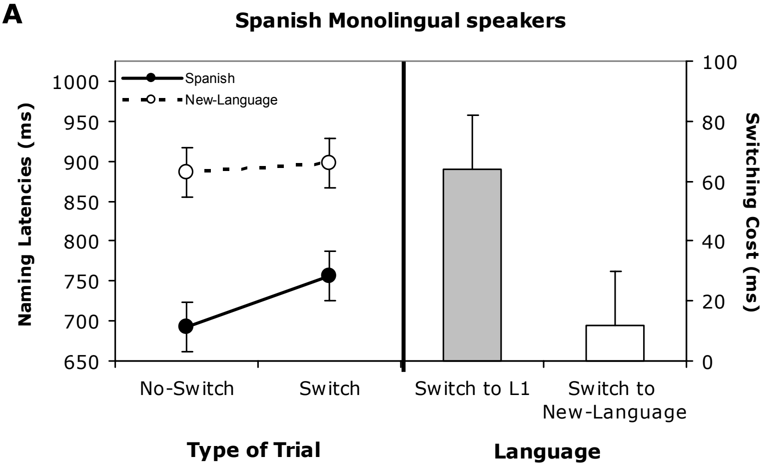
Results

Following the criteria presented above, 5.2% and 5.7% of the trials for the Spanish monolingual group (errors: 3.5%; outliers: 1.7%) and for the Spanish-Catalan bilingual group (errors: 4.4%; outliers: 1.3%) respectively, were removed from the analyses. The main effect of "Response Language" ($F1$ (1, 22) = 102.83; MSE = 9.68; p = .001; $F2$ (1, 9) = 41.3; MSE = 20.34; p = .001) was significant, revealing that participants made more errors in the "New-Language" (8.8%) than in L1 (2.1%). No other main effects were significant. The only significant interaction was that between "Response Language" and "Type of Trial". This interaction was clearly significant in the analysis by subjects, and approached significant values in the analysis by items ($F1$ (1, 22) = 7.12; MSE = 1.6; p = .014; $F2$ (1, 9) = 3.88; MSE = 2.11; p = .08). This interaction revealed that the difference in error rates between switch and non-switch trials was larger in L1 (2.8% and 1.8%) than in the "New-Language" (8.5% and 8.9%, respectively).

In the analyses of naming latencies, the main effects of "Response Language" ($F1$ (1, 22) = 78.41; MSE = 9306.54; p = .001; $F2$ (1, 9) = 74.27; MSE = 8059.47; p = .001) and "Type of Trial" ($F1$ (1, 22) = 70.83; MSE = 591.72; p = .001; $F2$ (1, 9) = 132.05; MSE = 286.58; p = .001) were significant. These results showed that participants were faster naming pictures in L1 than in "New-Language" (755 and 929 ms, respectively), and naming non-switch (821 ms) than switch trials (863 ms). Additionally, the Spanish monolinguals were 68 ms faster than the Spanish-Catalan bilinguals were. The main effect of "Group of Participants" was only marginally significant in the analysis by subjects ($F1$ (1, 22) = 3.04; MSE = 35940.13; p = .095; $F2$ (1, 9) = 70.93; MSE = 1231.83; $p < .001$). Importantly, the interaction between

"Response Language" and "Type of Trial" was significant (*F1* (1, 22) = 41.37; *MSE* = 290.4; *p* = .001; *F2* (1, 9) = 22.93; *MSE* = 399.33; *p* = .001). No other significant interactions were observed (see Figures 14A and 14B).

A



B

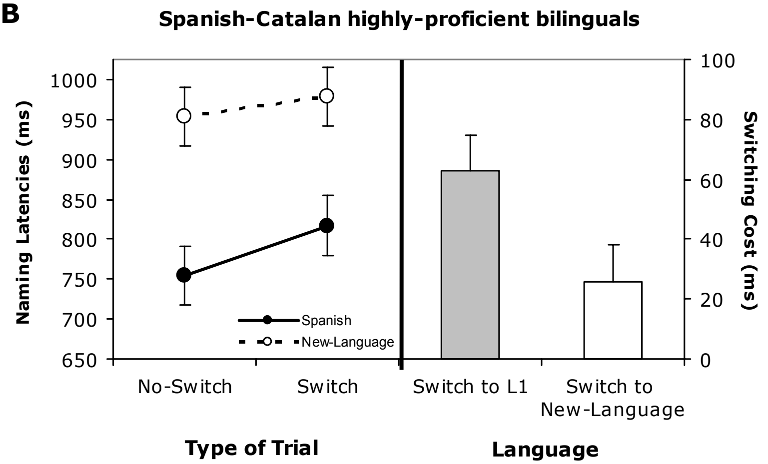


Figure 14. (A) Switching performance of Spanish Monolingual speakers in L1 and in the recently learned "New-Language" (left panel), and the magnitude of the switching cost for each language showed by the interaction plot (right panel). (B) Switching performance of Spanish-Catalan early learners and highly-proficient bilinguals in their L1 and in the recently learned "New-Language" (left panel), and the magnitude of the switching cost for each language showed by the interaction plot (right panel) (Experiment 11).

For a closer look at the performance of the two groups, independent ANOVA analyses of the monolingual and bilingual participants' results were done with "Response Language" and "Type of Trial" as dependent factors. These analyses revealed that the crucial two-way interaction between "Response Language" and "Type of Trial" was significant for both groups (monolinguals: $F1$ (1, 11) = 20.77; MSE = 396.83; p = .001; $F2$ (1, 9) = 19.76; MSE = 344.71; p = .002; bilinguals: $F1$ (1, 11) = 22.42; MSE = 183.97; p = .001; $F2$ (1, 9) = 11.56; MSE = 241.17; p = .008). This interaction shows that the magnitude of the switching cost was larger for L1 than for the "New-Language" (L1: 65 and 63 ms; "New-Language": 13 and 26 ms, for monolinguals and bilinguals, respectively)

Discussion

The results of this experiment reveal that both monolinguals and highly-proficient bilinguals suffer asymmetrical switching costs when the switching task involves their L1 and words from a recently learned "New-Language". That is, the magnitude of the switching cost was much larger for the dominant language (L1) than for the "New-Language". These results, together with those of Experiment 10, are at odds with the selection mechanism not resorting to inhibition that highly-proficient bilinguals had hypothetically developed. According to such a mechanism, highly-proficient bilinguals should not show asymmetrical switching costs under any circumstances. However, on some occasions, they do. Moreover, this is the first time that, under the same experimental conditions, highly-proficient bilinguals and monolinguals show the same performance in a language-switching task. This observation suggests that the mechanisms used by both populations for controlling speech production at very early stages of word learning in a new language are the same. The implications of this interpretation will be discussed in the General Discussion.

5 General Discussion

The main objective of this dissertation was to investigate which are the control mechanisms allowing bilingual speakers to access the words of the target language while avoiding interference from the non-response language. In particular, we have put to test the predictions derived from the most influential model of bilingual language control, the IC model (Green, 1986; 1998). This model proposes a lexical selection mechanism that considers for selection all activated lexical nodes, irrespective of the language membership. To prevent massive interference from the non-response language, the activation of the corresponding lexical items is suppressed.

The asymmetrical language-switching costs observed in the language-switching paradigm have been taken as evidence supporting the notion that bilingual speech production entails the use of inhibitory control mechanisms. However, given that such a pattern has been only reported for low-proficient bilinguals, it was important to study whether the IC model predictions could be generalized to other bilingual populations. The main objective of this dissertation was to test whether a difference in the proficiency levels of the two languages involved in the switching task affects the switching performance of highly-proficient bilinguals and L2 learners to the same extent.

We have reported eleven experiments exploring the language-switching performance of different types of L2 learners and highly-proficient bilinguals in various language-switching contexts. The findings reported in this dissertation show that although L2 learners rely on inhibitory control mechanisms while producing language, highly-proficient bilinguals have shifted to a language-specific selection mechanism. In other words, highly-proficient bilinguals do not need to use inhibitory control mechanisms in order to avoid massive interference from the words of the non-response language. However, in special cases (e.g., when speaking in a language in which they are at the first stages of word acquisition), highly-proficient bilinguals may be able to rely on inhibitory processes.

5.1 Overview of the results

In Experiment 1, two different groups of L2 learners (Spanish–Catalan and Korean–Spanish bilinguals) were asked to perform the switching task in their L1 and much weaker L2. Asymmetrical language-switching costs were reported for both groups (switching from L2 to L1 was harder than vice versa; replicating Meuter & Allport's (1999) observation).

In Experiment 2, highly-proficient Spanish–Catalan early bilinguals performed the same switching task as in Experiment 1. However, for these bilinguals symmetrical language-switching costs were reported (the magnitude of the switching cost was the same for L1 and L2), and naming latencies were faster in L2 than in L1.

In Experiments 3 and 4, the language-switching performance of highly-proficient bilinguals that spoke two very dissimilar languages (Spanish-Basque), or acquired their L2 late in life (Spanish-English) were compared to that of the Spanish-Catalan early bilinguals tested in Experiment 2. The results of both the Spanish-Basque early bilingual group and the Spanish-English late bilingual group resembled very much those observed for Spanish-Catalan bilinguals. For the three groups (a) the language-switching costs were of comparable magnitude for their two languages (symmetrical switching costs); and (b) naming latencies were faster in L2 than in L1. These results reveal that the leading factor for symmetrical language-switching costs is neither language similarity nor L2 AoA, but L2 proficiency.

Experiment 5 tested whether the cognate status of words affects the language-switching performance of L2 learners and highly-proficient bilinguals. The results of this experiment reveal that the cognate status of the words involved in the language-switching task does not affect the switching performance of either L2 learners or highly-proficient bilinguals. That is, L2 learners showed asymmetrical switching costs when the task involved cognate and non-cognate words, whereas highly-proficient bilinguals showed symmetrical switching costs in the same conditions. However, a significant main cognate facilitation effect was reported for both groups of participants, replicating Costa et al.'s (2000) observation. Moreover, highly-proficient bilinguals showed, once again, to be faster naming words in L2 than in L1, both when naming cognate and non-cognate words.

In Experiments 6 and 7 we explored a possible origin of a surprising effect observed in previous experiments: Naming latencies for L2 were faster than for L1 for highly-proficient bilinguals. In Experiment 6 we assessed whether such a difference was present when the naming task was language-blocked. To that end, highly-proficient bilinguals were asked to name pictures either in their L1 or L2. The results showed that the L2 advantage disappeared, and in fact reversed, responses in L1 being now faster than those in L2. Having established that the L2 advantage over L1 is related to some specific conditions of the switching task, in Experiment 7 we explored a possible explanation of the effect. We did so by minimizing the chances that participants develop a lexicalization bias for their weaker language. The results of this experiment showed: (a) a reduction of the overall magnitude of the switching cost; and (b) no modulation of the L2 advantage over L1.

Experiments 8 and 9 further tested the Inhibitory Control hypothesis in bilingual lexical access. Highly-proficient Spanish–Catalan bilinguals who were learners of English were asked to perform the switching task in one of their dominant languages (Experiment 8: L1, Spanish; Experiment 9: L2, Catalan) and in their much weaker L3 (English). The results resembled those observed for highly-proficient bilinguals in previous experiments: (a) the magnitude of the switching cost was similar for both languages (Spanish or Catalan and English); and (b) naming latencies were faster in the weak L3 than in the dominant L1 or L2.

In Experiment 10, highly-proficient bilinguals were asked to switch between two languages for which their proficiency was lower than for their dominant languages (English: L3 / French: L4). In this context, highly-proficient bilinguals showed, for the first time, asymmetrical switching costs. In Experiment 11, the performance of monolinguals and highly-proficient bilingual speakers in a language-switching task involving L1 and a recently learned "New-Language" was explored. The results of this experiment revealed, for the first time, the same pattern of switching costs for both types of speakers: an asymmetrical switching cost pattern (larger switching cost for their L1 than for the "New-Language"). Additionally, in both experiments, highly-proficient bilinguals were slower in the weaker language (L4 or "New-Language") than in their stronger language (L3 or L1).

To summarize, we have obtained significant language-switching costs in all types of bilingual speakers (all Experiments). Moreover, the following patterns of results have been found for each type of bilinguals:

- **L2 learners:**
    - *Asymmetrical language-switching costs* when they performed the task:
        - in two languages very different in strength, regardless of the cognate status of words (Experiments 1 and 5)
        - in their L1 and a very weak language (i.e., a language in which they were at very early stages of word learning; Experiment 11).

- **Highly-proficient bilinguals:**
  - *Symmetrical language-switching costs* when they performed the task:
    - in two languages of similar strength, regardless of the language similarity, the L2 AoA or the words' cognate status (Experiments 2, 3, 4 and 5)
    - in two languages very different in strength (Experiments 8 and 9)

    Additionally, a non-dominant over dominant language advantage effect was found for all these bilinguals showing symmetrical switching costs. Concretely, they were faster naming words in L2 than in L1 (Experiments 2, 3, 4 and 5); in L3 than in L1 (Experiment 8); and in L3 than in L2 (Experiment 9).

  - *Asymmetrical language-switching costs* when:
    - a very weak language was involved in the task (i.e., a language in which they were at very early stages of word learning; Experiments 10 and 11).

5.2 L2 learners and highly-proficient bilinguals: From inhibitory control to language-specific selection mechanisms

Following the main assumption that asymmetrical language-switching costs reflects the use of inhibitory control mechanisms during the production of speech, our results show that L2 learners rely on inhibitory processes. However, a more complicated pattern of results has been found for highly-proficient bilinguals. On the one hand, as the IC model predicts, symmetrical language-switching costs has been found for highly-proficient bilinguals switching between their two dominant languages. This is so regardless of the language similarity or the age of L2 acquisition, indicating that the different switching performance of bilingual speakers is caused by their attained L2 proficiency level. Problematic for this model, however, is the observation that highly-proficient bilinguals do not always show asymmetrical switching costs when the task involves two languages of different proficiency levels (either the strong L1 and a weak L3 or the strong L2 and a weak L3). Consequently, two main questions arise from these results:

(1) Why does a difference in the proficiency levels of the two languages involved in the switching task always lead to asymmetrical switching costs for L2 learners, but not for highly-proficient bilinguals?

(2) Why do highly-proficient bilinguals show differential performance (either symmetrical or asymmetrical one) when languages of different proficiency levels are involved in the task?

5.2.1 Shifting from inhibitory control to language-specific selection

The performance of highly-proficient bilinguals switching between their dominant L1 (or L2) and their non-dominant L3 contrasts sharply with the performance of L2 learners. As mentioned in the discussion section of Experiment 9, one could argue that such a difference is maybe revealing the way these two populations mastered the switching task. That is, by virtue of having practiced language-switching more often, the inhibitory control system of highly-proficient bilinguals works in a different way from that of L2 learners. For example, it could be the case that to become a highly-proficient bilingual would, among other things, entail the development of an inhibitory mechanism that is not reactive; that is, a mechanism that does not depend on the relative strength of the two languages involved in the switching task, as that used by L2 learners. That is, while L2 learners would inhibit their L1 more than their

L2, highly-proficient Spanish–Catalan bilinguals/learners of English would inhibit all of their languages to the same degree, irrespective of the strength (or availability) of the specific languages involved in the switching task. However, as we will further discuss below, such an assumption does not fit well with the L2-over-L1 advantage in naming latencies found for these bilinguals.

Another way to account for the striking difference between the switching performance of highly-proficient bilinguals and L2 learners is to assume that the two populations rely on the use of different lexical selection mechanisms. Therefore, it is possible that the difference between the ways in which these two populations perform the switching task is not quantitative (e.g., amount of inhibition applied to the languages) but qualitative (e.g., the way in which lexical selection is achieved). In this framework, we have proposed that a bilingual speaker has developed a lexical selection mechanism that is only sensitive to the activation levels of the words belonging to the intended language. Thus, we have adopted the view of Costa and collaborators (1999), and argue that for highly-proficient bilinguals the level of activation of the words belonging to the non-response language do not act as competitors at the level at which lexical selection is achieved. Therefore, there is no need to suppress their activation. In other words, we have put forward the following proposal: To achieve a high proficiency level in any pair of languages leads to a shift in the type of processes responsible for focusing on one language during lexical selection. In other words, ***we propose that while L2 learners rely on the use of inhibitory control mechanisms, highly-proficient bilinguals rely on language-specific selection mechanisms.*** Interestingly, though, the results of Experiments 10 and 11, in which asymmetrical switching costs for highly-proficient bilinguals were obtained, indicate that the development of such a language-specific selection mechanism does not imply the non-functionality of inhibitory control processes.

The question that becomes relevant then is one of trying to identify the conditions in which highly-proficient bilinguals make use of the language-specific selection mechanisms and those in which they rely more on the inhibitory control mechanism. To do that, it is necessary to look at the linguistic contexts in which highly-proficient bilinguals show symmetrical or asymmetrical switching performance.

5.2.2 On the limits of the functionality of the language-specific selection mechanism

There are several properties of the language-switching task irrelevant for the presence of symmetrical switching costs in highly-proficient bilinguals (see Figure 14):

(a) The differential level of proficiency between the two languages used in the switching task
(b) The similarities between the languages involved in the switching task
(c) The age at which the weak language involved in the switching task has been acquired
(d) The cognate status of the words produced in the switching tasks
(e) Whether the L1 of the bilingual speaker is involved or not in the switching task

This is because symmetrical rather than asymmetrical switching costs are observed when:

(a) the difference in the proficiency levels is large and when it is small (e.g., Experiment 2 vs. Experiments 8 and 9)
(b) the switching task involves both two very similar (Spanish-Catalan) and two very dissimilar languages (Basque-Spanish) (e.g., Experiment 2 vs. Experiment 3)
(c) the weak language has been acquired early in life but also when it has been acquired late (e.g., Experiment 2 vs. Experiment 4)
(d) cognate and non-cognate words are named in the task (e.g., Experiment 5)
(e) the L1 is present in the task but also when it is not (Experiments 2, 3, 4, 5, 6, 7 and 8 vs. Experiment 9).

However, there are some conditions in which highly-proficient bilinguals show asymmetrical switching costs. Interestingly, these conditions have a main commonality: a rather weak language was always involved in the task. That is, the lexical representations of one of the two languages involved in the switching task were not very well established (either L4 or a "New-Language": Experiments 10 and 11, respectively). However, why would this variable affect the control mechanism used by highly-proficient bilinguals to perform the language-switching task? There are two reasons of why this could be the case.

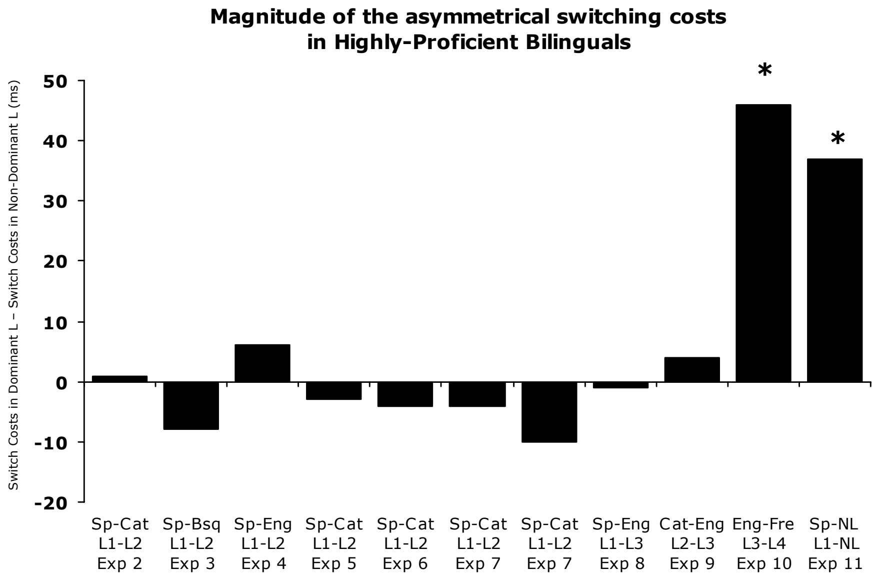


*Figure 14: Magnitude of the difference in switching costs for the two languages involved in several language-switching experiments in which highly-proficient bilinguals were tested. The data of each column corresponds to Experiments 2, 3, 4, 5 (Group 2), 6, 7 (Groups 1 and 2), 8, 9, 10 and 11 (Group 2), respectively. Significant difference (p<.01) in the magnitude of the switching costs for the two languages involved in the switching task are marked with *.*

First, the robustness (familiarity, frequency, automaticity) of the lexical representations of the weakest language involved in the switching task may be crucial for the functionality of the language-specific selection mechanism. Such a mechanism is assumed to guarantee lexical selection in the intended language by inspecting the activation of only those representations belonging to the language that has been chosen for production (the response language). If the lexical representations of the response language are integrated in a lexicon (represented in the long-term memory in an integrated lexicon; see Kroll & de Groot, 1997; Talamas, Kroll & Dufour, 1999; Van Hell & De Groot, 1998; for the variables that can affect such an integration), then the lexical selection mechanism can focus on that lexicon, and avoid interference from the other language without the need of inhibiting the lexical representations belonging to it. That is, the language-specific selection mechanism can only be sensitive to those representations that are integrated into a lexicon. When this criterion is not met, as presumably is the case at very early stages of word learning or with an L4, it is impossible for the selection mechanism to perform a restricted search over sparse lexical representations that do not belong to a specific lexicon. In short, the language-specific selection mechanism can only be functional when there actually is a language-specific lexicon to focus on.

However, participants nevertheless are able to perform a switching task involving a rather weak language. How do they do that? How do they manage to prevent lexical intrusions from their strong language(s) when speaking in the weak language? One possibility is that they prevent interference by actively inhibiting the lexical representations of their strong language(s). Note that the inhibitory mechanism can function without any problem since it operates primarily over the representations of the strong language. That is, this mechanism ensures the correct selection in the weak language by inhibiting the lexical representations belonging to the language that has not been chosen for production (the non-response language). Therefore, this mechanism can be fully functional when producing the recently learned words of the new language (or L4), given that it operates upon the well-established lexical representations.[17]

---

[17] For this argument to work we should assume that the lexical representations of the L3 (English) of the bilinguals tested in Experiment 10 are already integrated into a lexicon that allows the inhibitory mechanisms to work upon them. This assumption receives some support from the results of Experiments 8 and 9. In these experiments in which Spanish-Catalan bilinguals were asked to switch between their L1/L2 and their L3 (English) we observed

There is another reason of why the robustness of the lexical representations of the weakest language may be crucial for the functionality of the language-specific selection mechanism. It has long been argued (e.g., Kroll & Stewart, 1994) that, when the L2 of a bilingual is not well established yet, access to its lexical representations is mediated by previous access to the corresponding translation from the strong language. Once the bilingual increases proficiency in her weak language, the lexical representations of that language establish direct links with the conceptual system, allowing for a direct access to such lexical representations without the need of L1 mediation. What would be the consequences of such an architecture for the language-switching task? If L2 production involves L1 mediation, the language-specific selection mechanism cannot operate. This is because the lexical representations of the non-response language (L1) need to be selected in order to produce those in the response language (L2). Thus, a lexical selection mechanism that ignores the activation of the L1 representations when producing words in the weak language does not seem viable. However, in such circumstances the inhibitory control mechanism may still be functional. This is because, at some point during the lexicalization process in the weak language, the bilingual needs to avoid interference from the lexical representation of the strong language. Once such an L1 representation has been selected and translated into the weak language, it needs to be suppressed to prevent its overt production. In this framework, naming in the weak language would entail: a) retrieval of the lexical representations of the strong language, b) translation into the weak language, and c) inhibition of the lexical representations of the strong language to prevent their overt production. This last step would be behind the asymmetrical switching costs observed when the task involves one language in which the bilingual speaker has very low proficiency.

---

symmetrical switching costs. If we were to interpret the presence of symmetrical switching costs as revealing that the lexical representation of the L3 are robust enough to allow the language-specific selection mechanism to kick in, then we should conclude that they are also robust enough for the inhibitory mechanism to work as well. And given that the L3 of the participants in Experiments 8 and 9 was of similar strength to the L3 of the participants in Experiment 10, then we could assume that in both cases the lexical representations of the L3 were well enough established for the inhibitory mechanism to work upon them.

Note that the explanations given above of the presence of asymmetrical switching costs in highly-proficient bilinguals are based on whether the language-specific selection mechanism can operate over the representations of the weak language. Accordingly, the larger the robustness of these lexical representations, the more likely successful selection of those representations will be achieved without the need of inhibitory mechanisms. Thus, for highly-proficient bilinguals what matters for the presence or absence of asymmetrical switching costs is not the difference in proficiency levels between the two languages involved in the switching task but rather how well-established the weak language involved in the task is. Admittedly, and although this characterization captures the available experimental evidence, it is rather tentative and future research needs to assess its validity.

Thus, the results of Experiments 10 and 11 contribute to show that the inhibitory control mechanism is still functional for highly-proficient bilinguals, and that they can rely on this mechanism whenever the lexical representations of the language being spoken are not well-established.

5.3 Accounting for the performance of highly-proficient bilinguals: The advantage of L2/L3 over L1 in language-switching tasks

The results of experiment 6 confer the advantage of L2/L3 over L1 to some specific conditions of the language-switching context. In Experiment 7, we attempted to clarify the origin of the L2 advantage by assessing whether a bias to start lexicalization in the less dominant language, regardless of the language cue, was at the basis of this effect. However, the results of Experiment 7 failed to support such a hypothesis. Therefore we rule out such a bias as the critical factor behind the difference in L1–L2 naming latencies.

At first glance, the advantage of L2/L3 over L1 could be taken as revealing the existence of larger inhibition for L1 lexical representations in the switching task. In other words, naming latencies in L1 are slower than in L2/L3 because the L1 representations are more suppressed than those belonging to the other language. Although this account captures the L1 disadvantage, it fails to explain another crucial result in our investigation: the lack of asymmetrical switching costs. As we already noted above, independently of the difference in proficiency levels between the two languages involved in the task, symmetrical switching costs were present for highly-proficient bilinguals (Experiments 8 and 9). Thus, if in order to explain the L1 disadvantage in naming latencies we assume that L1 is more inhibited than L2/L3, then we are compelled to incorrectly predict the presence of asymmetrical switching costs. This is because the larger the inhibition applied to a given language the larger the switching cost associated with it. Hence, it appears that the assumption of inhibition creates problems when accounting for both the L2/L3 advantage over L1 and the presence or absence of asymmetrical switching costs.

Consequently, how can we account for the L2/L3 advantage over L1 without embracing the use of inhibitory processes? In the following we entertain one possible explanation that we refer to as the ‘‘language-specific selection threshold hypothesis.’’

5.3.1 The “language-specific threshold hypothesis”

One of the factors determining the speed of picture naming is how fast lexical selection is achieved. At the same time, there is wide agreement in assuming that the speed of lexical selection depends, among other things, on the availability of lexical representations. For example, the lexical nodes corresponding to pictures with high frequency names are selected and produced faster than those with low frequency names (Alario, Costa, & Caramazza, 2002; Caramazza, Costa, Miozzo, & Bi, 2001; Jescheniak & Levelt, 1994; Oldfield & Wingfield, 1965). In this scenario, one should expect L1 responses to be faster than L2 or L3 responses (at least in language-blocked naming conditions), given that L1 representations are presumably more available than the others (see, for example, Experiment 6). However, in the context of a language-switching task, participants may have tried to compensate such an imbalance by making the lexical representations of the weaker language more available. There are several ways in which such an increase in the availability of L2/L3 lexical representations may have come about. For example, it is possible that the criteria for lexical selection to proceed (e.g., the level of activation of the target in relation to other lexical nodes) can be set independently for different languages (language-specific). In this way, the time required for an L2/L3 word to reach the selection criterion would be shorter than for an L1 word. This imbalance will in turn lead to faster selection and production of L2/L3 words. According to this hypothesis, speakers should be able to use the information from the task instructions to manipulate either the level of activation of the two lexicons or the selection threshold for each of them. Interestingly, as mentioned above, there are some results suggesting that participants' criteria for responding in a given task is not fixed, but rather may vary depending on the context and stimuli of the task at hand (Lupker, Brown, & Colombo, 1997; Lupker, Kinoshita, Coltheart, & Taylor, 2003; Meyer, Roelofs, & Levelt, 2003).

At first sight, the ''language-specific selection threshold'' hypothesis appears to be similar to the inhibitory control account, in the sense that in both cases an imbalance in the availability of lexical representations is postulated. However, there is a major difference between these two explanations, which has implications for an account of the presence or absence of asymmetrical switching costs. According to the inhibitory control account, inhibition of one lexicon would affect subsequent naming performance in the inhibited language: the larger the inhibition, the larger the effects on the subsequent trial (and hence the asymmetrical switching costs). However, according to the ''language-specific threshold hypothesis'' the way in which lexical representations of L2/L3 become more available for production should equally affect switch and non-switch trials, and therefore should be independent of the magnitude of the switching cost. That is, an increase in the availability of the L2/L3 lexical representations would speed up lexical selection in that language both when the task requires a change of the ''language schema'' (switch trials) and when it does not (non-switch trials). Thus, the magnitude of the switching cost (which originates at a different stage of processing, viz. the selection of a ''language schema'') should be independent of the availability of lexical representations, and therefore no asymmetrical switching cost is expected. Consequently, the "language-specific threshold hypothesis" fits well with the presence of symmetrical language-switching costs for highly-proficient bilinguals switching between two languages that were very different in strength (Experiments 8 and 9).

At this point, it is worth mentioning an interesting observation: in those experiments where highly-proficient bilinguals did not show symmetrical language-switching costs, they did not show the effect of the advantage of non-dominant over dominant language observed in previous experiments. To the contrary, they showed faster responses in the dominant (L3 and L1) than in the non-dominant (L4 and "New-Language") language. Thus, this observation leads to an instructive association of effects: *when symmetrical switching costs are observed, latencies in the strong language are slower than in the weak language, and when asymmetrical switching costs are observed, latencies in the strong language are faster than in the weak language*.

This association of effects seems to favour the following argument: when highly-proficient bilinguals rely on language-specific mechanisms, they may also be able to set different selection thresholds for their two languages. Hence, in language-switching tasks, they would be able to prioritise selection in the weakest language. This is because, if the presence of symmetrical switching costs actually reveals the functionality of the language-selection mechanism, and the L2/L3 advantage over L1 is due to the flexibility given by such a mechanism to set different selection criteria thresholds, then we should actually predict that the L2/L3 advantage over L1 should be accompanied by symmetrical switching costs. Furthermore, we should also predict that in those conditions in which the lexical-selection mechanism cannot kick in, and as a consequence different selection thresholds cannot set up, then naming latencies in the strong language will be faster than in the weak language and asymmetrical switching costs will be observed even for highly-proficient bilinguals. This prediction is confirmed by the results of Experiments 10 and 11.

The notion that the bilingual cognitive system can modulate the availability of the lexical representations of the two languages without resorting to inhibitory control has already been put forward by several models of bilingual speech production (La Heij, 2005; Poulisse and Bongaerts, 1994; see note 4). Actually, the ‵‵language-specific threshold hypothesis′′ seems to fit better with the notion of language-specific selection mechanisms than with the inhibitory processes proposed by the IC model. At any rate, and despite the fact that this observation is consistent with the only proposed explanation of the paradoxical advantage of L2/L3 over L1, further research needs to assess the precise theoretical implications of this robust effect. Our contribution here is the observation that, in highly-proficient bilinguals, the advantage of the weak over the strong language disappears when asymmetrical switching costs are observed.

In summary, how do bilingual speakers prevent massive interference from the non-response language during speech production? The series of language-switching experiments we have reported here suggest that, whereas L2 learners rely on inhibitory processes to avoid interference from the non-response language, highly-proficient bilinguals do not necessarily do so. This is because, whereas L2 learners show asymmetrical switching costs (Experiments 1 and 5), highly-proficient bilinguals show symmetrical ones, both when switching between languages of similar strength (L1 and L2: Experiments 2, 3, 4, 5, 6 and 7), and even when doing it between languages of different strength (L1 and L3 or L2 and L3: Experiments 8 and 9, respectively). Consequently, we have proposed that those bilinguals who are highly-proficient in any two languages have developed a language selection mechanism that does not require the use of inhibitory processes to achieve lexical access in the intended language. Thus, we have argued that the language control mechanisms of highly-proficient bilinguals are qualitatively different from those of L2 learners. The development of such a different language switching mechanism, though, is apparently not a substitute for the inhibitory mechanisms L2 learners use, since it seems that, in some linguistic contexts, highly-proficient bilinguals can rely on inhibitory processes. This is because, whenever a language in which highly-proficient bilinguals are at the first stages of learning has to be produced in the language-switching task, asymmetrical switching costs are found. Consequently, we suggest that although in most linguistic contexts highly-proficient bilinguals do not rely on inhibitory mechanisms, their language control mechanisms seem to be flexible enough to allow them to rely on inhibitory control when necessary.

Finally, before concluding, it is worth mentioning the implications the results obtained in Experiment 5 will have on the theories accounting for the origin of the cognate effect in language production.

5.4 What does bilingual language-switching performance tell us about the origin of the cognate facilitation effect?

In Experiment 5 we explored whether the cognate status of the words affects the language-switching performance of bilingual speakers. The results revealed that, although a significant cognate facilitation effect was found for both L2 learners and highly-proficient bilinguals, their language-switching pattern was not modulated by the cognate status of the words. Thus, we concluded that the cognate status of words does not affect the switching performance of bilinguals.

How are cognates lexically represented?

In the discussion section of Experiment 4, we presented three hypotheses that have been put forward in order to account for the origin of the cognate effect in language production. We noted that both the semantic and the phonological hypotheses suggest that cognates are lexically represented in the same way as non-cognate words are (Van Hell & De Groot, 1998; Costa et al., 2000). However, according to the lexical hypothesis, cognate words are lexically represented in a different way than non-cognates (e.g., Kirsner et al., 1993). In the latter case, we argued that if cognate words share a lexical representation, the magnitude of the switching cost for cognate words should be smaller than for non-cognate words. In addition, we argued that the pattern of asymmetrical switching costs reflecting the use of inhibition when bilinguals perform the task with non-cognates should disappear for cognates.

Thus, as the shared cognate lexical representations are not inhibited, symmetrical switching costs were predicted for both L2 learners and highly-proficient bilinguals. The results of Experiment 5 replicate previous observations regarding the presence of: a) a general switch cost (switch trials more slowly than non-switch trials), b) a general language effect (L2 faster than L1)[18], and c) a general cognate effect (cognates faster than non-cognates). More important, however, is the fact that, for the two groups of bilinguals, *the magnitude of the switching cost was similar for cognate and non-cognate words*. In fact, contrary to what the lexical hypothesis predicted, both for L2 learners and for highly-proficient bilinguals, exactly the same pattern of switching cost (asymmetrical for L2 learners and symmetrical for highly-proficient bilinguals) was observed for cognate and non-cognate words. Hence, to the extent to which the language-switching costs reveal the processes involved in the retrieval of L1 and L2 lexical representations from the lexicon, we should conclude that *cognate and non-cognate words are represented and retrieved from the lexicon in a similar manner*.

However, these results could be accommodated in the two alternative hypotheses of the origin of the cognate effect discussed above (discussion section of Experiment 4). According to the semantic hypothesis (Van Hell & De Groot, 1998), cognate words enjoy a processing benefit because the conceptual overlap of the corresponding semantic representations is larger than that of non-cognate words. On the other hand, the phonological hypothesis states that the cognate effect arises at the level at which the phonological segments of words are retrieved (Costa et al., 2000). That is, although these two proposals locate the origin of the cognate effect at different levels of representation, both of them assume that at the lexical level

[18] Although the precise origin of this effect remains to be established, the fact that it is present also when cognate words are used is inconsistent with the lexical hypothesis. This is because, if cognate words share their lexical representation, then it would be difficult to account for the difference in naming latencies when this representation is retrieved in L1 or L2 naming contexts. For example, according to the ''language-specific selection threshold'' hypothesis presented above, it is difficult to know how speakers would be able to use information about the task instruction to manipulate differently either the level of activation or the selection threshold for the same lexical item.

cognate and non-cognate words are lexically represented in the same way. Hence, in the language-switching task, cognate facilitation effects should be predicted by these two hypotheses. Moreover, as both assume cognates and non-cognates are lexically represented in the same way, no modulation of bilinguals' language-switching performance by the cognate status of the words is predicted. Unfortunately, our experiments were not designed to adjudicate between the semantic and the phonological hypotheses, and, as a consequence, they are silent about the validity of any of them. However, they clearly challenge the lexical hypothesis of the origin of the cognate facilitation effect, and suggest that, at the lexical level, cognate and non-cognates are represented in the same way (see Costa, Santesteban, & Caño, 2005, for further discussion of the origin of the cognate facilitation effects in bilingual speech production).

6 Conclusion

Bilingual speakers need to acquire control mechanisms that allow them to restrict their lexicalization process to one of their languages while preventing massive interference from the other language. But what type of control mechanisms are those? In this dissertation, we have attempted to provide an answer to this question. For this purpose, we conducted several language-switching experiments. Interestingly, these experiments reveal striking differences in the language-switching performance of L2 learners and highly-proficient bilinguals.

Here we have interpreted the different performance profiles of L2 learners and highly-proficient bilinguals as an indicator that these two groups make use of qualitatively different language control mechanisms. More specifically, we have proposed that increase of the L2 proficiency level leads bilinguals to shift from the use of inhibitory control to language-specific selection mechanisms during lexical access. That is, while the language control mechanisms of L2 learners will be able to guarantee selection in the response language by means of inhibitory processes (e.g. Green, 1986; 1998), highly-proficient bilinguals' language control mechanisms will be flexible enough to allow them to use non-inhibitory processes. Specifically, we propose that becoming a highly-proficient bilingual leads to the development of a language-specific selection mechanism to manage language control (a mechanism earlier proposed by Costa and collaborators, 1999). Furthermore, to attain high proficiency in a second language seems to have implications not only for the way the two dominant languages (L1–L2) are processed, but also for the way a much weaker language is processed (L3). That is, the effects of bilingualism on the way lexical access is achieved are not limited to the two languages for which the bilingual is proficient, but they also extend to other languages in which the bilingual is low-proficient. What is more, interestingly, in special linguistic contexts in which such a language-specific selection mechanism cannot work (e.g. when a language in which bilinguals are at the first stages of word acquisition and have not reached a minimal degree of mastering), these bilinguals show the ability to resort on inhibitory processes to perform lexical selection.

According to folk wisdom, it is easier for bilingual (or multilingual) speakers to learn another language than for a monolingual speaker to learn a second language. That is, more effort is required for monolinguals to make progress when learning another language than is required for bilinguals to learn a third language. Our findings are silent about whether bilinguals have any advantage acquiring an L3, but, interestingly, they reveal a clear influence of bilingualism on the way a third language is processed. Specifically, they reveal a difference in the way monolinguals and bilinguals perform lexical access in their third language. Indeed, the notion that bilingualism exerts an influence on the way bilinguals acquire and process new languages has been proposed some years ago (e.g., Albert & Obler, 1978). This idea has been put forward again by several authors (e.g., Cenoz & Valencia, 1994; Lasagabaster, 2000; Sanz, 2000). Some of these studies reveal that even when several important variables such as general intelligence or similarity between languages are controlled for, bilingual speakers show an advantage in learning an L3. For example, Brohy (2001) measured the general ability of Romansch-German bilinguals and German monolingual speakers in French as an L3, and found that bilinguals obtained significantly higher scores than monolinguals. Sanz (2000) also reported similar results for Catalan-Spanish bilinguals and Spanish monolingual speakers learning English. In this case, bilinguals obtained higher scores than monolinguals in the English grammar and vocabulary tests they were required to complete. Furthermore, differences in L3 acquisition seem to correlate with the degree of bilingual proficiency. For example, the study of Sagasta (2003) showed that a higher level of bilingualism in Spanish–Basque bilinguals correlated with a better performance in acquiring English as an L3. In summary, the notion that bilingualism may exert an influence on the way a third language is processed is defended by several researchers (see Cenoz, 2003, for a review on third language acquisition by bilingual and monolingual speakers). Following this view, our results support the notion that, when a minimal amount of experience has been attained in a third language, bilingual speakers make use of qualitatively different processes than those used by monolingual speakers during lexical access. Further research would determine the extent to which bilingualism affects third language processing.

An interesting way of putting to test the proposal presented here is to use neuroimaging techniques. For example, as mentioned above (section 2.2.1), evidence converging on the assumption that L2 learners rely on the use of inhibition to produce language comes from an event-related electrical potentials (ERP) experiment. In this study, Jackson and collaborators (2001) recorded the ERPs of low-proficient bilinguals performing a language-switching task. In this experiment, a component that is argued to reflect response suppression was found at fronto-central sites: the frontal N2 (e.g., Eimer, 1993; Kok, 1986; Jackson et al., 1999; Van Boxtel, Van der Molen, Jennings & Brunia, 2001; for a different view about the N2 component see Donkers & Van Boxtel, 2004; Nieuwenhuis, Yeung, Van den Wildenberg & Ridderinkhof, 2003). Specifically, an asymmetrical (larger when switching into L2 than into L1) enhanced negativity of the fronto-central N2 was found. This asymmetrical N2 component was interpreted as revealing the larger suppression of L1 when speaking in L2 than vice versa. Hence, if highly-proficient bilinguals do not make use of inhibitory processes during language production, we should predict no appearance of N2 components while they switch between languages. In fact, using a similar procedure as the one of Jackson and collaborators (2001), at this time we are recording the ERPs and the behavioural performance of highly-proficient bilinguals performing a language-switching task. Our preliminary results show symmetrical language-switching costs in the reaction times analysis. More importantly, no modulation of the fronto-central N2 component is shown when switching either into L1 or into L2.

Whether the same results would be also found for these bilinguals switching between their strong L1 and a weak L3, or even between their L1 and a language in which they are at the first stages of acquisition is to be seen.

Another interesting related question is whether highly-proficient bilingualism may affect performance in other cognitive domains that do not involve linguistic components. In this sense, the studies of Bialystok and collaborators (Bialystok, 1999, 2005; Bialystok, Craik, Klein, y Viswanathan, 2004; Bialystok, Craik, Grady et al., 2005) are of special relevance, as they show that bilingualism positively affects the development of processes involved in executive control mechanisms. Bialystok argues that bilingualism has an impact in children's non-linguistic cognitive development. Specifically, she argued that bilingual children develop control processes (e.g., selective attention, inhibitory control) faster than monolingual children do, while both groups show a similar development of the representational processes (e.g., problem solving, access to relevant knowledge, logic inferences realization). Importantly, these observations have been related with the extensive practice of the inhibitory control mechanisms bilingual children have in the first few years of life. That is, bilingual children's extensive practice in inhibiting languages carries over to processing in other cognitive domains, and, therefore, bilinguals should be better able than monolinguals to perform tasks that require the inhibition of irrelevant information. Moreover, the differences between bilingual and monolingual speakers are not limited to childhood. Bialystok and collaborators (2004) tested elderly bilingual and monolingual speakers' performance in a Simon task[19] in which participants had to attend to

[19] The Simon task is based on stimulus-response compatibility and assesses the extent to which the prepotent association to irrelevant spatial information affects participants' response to task-relevant non-spatial information. In the simplest version of this task, participants have to respond to a given series of color stimuli by pressing a response key located at either the left or the right side of the keyboard (e.g., if the stimulus is green, press the left-key; if it is red, press the right-key). However, the colored stimuli can be presented either on the left or on the right side of a computer screen. So, as a result of the combination of the relevant (color) and irrelevant (spatial) information, congruent and incongruent trials are presented. On congruent trials, the key that is the correct response for that color is on the same side as the stimulus; on incongruent trials, the correct response key is on the opposite side. The irrelevant (spatial)

a specific property of the stimuli while ignoring another one. Results revealed that the irrelevant information interfered more for monolingual than for bilingual elderly speakers, suggesting that bilingualism helps to maintain the age-related impairment of some executive control processes, minimizing the decline of the efficiency of inhibitory processes.

Importantly, the collateral effects of bilingualism on non-linguistic cognitive processes have also been observed by means of neuroimaging techniques. Specifically, cerebral activation with the magneto-encephalography (MEG) technique was registered while participants performed a Simon task. In this study, Bialystok, Craik, Grady and collaborators (2005) did not find reaction time differences in the magnitude of the Simon effect showed by bilingual and monolingual young adults. However, the pattern of cerebral activity was different for both groups, viz. the implication of the left hemisphere superior and middle temporal, cingulate, and superior and inferior frontal regions was larger in the bilinguals than in the monolinguals. Interestingly, some of these regions, and especially the left inferior frontal cortex, had not been previously described as areas implied in the resolution of the Simon task. According to the authors, these results may suggest that bilingualism can increase the control processes of the left frontal lobe making these areas accessible to the execution of other tasks requiring inhibition, even in non-verbal tasks.

All these results suggest that becoming highly proficient in a second language has some effects in the general attentional control processes. Here we have suggested that, at least in linguistic tasks, these effects are not quantitative, but qualitative. That is, we have argued that highly-proficient bilinguals rely on different control mechanisms than those used by L2 learners. Whether these qualitative changes are generalized to cognitive domains other than those involving linguistic components is an account that requires further research.

---

information usually produces reliably longer reaction times for incongruent than for congruent trials. This difference is what is referred to as the Simon effect (see Lu & Proctor, 1995, for a review of Simon tasks).

7 References

Alario, F.-X., Costa, A., & Caramazza, A. (2002). Frequency effects in noun phrase production: Implications for models of lexical access. *Language and Cognitive Processes, 17*, 299 -319.

Albert, M.L., & Obler, L.K. (1978). *The bilingual brain*. New York: Academic Press.

Allport, A., Styles, E. A., & Hsieh, S. (1994). Shifting intentional set: Exploring the dynamic control of tasks. In C. Umilta & M. Moscovitch (eds.), *Attention and performance XV: Conscious and nonconscious information processing* (pp. 421-452). Hillsdale, NJ: Erlbaum.

Allport, A., & Wylie, G. (1999). Task-switching: Positive and negative priming of task-set. In G.M. Humphreys, J. Duncan, & A.M. Treisman, (eds.), *Attention, space, and action: Studies in cognitive neuroscience* (pp. 273-296). London, Oxford University Press.

Allport, D.A., & Wylie, G. (2000). 'Task-switching', stimulus-response bindings, and negative priming. In S. Monsell & J. Driver (eds.), *Control of cognitive processes: Attention and performance XVIII* (pp. 35-70). Cambridge, MA: MIT press.

Baars, B.J., Motley, J.T., & MacKay, D. (1975). Output editing for lexical status from artificially elicited slips of the tongue. *Journal of Verbal Learning and Verbal Behavior, 14*, 382-391.

Basque Government. (2004). *Euskararen jarraipena III: Euskal Herriko soziolinguistikazko inkesta 2001* [The continuity of Basque III: Sociolinguistic survey of the Basque Country]. Vitoria-Gasteiz: Basque Government's Publication Service (available on: http://www9.euskadi.net/euskara_inkestak/ini_in.pdf).

Bialystok, E. (1999). Cognitive complexity and attentional control in the bilingual mind. *Child Development, 70*, 636-644.

Bialystok, E. (2005). Consequences of bilingualism for cognitive development. In J.F. Kroll & A.M.B. de Groot (eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 417-432). New York: Oxford University Press.

Bialystok, E., Craik, F.I.M., Klein, R., & Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: Evidence from the Simon task. *Psychology and Aging, 19*, 290-303.

Bialystok, E., Craik, F.I.M., Grady, C., Chau, W. Ishii, R., Gunji, A., & Pantev, C. (2005). Effect of bilingualism on cognitive control in the Simon task: evidence from MEG. *NeuroImage 24*, 40-49.

Birdsong, D. (1999). *Second language acquisition and the critical period hypothesis*. Mahwah, NJ: Lawrence Erlbaum.

Birdsong, D., & Molis, M. (2001). On the evidence for maturational constraints in second-language acquisition. *Journal of Memory and Language, 44*, 235–249.

Bloem, I., & La Heij, W. (2003). Semantic facilitation and semantic interference in word translation: Implications for models of lexical access in language production. *Journal of Memory and Language, 48*, 468–488.

Bloem, I., van der Boogaard, S., & La Heij, W. (2004). Semantic facilitation and semantic interference in language production: Further evidence for the conceptual selection model of lexical access. *Journal of Memory and Language, 51*, 307–323.

Bock, J.K. (1991). A sketchbook of production problems. *Journal of Psycholinguistic Research, 20*, 141-160.

Bock, K., & Levelt, W.J.M. (1994). Language production: Grammatical encoding. In M. A. Gernsbacher (ed.). *Handbook of psycholinguistics*. San Diego, Academic Press.

Brohy, C. (2001). Generic and/or specific advantages of bilingualism in a dynamic plurilingual situation:The case of French as official L3 in the school of Samedan (Switzerland). *International Journal of Bilingual Education and Bilingualism, 4*, 38-49.

Butterworth, B. (1989). Lexical access in speech production. In W. Marslen-Wilson (ed.), *Lexical representation and process* (pp. 108-135). Cambridge, MA: MIT press.

Caramazza, A., (1997). How many levels of processing are there in lexical access? *Cognitive Neuropsychology, 14*, 177-208.

Caramazza, A., & Costa, A. (2000). The semantic interference effect in the picture–word interference paradigm: Does the response set matter? *Cognition, 75*, B51–B64.

Caramazza, A, Costa, A., Miozzo, M., & Bi, Y. (2001). The specific-word frequency effect: Implications for the representation of homophones. *Journal of Experimental Psychology: Learning, Memory and Cognition, 27*, 1430-1450.

Cenoz, J. (2003). The additive effect of bilingualism on third language acquisition: A review. *International Journal of Bilingualism, 7*, 71-87.

Cenoz, J., & Valencia, J.F. (1994). Additive trilingualism: Evidence from Basque Country. *Applied Psycholinguistics, 15*, 195-207.

Christoffels, I.K., & De Groot, A.M.B. (2004). Components of simultaneous interpreting: Comparing interpreting with shadowing and paraphrasing. *Bilingualism: Language and Cognition, 7*, 227-240.

Colomé, A. (2001). Lexical activation in bilinguals' speech production: language-specific or language-independent? *Journal of Memory and Language, 45*, 721-736.

Costa, A. (2005). Lexical access in bilingual production. In J.F., Kroll & A.M.B. De Groot (eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 308-325). New York: Oxford University Press.

Costa, A., Alario, F.-X., & Caramazza, A. (2005). On the categorical nature of the semantic interference effect in the picture-word interference paradigm. *Psychonomic Bulletin and Review, 12*, 125-131.

Costa, A., & Caramazza, A. (1999). Is lexical selection in bilingual speech production language-specific? Further evidence from Spanish-English and English-Spanish bilinguals. *Bilingualism: Language and Cognition, 2*, 231-244.

Costa, A., & Caramazza, A. (2002). The production of noun phrases in English and Spanish: Implications for the scope of phonological encoding in speech production. *Journal of Memory and Language, 46 (1)*, 178-198.

Costa, A., Caramazza, A., & Sebastián-Gallés, N. (2000). The cognate facilitation effect: Implications for models of lexical access. *Journal of Experimental Psychology: Learning, Memory and Cognition, 26*, 1283-1296.

Costa, A., Colomé, A., Gómez, O., & Sebastián-Gallés, N. (2003). Another look at cross-language competition in bilingual speech production: Lexical and phonological factors. *Bilingualism: Language and Cognition, 6 (3)*, 167-179.

Costa, A., La Heij, W., & Navarrete, E. (2006). The dynamics of bilingual lexical access. *Bilingualism: Language and Cognition, 9 (2)*, 137-151. Special Issue on *Lexical Access in Bilingual Speech Production*.

Costa, A., Mahon, B., Savova, V., & Caramazza, A. (2003). Level of categorization effect: A novel effect in the picture-word interference paradigm. *Language and Cognitive Processes, 18*, 205-233.

Costa, A., Miozzo, M., & Caramazza, A. (1999). Lexical selection in bilinguals: Do words in the bilingual's two lexicons compete for selection? *Journal of Memory and Language, 41*, 365-397.

Costa, A,, & Santesteban, M. (2004a). Bilingual word perception and production: Two sides of the same coin? *Trends in Cognitive Sciences, 8*, 253.

Costa, A., & Santesteban, M. (2004b). Lexical access in bilingual speech production: Evidence from language switching in highly proficient bilinguals and L2 learners. *Journal of Memory and Language, 50*, 491-511.

Costa, A., Santesteban, M., & Caño, À. (2005). On the facilitatory effects of cognate words in bilingual speech production. *Brain and Language, 94,* 94-103.

Costa, A., Santesteban, M., & Ivanova, I. (in press). How do highly proficient bilinguals control their lexicalization process? Inhibitory and Language-

Specific Selection mechanisms are both functional. *Journal of Experimental Psychology: Learning, Memory and Cognition.*

Costa, A., & Sebastián-Gallés, N. (1998). Abstract phonological structure in language production: Evidence from Spanish. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 24*, 886–903.

Costa, A., Sebastián-Gallés, N., Pallier, C., & Colomé, A. (2001). El desarrollo temporal de la codificación fonológica: ¿Un procesamiento estrictamente serial? (The time course of segment-to-frame association in phonological encoding: A strictly serial processing?). *Cognitiva, 13*, 3-34.

Damian, M.F., & Martin, R.C. (1999). Semantic and phonological codes interact in single word production. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 25*, 345-361.

De Angelis, G., & Selinker, L. (2001). Interlanguage transfer and competing linguistic systems in the multilingual mind. In J. Cenoz, B. Hufeisen, & U. Jessner (eds.), *Cross-linguistic influence in third language acquisition: Psycholinguistic perspectives* (pp. 42-58). Clevedon, UK: Multilingual Matters.

De Bot, K. (1992). A bilingual production model: Levelt's speaking model adapted. *Applied Linguistics, 13*, 1-24.

De Groot, A.M.B., & Keijzer, R. (2000). What is hard to learn is easy to forget: The roles of word concreteness, cognate status, and word frequency in foreign-language vocabulary learning and forgetting. *Language Learning, 50 (1)*, 1-56.

De Groot, A.M.B., & Nas, G.L. (1991). Lexical representation of cognates and noncognates in compound bilinguals. *Journal of Memory and Language, 30 (1)*, 90–123.

De Jong, R. (1995). Strategic determinants of compatibility effects with task uncertainty. *Acta Psychologica, 88*, 187-207.

Dell, G.S. (1986). A spreading activation theory of retrieval in sentence production. *Psychological Review, 93*, 283-321.

Dell, G.S. (1988). The retrieval of phonological forms in production: Tests of predictions from a connectionist model. *Journal of Memory and Language, 27*, 124-142.

Dell, G.S., & O'Seaghdha, P.G. (1991). Mediated and convergent lexical priming in language production: A comment on Levelt et al. *Psychological Review, 98*, 604-614.

Dell, G.S., & O'Seaghdha, P.G. (1992). Stages of lexical access in language production. *Cognition, 42*, 287-314.

Dell, G.S., & Reich, P.A. (1981). Stages in sentence production: An analysis of speech error data. *Journal of Verbal Learning and Verbal Behaviour, 20*, 611-629.

Dell, G.S., Schwartz, M.F., Martin, N., Saffran E.M. & Gagnon, D.A. (1997). Lexical access in aphasic and nonaphasic speakers. *Psychological Review, 104 (4)*, 801-838.

Donkers, F.C.L. & Van Boxtel, G.J.M. (2004). The N2 in go/no-go tasks reflects conflict monitoring not response inhibition. *Brain and Cognition, 56*, 165-176.

Eimer, M. (1993). Effects of attention and stimulus probability on ERPs in a go/nogo task. *Biological Psychology, 35*, 123-138.

Etxebarria, M. (2002). *La diversidad de Lenguas en España* [Language Diversity in Spain]. Madrid: Espasa Calpe.

Finkbeiner, M., Almeida, J., Janssen, N., & Caramazza, A. (in press). Asymmetrical costs of language switching: Is this evidence of language suppression? *Journal of Experimental Psychology: Learning, Memory and Cognition*.

Finkbeiner, M., Nicol, J., Nakamura, K. & Greth, D. (2002). The role of language in memory for actions. *Journal of Psycholinguistic Research, 31 (5)*, 447-457.

Flege, J.E., 1999. Age of learning and second-language speech. In D. Birdsong (ed.), *Second language acquisition and the critical period hypothesis* (pp. 101–132). Mahwah, NJ: Lawrence Erlbaum.

Flege, J.E., Yeni-Komshian, G.H., & Liu, S. (1999). Age constraints on second-language acquisition. *Journal of Memory and Language, 41*, 78–104.

Garrett, M.F. (1975). The analysis of sentence production. In G.H. Bower (ed.), *The psychology of learning and motivation, Advances in research and theory* (Vol. 9), New York: Academic Press.

Garrett, M.F. (1980). Levels of processing in sentence production. In B. Butterworth (ed.), *Language production: Vol.1 Speech and talk*. London: Academic Press.

Garrett, M.F. (1982). Production of speech: Observations from normal and pathological language use. In A. Ellis (ed.), *Normality and Pathology in Cognitive Functions*. London: Academic Press.

Garrett, M.F. (1992). Disorders of lexical selection. *Cognition, 42*, 143-180.

Glaser, W.R., & Düngelhoff, F.-J. (1984). The time course of picture-word interference. *Journal of Experimental Psychology: Human Perception and Performance,* 10, 640-654.

Glaser, W.R., & Glaser, M.O. (1989). Context effects on Stroop-like word and picture processing. *Journal of Experimental Psychology: General, 118*, 13-42.

Goetz, P. (2003). The effects of bilingualism on theory of mind development. *Bilingualism; Language and Cognition, 6 (1)*, 1-15.

Gollan, T.H., & Acenas, L.A. (2004). What is a TOT? Cognate and translation effects on tip-of-the-tongue states in Spanish–English and Tagalog–English bilinguals. *Journal of Experimental Psychology: Learning, Memory and Cognition,* 30 (1), 246–269.

Gollan, T.H., & Kroll, J.F. (2001). Bilingual lexical access. In Rapp, B. (Ed.), *The handbook of cognitive neuropsychology: What deficits reveal about the human mind* (pp. 321-345). Philadelphia, PA: Psychology Press.

Green, D.W. (1986). Control, activation and resource. *Brain and Language, 27*, 210-223.

Green, D.W. (1993). Towards a model of L2 comprehension and production. In R. Schreuder & B. Weltens (eds.), *The bilingual lexicon*. (pp. 249-277). Amsterdam/Philadelphia: John Benjamins.

Green, D.W. (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition, 1*, 67-81.

Grosjean, F. (2001). The bilingual's language modes. In J. Nicol (ed.). *One mind, two languages: Bilingual language processing* (pp. 1-22). Oxford: Blackwell.

Harley, T.A. (1984). A critique of top-down independent levels models of speech production: Evidence from non-plan-internal speech errors. *Cognitive Science, 8*, 191-219.

Harley, T.A. (1993). Phonological activation of semantic competitors during lexical access in speech production. *Language and Cognitive Processes, 8*, 291-309.

Hermans, D. (2000). *Word production in a foreign language.* Unpublished dissertation. The Netherlands: University of Nijmegen.

Hermans, D. (2004). Between-language identity effects in picture-word interference tasks: A challenge for language-nonspecific or language-specific models of lexical access? *International Journal of Bilingualism, 8 (2)*, 115-125.

Hermans, D., Bongaerts, T., de Bot, K., & Schreuder, R. (1998). Producing words in a foreign language: can speakers prevent interference from their first language? *Bilingualism: Language and Cognition, 1*, 213-230.

Hernandez, A.E., & Kohnert, K. (1999). Aging and language switching in bilinguals. *Aging, Neuropsychology, and Cognition, 6,* 69-83.

Hernandez, A.E., Martinez, A., & Kohnert, K. (2000). In search of the language switch: An fMRI study of picture naming in Spanish–English bilinguals. *Brain and Language, 73*, 421–431.

Hernandez, A.E., Dapretto, M., Mazziotta, J., & Bookheimer, S. (2001) Language switching and language representation in Spanish–English bilinguals: An fMRI study. *NeuroImage, 14*, 510–520.

Jackson, S.R., Jackson, G.M., & Roberts, M. (1999). The selection and suppression of action: Electrophysiological correlates of executive control in humans. *Neuroreport, 10*, 861-864.

Jackson, G.M., Swainson, R., Cunnington, R., & Jackson, S.R. (2001). ERP correlates of executive control during repeated language switching. *Bilingualism: Language and Cognition, 4*, 169-178.

Janssen, N. (1999). *Bilingual word production: The time course of lexical activation in a a mixed language context*. Unpublished Master's thesis, University of Nijmegen.

Jersild, A.T. (1927). Mental set and shift. *Archives of Psychology, 89*, 5-82.

Jescheniak, J.D., & Levelt, W.J.M. (1994). Word frequency effects in speech production: Retrieval of syntactic information and of phonological form. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 20*, 824-843.

Jescheniak, J.D., & Schriefers, H.J. (1998). Serial versus cascaded processing in lexical access in language production: Further evidence from the coactivation of nearsynonyms. *Journal of Experimental Psychology: Learning, Memory and Cognition, 24 (5)*, 1256–1274.

Kempen, G., & Huijbers, P. (1983). The lexicalization process in sentence production and naming: Indirect election of words. *Cognition, 14*, 185-209.

Kirsner, K., Lalor, E., & Hird, K. (1993). The bilingual lexicon: Exercise, meaning and morphology. In R. Schreuder & B. Weltens (eds.), *The bilingual lexicon* (pp. 215–246). Amsterdam: John Benjamins.

Kok, A. (1986). Effects of degradation of visual stimulation components of the event-related potential (ERP) in go/no-go reaction tasks. *Biological Psychology, 23*, 21-38.

Konhert, K. (2004). Cognitive and cognate-based treatments for bilingual aphasia: A case study. *Brain and Language, 91*, 294-302.

Konhert, K., Bates, E., & Hernandez, A. (1999). Balancing bilinguals: Lexical-semantic production and cognitive processing in children learning Spanish and English. *Journal of Speech Language and Hearing Research, 42*, 1400-1413.

Kroll, J.F. & De Groot, A.M.B. (1997). Lexical and conceptual memory in the bilingual: Mapping form to meaning in two languages. In A.M.B. de Groot & J.F. Kroll (eds.), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 169-199). Mahwah, NJ: Erlbaum.

Kroll, J.F., Dijkstra, A., Janssen, N., & Schriefers, H. (2000). Selecting the language in which to speak: Experiments on lexical access in bilingual production. Paper presented at the *41st Annual Meeting of the Psychonomic Society*, New Orleans, LA.

Kroll, J.F., Bobb, S., & Wodniecka, Z. (2006). Language selectivity is the exception, not the rule: Arguments against a fixed locus of language selection in bilingual speech. *Bilingualism: Language and Cognition, 9*

(2), 119-135. Special Issue on *Lexical Access in Bilingual Speech Production*.

Kroll, J.F. & Stewart E. (1994). Category interference in translation and picture naming: evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language, 33*, 149-174.

La Heij, W. (1988). Components of Stroop-like interference in picture naming. *Memory and Cognition, 16*, 400-410.

La Heij, W. (2005). Monolingual and bilingual lexical access in speech production: Issues and models. In J.F. Kroll & A.M.B. de Groot (eds.) *Handbook of bilingualism: Psycholinguistic approaches* (pp. 289-307). New York: Oxford University Press.

Laka, I. (1996). *A Brief Grammar of Euskara, the Basque Language*. Ms., University of the Basque Country, Vitoria-Gasteiz. [Available at http://www.ehu.es/grammar/index.htm]

Lasagabaster, D. (2000). Three languages and three linguistic models in the Basque educational system. In J. Cenoz & U. Jessner (eds.), *English in Europe: The acquisition of a third language* (pp. 179-197). Clevedon: Multilingual Matters.

Lee, M.-W, & Williams, J.N. (2001). Lexical access in spoken word production by bilinguals: Evidence from the semantic competitor priming paradigm. *Bilingualism: Language and Cognition 4*, 233-248.

Levelt, W.J.M. (1989). *Speaking: From intention to articulation*. Cambridge: MIT Press.

Levelt, W.J.M. (1992). Accessing words in speech production: Stages, processes and representations. *Cognition, 42*, 1-22.

Levelt, W.J.M. (2001). Spoken word production: A theory of lexical access. *Proceedings of the. National. Academy of Sciences, 98*, 13464-13471.

Levelt, W.J.M., Roelofs, A., & Meyer, A. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences, 22*, 1-75.

Levelt, W.J.M., Schriefers, H., Vorberg, D., Meyer, A.S., Pechnaatm, T., & Havinga, J. (1991). The time course of lexical access in speech production: A study of picture naming. *Psychological Review, 98*, 122-142.

Lotto, L., & De Groot, A.M.B. (1998). Effects of learning method and word type on acquiring vocabulary in an unfamiliar language. *Language Learning, 48 (1)*, 31-69.

Li, P. & Gleitman, L. (2002). Turning the tables: Language and spatial reasoning. *Cognition, 83*, 265-294.

Lu, C-H., & Proctor, R.W. (1995). The influence of irrelevant location information on performance: A review of the Simon and spatial Stroop effects. *Psychonomic Bulletin & Review, 2*, 174-207.

Lupker, S.J. (1979). The semantic nature of response competition in the picture-word interference task. *Memory and Cognition, 7*, 485-495.

Lupker, S.J. (1982). The role of phonetic and orthographic similarity in picture–word interference. *Canadian Journal of Psychology, 36*, 349–367.

Lupker, S.J., Brown, P., & Colombo, L. (1997). Strategic control in a naming task: Changing routes or changing deadlines? Journal of Experimental Psychology: *Learning, Memory, & Cognition, 23*, 570-590.

Lupker, S.J., Kinoshita, S., Coltheart, M., & Taylor, T.T. (2003). Mixing costs and mixing benefits in naming words, pictures, and sums. *Journal of Memory and Language, 49*, 556-575.

MacKay, D. G. (1987). *The organization of perception and action: A theory for language and other cognitive skills*. New York: Springer-Verlag.

MacLeod, C.M. (1991). Half a century of research on the Stroop effect: An integrative review. *Psychological Bulletin, 109 (2)*, 163-203.

MacNamara, J., Krauthammer, M., & Bolgar, M. (1968). Language switching in bilinguals as a function of stimulus and response uncertainty. *Journal of Experimental Psychology, 78*, 208-215.

Mahon, B., Costa, A., Shapiro, K., & Caramazza, A. (2002). Grammatical class constraints on lexical selection in speech production: Functional and neuroanatomical considerations. Paper presented at the *Euresco Conference; "The Science of Aphasia: Functional Neuroimaging Studies of Language and its Impairment"*. Maratea (Italy).

Meiran, N. (1996). Reconfiguration of processing mode prior to task performance. *Journal of Experimental Psychology: Learning, Memory and Cognition, 22*, 1423-1442.

Meiran, N. (2000). Modeling cognitive control in task-switching. *Psychological Research, 63*, 234-249.

Meuter, R. F. I. (2005). Language selection in bilinguals: Mechanisms and processes of change. In Kroll, J.F. & De Groot, A.M.B. (eds.), *Handbook of bilingualism: Psycholinguistic approaches*. New York: Oxford University Press.

Meuter, R.F.I, & Allport, A (1999). Bilingual language switching in naming: Asymmetrical costs of language selection. *Journal of Memory and Language, 40*, 25-40.

Meuter, R.F.I., Humphreys, G.W., & Rumiati, R.I. (2002). The frontal lobes and bilingual language switching: Modulatory control in language selection. *International Journal of Bilingualism, 6*, 109-124.

Meyer, A.S. (1996). Lexical access in phrase and sentence production: Results from picture-word interference experiments. *Journal of Memory and Language, 35 (4)*, 477-496.

Meyer, A.S., Roelofs, A., & Levelt, W.J.M. (2003). Word length effects in object naming: The role of a response criterion. *Journal of Memory & Language, 48*, 131-147.

Meyer, A.S., & Schriefers, H. (1991). Phonological facilitation in picture–word interference experiments: Effects of stimulus onset asynchrony and types of interfering stimuli. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 17*, 1146–1160.

Miozzo, M. & Caramazza, A. (1997). The retrieval of lexical-syntactic features in tip-of-the-tongue states. *Journal of Experimental Psychology: Learning, Memory and Cognition, 23*, 1410-1423.

Monsell, S. (2003). Task switching. *Trends in Cognitive Sciences, 3*, 134-140.

Monsell, S., & Driver, J. (eds., 2000): *Control of Cognitive Processes: Attention and Performance XVIII*. Cambridge, MA: MIT Press.

Monsell, S.; Yeung, N., & Azuma, R. (2000). Reconfiguration of task-set: Is it easier to switch to the weaker task? *Psychological Research, 63*, 250-264.

Navarrete, E., & Costa, A. (2005) Phonological activation of ignored pictures: Further evidence for a cascade model of lexical access. *Journal of Memory and Language,* 53, 359-377.

Newport, E.L. (1990). Maturational constraints on language learning. *Cognitive Science, 14*, 11–28.

Newport, E.L. (1991). Contrasting conceptions of the critical period for language. In S.C.R. Gelman (ed.), *The epigenesis of mind* (pp. 111–130). Hillsdale, NJ: Lawrence Erlbaum.

Nieuwenhuis, S., Yeung, N., van den Wildenberg, W., & Ridderinkhof, K.R. (2003). Electrophysiological correlates of anterior cingulate function in a Go/No-Go task: Effects of response conflict and trial-type frequency. *Cognitive, Affective, & Behavioral Neuroscience, 3*, 17–26.

Oldfield, R.C., & Wingfield, A. (1965). Response latencies in naming objects. *Quarterly Journal of Experimental Psychology, 17*, 273-281.

Pallier, C., Colomé, A., & Sebastián-Gallés, N. (2001). The influence of native-language phonology on lexical access: Exemplar-based versus abstract lexical entries. *Psychological Science. 12*, 445-449.

Paradis, M. (1997). The cognitive neuropsychology of bilingualism. In A.M.B. De Groot & J.F. Kroll (eds.) *Tutorials in Bilingualism: Psycholinguistic perspectives* (pp. 331-354). Mahwah: NJ, Erlbaum.

Paradis, M. (2004). *A neurolinguistic theory of bilingualism*. Amsterdam: John Benjamins.

Pechmann, T., & Zerbst, D. (2002). The activation of word class information during speech production. *Journal of Experimental Psychology: Learning, Memory, and Cognition. 28*, 233-243.

Perani, D., Paulesu, E., Sebastián-Gallés, N., Dupoux, E., Dehaene, S., Bettinardi, V., Cappa, S.F., Fazio, F., & Mehler, J. (1998). The bilingual brain: Proficiency and age of acquisition of the second language. *Brain, 121*, 1841-1852.

Peterson, R.R. and Savoy, P. (1998) Lexical selection and phonological encoding during language production: Evidence for cascaded processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 2*, 539-557.

Potter, M.C., So, K.F., Von Eckhardt, B., & Feldman, L.B. (1984). Lexical and conceptual representation in beginning and more proficient bilinguals. *Journal of Verbal Leaning and Verbal Behavior, 23*, 23-38.

Poulisse, N. (1999). *Slips of the tongue: Speech errors in first and second language production*. Amsterdam and Philadelphia: John Benjamins.

Poulisse, N., & Bongaerts, T. (1994). First language use in second language production. *Applied Linguistics, 15*, 36-57.

Price, C.J., Green, D.W., & Von Studnitz, R. 1999. A functional imaging study of translation and language switching. *Brain, 122*, 2221–2235.

Rapp, B.C., & Goldrick, M. (2000). Discreteness and interactivity in spoken word production. *Psychological Review, 107*, 460–499.

Ringbom, H. (2001). Lexical transfer in L3 production. In J. Cenoz, B. Hufeisen, & U. Jessner (eds.), *Cross-linguistic influence in third language acquisition: Psycholinguistic perspectives* (pp. 59-68). Clevedon, UK: Multilingual Matters.

Roberts, P., & Deslauriers, L. (1999). Picture naming of cognate and non-cognate nouns in bilingual aphasia. *Journal of Communication Disorders, 32*, 1–23.

Rodriguez-Fornells, A., Van der Lugt. A., Rotte, M., Britti, B., Heinze, H-J., & Münte, T.F. (2005). Second language interferes with word production in fluent bilinguals: Brain potential and functional imaging evidence. *Journal of Cognitive Neuroscience, 17*, 422-433.

Roelofs, A. (1992). A spreading-activation theory of lemma retrieval in speaking. *Cognition, 42*, 107-142.

Roelofs, A. (1993). Testing a non-decompositional theory of lemma retrieval in speaking: Retrieval of verbs. *Cognition, 47*, 59–87.

Roelofs, A. (1997). The WEAVER model of word-form encoding in speech production. *Cognition, 64*, 249-284.

Roelofs, A. (1998). Lemma selection without inhibition of languages in bilingual speakers. *Bilingualism: Language and Cognition, 1*, 94-95.

Roelofs, A., & Verhoef, K. (2006). Modeling the control of phonological encoding in bilingual speakers. *Bilingualism: Language and Cognition, 9 (2)*, 167-176. Special Issue on *Lexical Access in Bilingual Speech Production*.

Rogers, R.D., & Monsell, S. (1995). Costs of a predictable switch between simple cognitive tasks. *Journal of Experimental Psychology: General, 124*, 207-231.

Rosinski, R.R. (1977). Picture-word interference is semantically based. *Child Development, 48 (2)*, 643–647.

Ruthruff, E., Remington, R.W., & Johnston, J.C. (2001). Switching between simple cognitive tasks: The interaction of top-down and bottom-up factors. *Journal of Experimental Psychology: Human Perception and Performance, 27*, 1404-1419.

Sagasta, M.P. (2003). Acquiring writing skills in a third language: The positive effects of bilingualism. *International Journal of Bilingualism, 7*, 27-42.

Sánchez-Casas, R.M., & García-Albea, J.E. (2005). The representation of cognate and noncognate words in bilingual memory: Can cognate status be characterized as a special kind of morphological relation? In J.F., Kroll & A.M.B. De Groot (eds.), *Handbook of Bilingualism: Psycholinguistic Approaches*. New York: Oxford University Press.

Sanz, C. (2000). Bilingual education enhances third language acquisition: Evidence from Catalonia. *Applied Psycholinguistics, 21*, 23-44.

Schriefers, H., Meyer, A.S., & Levelt, W.J.M. (1990). Exploring the time course of lexical access in language production: Picture-word interference studies. *Journal of Memory and Language, 29*, 86-102.

Sebastián-Gallés, N., & Bosch, L. (2002). The building of phonotactic knowledge in bilinguals: The role of early exposure. *Journal of Experimental Psychology: Human, Perception and Performance, 28*, 974-989.

Sebastián-Gallés, N., Echeverría, S., & Bosch, L. (2005). The influence of initial exposure on lexical representation: Comparing early and simultaneous bilinguals. *Journal of Memory and Language, 52*, 240-255.

Sebastián-Gallés, N., & Kroll, J.F.K. (2003). Phonology in bilingual language processing: Acquisition, perception and production. In N.O. Schiller & A.S. Meyer (eds.), *Phonetics and phonology in language comprehension and production* (pp. 279–317). Berlin: Mouton de Gruyter.

Sebastián-Gallés, N., & Soto-Faraco, S. (1999). On-line processing of native and non-native phonemic contrasts in early bilinguals. *Cognition, 72*, 112-123.

Sigala, N., & Logothetis, N.K. (2002). Visual categorization shapes feature selectivity in the primate temporal cortex. *Nature, 415*, 318-320.

Sohn, M.-H., & Anderson, J.R. (2001). Task preparation and task repetition: two-component model of task switching. *Journal of Experimental Psychology: General, 130*, 764- 778.

Starreveld, P.A. & La Heij, W. (1995) Semantic interference, orthographic facilitation and their interaction in naming tasks. *Journal of Experimental Psychology: Learning, Memory and Cognition, 21 (3)*, 686–698.

Starreveld, P.A. & La Heij, W. (1996). Time-course analysis of semantic and orthographic context effects in picture naming. *Journal of Experimental Psychology: Learning, Memory and Cognition, 22 (4)*, 896-918.

Stemberger, J.P. (1985). An interactive activation model of language production. In A.W. Ellis (ed.). *Progress in the psychology of language* (Vol.1, pp. 143–186). Hillsdale: Erlbaum.

Stroop, J.R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18*, 643-662.

Talamas, A., Kroll, J.F., & Dufour, R. (1999) From form to meaning: Stages in the acquisition of second-language vocabulary. *Bilingualism: Language and Cognition, 2*, 45-58.

Tipper, S.P. (2001). Does negative priming reflect inhibitory mechanisms? A review and integration of conflicting views. *Quarterly Journal of Experimental Psychology, 54*, 321-343.

Van Boxtel, G.J., van der Molen, J.R., Jennings, C.H. & Brunia, A. (2001). Psychophysiological analysis of inhibitory motor control in the stop-signal paradigm. *Biological Psychology, 58*, 229-262.

Van Hell, J.G., & De Groot, A.M.B. (1998). Conceptual representation in bilingual memory: Effects of concreteness and cognate status in word association. *Bilingualism: Language and Cognition, 1*, 193-211.

Vigliocco, G., & Hartsuiker, R.J. (2002). The interplay of meaning, sound, and syntax in sentence production. *Psychological Bulletin, 128*, 442-472.

Vigliocco, G., Vinson, D.P., & Siri, S. (2005). Semantic similarity and grammatical class in naming actions. *Cognition, 94*, B91-B100.

Vila i Moreno, F.X. (2004). El coneixement del català [The knowledge of Catalan]. Institut d'Estadística de Catalunya. (Available at: http://www.iecat.net/cruscat/documents/coneixementiusos/)

Von Studnitz, R.E., & Green, D.W. (2002). The cost of switching language in a semantic categorization task. *Bilingualism: Language and Cognition, 5*, 241-251.

Wartenburger, I., Heekeren, H.R., Abutalebi, J., Cappa, S.F., Villringer, A., & Perani, D. (2003). Early setting of grammatical processing in the bilingual brain. *Neuron, 37*, 159-170.

Weber-Fox, C.M., & Neville, H.J. (1996). Maturational constraints on functional specialization for language processing: ERP and behavioral evidence in bilingual speakers. *Journal of Cognitive Neuroscience, 8*, 231-256.

Weber-Fox, C.M., & Neville, H.J. (1999). Functional neural subsystems are differentially affected by delays in second language immersion: ERP and behavioral evidence in bilinguals. In D. Birdsong (ed.), *Second language acquisition and the critical period hypothesis* (pp. 23–38). Mahwah, NJ: Lawrence Erlbaum.

Wheeldon, L.R., & Levelt, W.J.M. (1995). Monitoring the time course of phonological encoding*. Journal of Memory and Language, 34*, 311-334.

Williams, S., & Hammarberg, B. (1998). Language switches in L3 production: Implications for a polyglot speaking model. *Applied Linguistics, 19 (3),* 295-333.

Yeung, N., & Monsell, S. (2003). The effects of recent practice on task switching. *Journal of Experimental Psychology: Human Perception and Performance, 29*, 919-936.

8 APPENDICES

8.1 Appendix A. Language history and the self-assessed proficiency for all participants

Language history and the self-assessed proficiency scores of the participants in all the experiments reported in the dissertation. Mean age and the standard deviation (SD) are given in years. The onset of the L2 acquisition refers to the mean age (in years) at which participants started learning Catalan. "Use of L2" refers to how long (in years) participants had been using the L2 regularly. The proficiency scores were obtained through a questionnaire filled out by the subjects after the experiment (see Appendix I). The scores are on a 4 point scale, in which 4 represents native speaker level; 3, good level; 2, medium level; and 1, bad level of proficiency. The self assessed index is the average of the participants' responses to four domains (speech comprehension, speech production, reading and writing).

		Age	L2 Onset	L2 Use	L3 Onset	L3 Use	L4 Onset	L4 Use	# Years in Catalunya
Language History									
Korean Learners of Spanish	(Exp. 1)	31 (7)	26 (6)	4 (5)					5 (5)
Spanish Learners of Catalan	(Exp. 1)	29 (4)	28 (4)	1 (.4)					1.5 (1)
Spanish-Catalan Early Bilinguals	(Exp. 2)	23 (3)	4 (2)	18 (3)					23 (3)
Spanish-Basque Early Bilinguals	(Exp. 3)	22 (2)	3 (2)	19 (2)					22 (2)*
Spanish-English Late Bilinguals	(Exp. 4)	25 (6)	10 (4)	16 (4)					
Spanish Learners of Catalan	(Exp. 5)	25 (4)	23 (4)	1 (1)					2.5 (2)
Spanish-Catalan Early Bilinguals	(Exp. 5)	21 (2)	3 (2)	17 (2)					19 (4)
Spanish-Catalan Early Bilinguals	(Exp. 6)	21 (1)	4 (3)	15 (3)					21 (1)
Spanish-Catalan Early Bilinguals	(Exp. 7)	22 (6)	3.7 (1)	16 (6)					22 (6)
Spanish-Catalan Early Bilinguals	(Exp. 8)	21 (1)	4 (4)	16 (5)	10 (3)	11 (4)			21 (2)
Spanish-Catalan Early Bilinguals	(Exp. 9)	21 (2)	5 (2)	16 (3)	9 (2)	10 (2)			21 (2)
Spanish-Catalan Early Bilinguals	(Exp. 10)	23 (5)	2 (3)	20 (5)	8 (2)	10 (3)	15 (4)	3 (2)	23 (5)
Spanish Monolinguals	(Exp. 11)	24 (4)	10 (2)						
Spanish-Catalan Early Bilinguals	(Exp. 11)	22 (2)	5 (2)	17 (3)					22 (2)

* Years in the Basque Country

		L1	L2	L3	L4
Self Assessed Proficiency					
Korean Learners of Spanish ……	(Exp. 1)	4.00	2,30		
Spanish Learners of Catalan ……	(Exp. 1)	3.97	2,67		
Spanish-Catalan Early Bilinguals	(Exp. 2)	3.95	3.65		
Spanish-Basque Early Bilinguals	(Exp. 3)	3.82	3.55		
Spanish-English Late Bilinguals	(Exp. 4)	4.00	3.67		
Spanish Learners of Catalan …..	(Exp. 6)	3.99	2.16		
Spanish-Catalan Early Bilinguals	(Exp. 6)	3.97	3.80		
Spanish-Catalan Early Bilinguals	(Exp. 7)	3.95	3.72		
Spanish-Catalan Early Bilinguals	(Exp. 8)	3.97	3.75		
Spanish-Catalan Early Bilinguals	(Exp. 9)	3.95	3.85	2.77	
Spanish-Catalan Early Bilinguals	(Exp. 10)	4.00	3.58	2.15	
Spanish-Catalan Early Bilinguals	(Exp. 11)	3.95	3.88	2.98	1.59
Spanish Monolinguals ……………..	(Exp. 12)	3.85	1.88		
Spanish-Catalan Early Bilinguals	(Exp. 12)	3.91	3.85		

8.2 Appendix B. Materials employed in Experiments 1, 2, 3, 4, 7, 8 and 9

Materials used in Experiments 1, 2, 3, 4, 7, 8 and 9. In Experiments 1 (Group 1), 2, 4, 7, 8 and 9 words marked with an asterisk were used. The materials marked with the symbol @ were used in the Experiment 1 (Group 2). The materials marked with the symbol # were used in the Experiment 3. All the words used in these experiments were non-cognates.

The Catalan and Spanish names of the pictures presented in the Experiments 1 (Group 1), 2 and 7 were matched for number of phonemes, 5.7 vs. 5.6, respectively (t (9) = .16, p = .872). Each word and its translation had the same gender value. The Korean and Spanish names of the pictures used in Experiment 1 (Group 2) were matched for number of phonemes, 4.5 and 5.6, respectively (t (9) = 1.42, p = .187). The Spanish and Basque names of the pictures used in Experiment 3 were matched for number of phonemes as well: 4.7 and 5.2, respectively (t (9) = 1.26, p = .244). However, in Experiment 8, Spanish names were longer than English names (5.6 and 3.6 main number of phonemes, respectively; t (9) = 3.87, p = .004). In Experiment 9, the Catalan names of the pictures were longer than the English names as well (5.7 and 4.1 respectively; t (9) = 2.95, p = .016).

Spanish Name	Catalan Name	Korean Name	English Name	Basque Name
*Sombrero @	Barret	/moja/	Hat	
*Zanahoria @	Pastanaga	/dangken/	Carrot	
*Manzana # @	Poma	/sakwa/	Apple	Sagarra
*Mesa #	Taula		Table	Mahaia
*Perro # @	Gos	/ke/	Dog	Txakurra
*Hoja # @	Fulla	/manutip/	Leaf	Hostoa
*Cuchillo # @	Ganivet	/khal/	Knife	Labana
*Ventana # @	Finestra	/tchangmun/	Window	Leihoa
*Lluvia # @	Pluja	/bi/	Rain	Euria
*Queso #	Formatge		Cheese	Gazta
Búho #			Owl	Ontza
Llave #			Key	Giltza
Huevo @		/gyeran/	egg	
Silla @		/eyja/	chair	

8.3 Appendix C. Materials employed in Experiment 5

Materials used in Experiment 5. For this experiment the same 10 pictures with non-cognate names used in Experiments 1 (Group 1), 2, 4, 7, 8 and 9 (marked with an asterisk) plus 10 new pictures with cognate names were used. The Spanish and Catalan names of the pictures were matched for number of phonemes, 5.3 and 5.1, respectively.

Spanish Name	Catalan Name	English Name
Caballo	Cavall	Horse
Flor	Flor*	Flower
Árbol	Arbre	Tree
Cañón	Canyo	Canon
Libro	Llibre	Book
Luna	Lluna	Moon
Martillo	Martell	Hammer
Oreja	Orella	Ear
Pez	Peix	Fish
Rueda	Roda	Wheel
*Sombrero	Barret	Hat
*Zanahoria	Pastanaga	Carrot
*Manzana	Poma	Apple
*Mesa	Taula	Table
*Perro	Gos	Dog
*Hoja	Fulla	Leaf
*Cuchillo	Ganivet	Knife
*Ventana	Finestra	Window
*Lluvia	Pluja	Rain
*Queso	Formatge	Cheese

* Although the word "flower" have the same orthographic form in both Spanish and Catalan, they differ at phonological form in one phoneme. Whereas the phonological form in Spanish is /flor/, its phonological form in Catalan is /flo/.

8.4 Appendix D. Materials employed in Experiment 6

Materials used in Experiment 6. The same 10 words used in Experiments 1 (Group 1), 2, 4, 7, 8 and 9 plus 30 new pictures were selected. All the pictures used in this experiment had non-cognate names. Each word and its translation had the same gender value. Care was taken to select a collection of pictures from various semantic categories and to select those pictures for which their corresponding Spanish and Catalan words were of similar length: 5.1 vs. 5.2 number of phonemes, respectively (t (39) = .52, p = .605).

Spanish Name	Catalan Name	English Name
Sombrero	Barret	Hat
Zanahoria	Pastanaga	Carrot
Manzana	Poma	Apple
Mesa	Taula	Table
Perro	Gos	Dog
Hoja	Fulla	Leaf
Cuchillo	Ganivet	Knife
Ventana	Finestra	Window
Lluvia	Pluja	Rain
Queso	Formatge	Cheese
Rama	Branca	Branco
Gusano	Cuc	Worm
Red	Xarxa	Net
Jaula	Gàbia	Cage
Corcho	Suro	Cork
Jamón	Pernil	Ham
Melocotón	Préssec	Peach
Mujer	Dona	Woman
Hueso	Os	Bone
Dedo	Dit	Finger
Huevo	Ou	Egg
Ojo	Ull	Eye
Pañuelo	Mocador	Handkerchief
Muleta	Crossa	Crutch
Calcetín	Mitjó	Sock
Rana	Granota	Frog
Pimiento	Pebrot	Pepper
Vela	Espelma	Candle
Búho	Mussol	Owl
Cepillo	Raspall	Brush
Cerdo	Porc	Pig

Silbato	Xiulet	Whistle
Pato	Ànec	Duck
Mariposa	Papallona	Butterfly
Silla	Cadira	Chair
Mancha	Taca	Blot
Burro	Ase	Donkey
Hoz	Falç	Sickle
Zueco	Esclop	Clog
Colchón	Matalàs	Mattress

8.5 Appendix E. Materials employed in Experiment 10

Materials used in Experiment 10. For this experiment, 8 out of 10 of the words used in the Experiments 1, 2, 4, 7, 8 and 9 were changed in order to avoid possible cognate interference from the subjects' dominant languages (Spanish and Catalan). The French and English names of the pictures were matched for number of phonemes: 4.6 and 4.0, respectively (t (9) = 1.61, p < .140).

English Name	French Name
Hat	Chapeau
Dog	Chien
Bell	Cloche
Star	Étoile
Glass	Verre
Leg	Jambe
House	Maison
Suitcase	Valise
Car	Voiture
Pencil	Crayon

8.6 Appendix F. Materials employed in Experiment 11

Materials used in Experiment 11. For this experiment, the same 10 pictures used in Experiments 1 (Group 1), 2, 4, 7, 8 and 9 were selected. In Experiment 11, care was taken to built "New-Language" words for which their corresponding Spanish words were of similar length (5.6 and 6.4 number of phonemes for Spanish and "New-Language" words, respectively [t (9) = .92, p = .38]). To maximize the similarity of the learning process of a new language, some of the "New-Language" words were built following phonotactic rules not allowed by learners' languages. For example, neither Spanish or Catalan admit word initial consonant clusters like "sl-", or their phonemic repertoire does not contain the allophonic geminate plosive forms of the phoneme "p" of the "New-Language" word "clappede" (pronounced like in the Italian word "cappello" [hat]). All the pictures had non-cognate names.

Spanish Name	New-Language Name
Sombrero	Inderut
Zanahoria	Pinca
Manzana	Galvek
Mesa	Silto
Perro	Slompuki
Hoja	Pirte
Cuchillo	Plavintu
Ventana	Funo
Lluvia	Clappede
Queso	Guispemoke

8.7

Appendix G. Main differences between Basque and Spanish and the sociolinguistic situation in the Basque Country

Basque and Spanish are very different at the lexical, morphological, and syntactic levels. Basque is a non-Indo-European language typologically very far away from Romance languages (e.g. Spanish, Catalan, Italian, French). Although Basque has been in contact with Romance languages (Latin and Spanish) in the course of many centuries, and has taken and adapted words from them, it remains different in many linguistic aspects. For example, Basque is an agglutinative language that could attach to the lexical roots morphemes with syntactic information like number, case, aspect, mode, etc. In such a way, large words are created in Basque. In contrast, Spanish and Catalan are flexive languages. These languages attach to the lexical roots derivational suffixes or gender, number, mode or verb aspect inflexions. In addition, Basque is an ergative language, whereas Spanish and Catalan are accusative languages. Basque is a head-final parameter language that establishes the Subject-Object-Verb order as its canonical sentence word order, while Spanish is a head-initial parameter language (like English) with Subject-Verb-Object as the canonical sentence word order. Basque has postpositions, whereas Spanish has prepositions. Basque does not mark gender for common nouns while Spanish does (for a brief description of Basque grammar see Laka, 1996). All these factors, among others (e.g., percentage of cognate words), make Basque much harder to learn than Catalan for a native Spanish speaker.

Regarding the sociolinguistic situation in the Basque Country, it is worth noting that the percentage of bilingual individuals in the Basque Country is relatively low. From the population of above 15 years of age, only about 25% are balanced bilinguals, whereas about 10% are passive bilinguals that do not speak Basque fluently but can understand it. Then, at least about 64% of the population does not understand Basque (Basque Government, 2004). This scenario certainly reduces the chances that a conversation between several people can be conducted switching between the two languages, as some of the interlocutors would likely be excluded because of the use of Basque. On such occasions, Spanish (which is spoken by everyone in the Spanish part of the Basque Country) or French (in the case of the part of the French Basque Country) becomes the language used in a conversation (see Etxebarria, 2002, for a detailed comparative description of the sociolinguistic situation of the Basque Country and Catalonia). In short, although L2 proficiency might be, a priori, independent of the similarity between languages, the fact that some bilinguals switch more often than others may affect the processing mechanisms they use to control lexical access in the two languages.

8.8 Appendix H. Tables of results of all the Experiments

Table 1. Mean Reaction Time (RT) and Error Percentage (% E) for the Spanish learners of Catalan and the Korean learners of Spanish participants tested in Experiment 1. The data of the non-switch and switch trials in both L1 (Spanish) and L2 (Catalan) are reported.

	Type of Trial					
	Non-Switch trials		*Switch trials*		*Switching Cost*	
Spanish learners of Catalan						
	RT	% E	RT	% E	RT	% E
L1 (Spanish)	792	5.4	863	5.6	71	0.2
L2 (Catalan)	775	6.2	810	6.0	35	-0.2
Language Effect	-18		-53			
Korean learners of Spanish						
	RT	% E	RT	% E	RT	% E
L1 (Korean)	719	6.5	800	7.0	81	0.5
L2 (Spanish)	748	6.9	790	7.1	42	0.2
Language Effect	29		-10			

Table 2. Mean Reaction Time (RT) and Error Percentage (% E) for the Spanish-Catalan highly-proficient bilingual participants tested in Experiment 2. The data of the non-switch and switch trials in both L1 (Spanish) and L2 (Catalan) are reported.

	Type of Trial					
	Non-Switch trials		*Switch trials*		*Switching Cost*	
	RT	% E	RT	% E	RT	% E
L1 (Spanish)	716	4.4	763	6.2	47	1.8
L2 (Catalan)	697	4.6	744	5.4	47	0.8
Language Effect	-19		-19			

Table 3. Mean Reaction Time (RT) and Error Percentage (% E) for the Spanish-Basque highly-proficient early bilingual participants tested in Experiment 3. The data of the non-switch and switch trials in both L1 (Spanish) and L2 (Basque) are reported.

	Type of Trial					
	Non-Switch trials		*Switch trials*		*Switching Cost*	
	RT	% E	RT	% E	RT	% E
L1 (Spanish)	777	6.2	801	7.7	24	1.5
L2 (Basque)	698	4.6	739	5.9	41	1.4
Language Effect	-79		-62			

Table 4. Mean Reaction Time (RT) and Error Percentage (% E) for the Spanish-English highly-proficient late bilingual participants tested in Experiment 4. The data of the non-switch and switch trials in both L1 (Spanish) and L2 (English) are reported.

	Type of Trial					
	Non-Switch trials		*Switch trials*		*Switching Cost*	
	RT	% E	RT	% E	RT	% E
L1 (Spanish)	698	6.2	741	8.6	43	2.4
L2 (English)	674	4.8	712	6.0	37	1.2
Language Effect	-24		-29			

Table 5. Mean Reaction Time (RT) and Error Percentage (% E) for the Spanish learners of Catalan and the Spanish-Catalan highly-proficient bilingual participants tested in Experiment 5. The data of the non-switch and switch trials in both L1 (Spanish) and L2 (Catalan) are reported.

	Type of Trial					
	Non-Switch trials		*Switch trials*		*Switching Cost*	
Spanish learners of Catalan						
	RT	% E	RT	% E	RT	% E
Non-Cognates						
L1 (Spanish)	792	5.0	879	7.5	87	2.5
L2 (Catalan)	757	5.9	820	6.3	63	0.4
Language Effect	-35		-59			
Cognates						
L1 (Spanish)	701	5.5	786	6.9	85	1.4
L2 (Catalan)	699	4.8	753	4.8	54	0.0
Language Effect	-2		-33			
Spanish-Catalan bilinguals						
	RT	% E	RT	% E	RT	% E
Non-Cognates						
L1 (Spanish)	763	4.0	822	5.1	59	1.1
L2 (Catalan)	717	2.5	784	4.8	67	2.3
Language Effect	-46		-38			
Cognates						
L1 (Spanish)	692	2.7	748	4.8	56	2.1
L2 (Catalan)	670	1.9	724	2.9	54	1.0
Language Effect	-22		-24			

Table 6. Mean Reaction Time (RT) and Error Percentage (% E) for the Spanish-Catalan highly-proficient bilingual participants tested in Experiment 6. The data of the non-switch and switch trials in both L1 (Spanish) and L2 (Catalan) are reported for the language-switching task. For the monolingual mode simple picture naming task, the data of the L1 (Spanish) and L2 (Catalan) are reported.

Monolingual Mode Picture Naming Task

	RT	%E
L1 (Spanish)	607	4.8
L2 (Catalan)	645	5.2
Language Effect	38	

Language-Switching Picture Naming Task

	Type of Trial					
	Non-Switch trials		*Switch trials*		*Switching Cost*	
	RT	% E	RT	% E	RT	% E
L1 (Spanish)	849	5.5	914	6.9	65	1.4
L2 (Catalan)	757	5.2	826	5.8	69	0.6
Language Effect	-92		-88			

Table 7. Mean Reaction Time (RT) and Error Percentage (% E) for the Spanish-Catalan highly-proficient bilingual participants tested in Experiment 7 (SOA 500 and SOA 800). The data of the Spanish-Catalan highly-proficient bilinguals tested in Experiment 2 (SOA 0) are also presented simultaneously. The data of the non-switch and switch trials in both L1 (Spanish) and L2 (Catalan) are reported.

	Type of Trial					
	Non-Switch trials		*Switch trials*		*Switching Cost*	
	RT	% E	RT	% E	RT	% E
SOA 0						
L1 (Spanish)	716	4.4	763	6.2	47	1.8
L2 (Catalan)	697	4.6	744	5.4	47	0.8
Language Effect	-19		-19			
SOA 500						
L1 (Spanish)	677	4.8	702	6.2	25	1.4
L2 (Catalan)	656	4.3	685	5.3	29	1.0
Language Effect	-22		-18			
SOA 800						
L1 (Spanish)	702	5.3	714	6.1	12	0.8
L2 (Catalan)	678	5.0	700	6.3	22	1.3
Language Effect	-24		-14			

Table 8. Mean Reaction Time (RT) and Error Percentage (% E) for the Spanish-Catalan highly-proficient bilingual participants tested in Experiment 8. The data of the non-switch and switch trials in both L1 (Spanish) and L3 (English) are reported.

	Type of Trial					
	Non-Switch trials		*Switch trials*		*Switching Cost*	
	RT	% E	RT	% E	RT	% E
L1 (Spanish)	703	5.8	750	8.0	47	2.2
L3 (English)	665	5.4	713	6.2	48	0.8
Language Effect	-38		-37			

Table 9. Mean Reaction Time (RT) and Error Percentage (% E) for the Spanish-Catalan highly-proficient bilingual participants tested in Experiment 9. The data of the non-switch and switch trials in both L2 (Catalan) and L3 (English) are reported.

	Type of Trial					
	Non-Switch trials		*Switch trials*		*Switching Cost*	
	RT	% E	RT	% E	RT	% E
L2 (Catalan)	884	5.1	941	8.0	57	2.9
L3 (English)	844	4.7	897	6.8	53	2.1
Language Effect	-40		-44			

Table 10. Mean Reaction Time (RT) and Error Percentage (% E) for the Spanish-Catalan highly-proficient bilingual participants tested in Experiment 10. The data of the non-switch and switch trials in both L3 (English) and L4 (French) are reported.

	Type of Trial					
	Non-Switch trials		*Switch trials*		*Switching Cost*	
	RT	% E	RT	% E	RT	% E
L3 (English)	815	4.0	879	4.9	64	0.8
L4 (French)	954	8.0	972	9.4	18	1.5
Language Effect	139		93			

Table 11. Mean Reaction Time (RT) and Error Percentage (% E) for the Spanish monolingual and the Spanish-Catalan highly-proficient bilingual participants tested in Experiment 11. The data of the non-switch and switch trials in both L1 (Spanish) and the "New-Language" are reported.

	Type of Trial					
	Non-Switch trials		*Switch trials*		*Switching Cost*	
Spanish monolinguals						
	RT	% E	RT	% E	RT	% E
L1 (Spanish)	691	1.6	756	2.7	65	1.1
"New-Language"	886	8.5	898	8.3	12	-0.2
Language Effect	195		142			
Spanish-Catalan bilinguals						
	RT	% E	RT	% E	RT	% E
L1 (Spanish)	754	1.9	817	2.9	63	1.0
"New-Language"	953	9.3	979	8.7	26	-0.6
Language Effect	199		162			

8.9 Appendix I. Language-History Questionnaire

Name .... Phone: ....

Age ....   Place of birth ....

Place of current residence ....

If different from your birthplace, how long have you been living in the place of your current residence? ....

Father's place of birth ....

Mother's place of birth ....

At what age did you get continuous exposure to (did you start listening to) Catalan? …...............

At what age did you start using (speaking) Catalan? …...............

How (where) did you learn Catalan? …...............

At what age did you get continuous exposure to (did you start listening to) Spanish? ……..............

At what age did you start using (speaking) Spanish? …...............

a) What is the language (Spanish, Catalan, both or other) you normally use to speak to your:

father: mother: sibling(s):   boyfriend/girlfriend:

b) If at an earlier age you used to speak to your family members in another language, at what age did the change take place?

father: mother: sibling(s):   boyfriend/girlfriend:

c) What other languages can you use (speak, read or write)?

………..

At what age did you start formal instruction in these languages?

………..

Underline the option that is the most representative of your language skills for each of the following questions:

What is your COMPREHENSION level in each of these languages?

Spanish:	perfect	good	basic	very poor
Catalan:	perfect	good	basic	very poor
English:	perfect	good	basic	very poor
French:	perfect	good	basic	very poor

What is your READING level in each of these languages?

Spanish:	perfect	good	basic	very poor
Catalan:	perfect	good	basic	very poor
English:	perfect	good	basic	very poor
French:	perfect	good	basic	very poor

What is your SPEAKING (FLUENCY) level in each of these languages?

Spanish:	perfect	good	basic	very poor
Catalan:	perfect	good	basic	very poor
English:	perfect	good	basic	very poor
French:	perfect	good	basic	very poor

What is your SPEAKING (PRONUNCIATION) level in each of these languages?

Spanish:	perfect	good	basic	very poor
Catalan:	perfect	good	basic	very poor
English:	perfect	good	basic	very poor
French:	perfect	good	basic	very poor

What is your WRITING level in each of these languages?

Spanish:	perfect	good	basic	very poor
Catalan:	perfect	good	basic	very poor
English:	perfect	good	basic	very poor
French:	perfect	good	basic	very poor

What language do you feel more comfortable speaking?

Spanish Catalan Both

If unfortunately you suffered a brain injury that implied the loss of one of your languages, which of them would you prefer to keep (without taking into account practical reasons)?

Spanish Catalan Both

If you have (or if you had) a dog or a cat, in what language do you (would you) speak to them?

Spanish Catalan Both

Do you perceive dialectal differences?

In Spanish

*No *Only among some dialects *Yes, clearly

In Catalan

*No *Only among some dialects *Yes, clearly

In English

*No *Only among some dialects *Yes, clearly

9 Selección y representación léxica en la producción del habla bilingüe (Resumen en Español)

Una de las habilidades humanas que más nos diferencian del resto de especies animales es la del lenguaje. Esta habilidad lingüística nos permite transformar nuestras ideas en vocalizaciones lingüísticas que pueden ser perfectamente interpretables por otros humanos, dotándonos así de una potente herramienta comunicativa.

Durante los últimos 30 años un gran número de investigadores se ha dedicado al estudio de un aspecto muy importante para el uso de esta habilidad: la arquitectura y funcionamiento del sistema de producción del lenguaje. Principalmente debido a la dificultad que entraña el desarrollo de estudios experimentales enfocados a la producción de estructuras complejas (p. ej., oraciones), la mayor parte de esta investigación se ha limitado al estudio de la representación y codificación de palabras aisladas. Sin embargo, gracias a estos estudios, han sido muchos los avances realizados en el conocimiento del complejo sistema de producción del habla. Por ejemplo, estas investigaciones han permitido mejorar nuestro conocimiento acerca de las representaciones y procesos cognitivos que nos permiten transformar nuestros pensamientos en vocalizaciones lingüísticas.

Los hablantes han de seleccionar el concepto que desean comunicar, seleccionar la entrada léxica apropiada para expresar este concepto, y recuperar la información fonológica de la palabra para poder articularla. Es decir, tal y como asumen los principales modelos de producción del lenguaje, existen al menos tres niveles de representación diferentes en la arquitectura del sistema: conceptual, léxico y fonológico (Caramazza, 1997; Dell, 1986; Levelt, Roelofs y Meyer, 1999). Además, los modelos de producción asumen dos presupuestos principales respecto al modo en el que es procesada la información: (1) el flujo de activación que proviene del nivel conceptual se extiende masivamente hacia el nivel léxico, activando múltiples entradas léxicas, y (2) la selección léxica está gobernada por un principio de competición entre las diferentes entradas léxicas activadas, en el que la entrada con un mayor nivel de activación es finalmente seleccionada.

La principal evidencia a favor de estos postulados proviene tanto de estudios observacionales (e.g., afásia, efectos de punta de la lengua, errores del habla) como experimentales (e.g., paradigma de interferencia dibujo-palabra). Por ejemplo, en el paradigma de interferencia dibujo-palabra se pide a los participantes que denominen un dibujo mientras ignoran la presentación de una palabra distractora. En este paradigma, los participantes muestran latencias de respuesta diferentes en base a la relación existente entre el nombre del dibujo y la palabra presentada. Por ejemplo, las latencias de respuesta son mayores cuando la palabra distractora (e.g., "silla") está semánticamente relacionada con el dibujo que se ha de denominar (e.g., "mesa") que cuando no mantiene ninguna relación (e.g., "gato"). Éste es el denominado efecto de interferencia semántica. Sin embargo, este efecto desaparece cuando los participantes han de realizar tareas no-lingüísticas. Por ejemplo, Schriefers, Meyer y Levelt (1990) no encontraron efectos semánticos en una tarea de reconocimiento de dibujos en la que la respuesta se realiza presionando un botón, sugiriendo que el efecto de interferencia semántica surge en el nivel léxico, y no en el conceptual. Por lo tanto, este efecto ha sido interpretado como evidencia de que en los procesos de lexicalización existe activación léxica múltiple (tanto la palabra objetivo como la palabra distractora son activadas) y de que la selección léxica se resuelve mediante procesos de competición (la palabra con mayor nivel de activación es seleccionada) (e.g., Caramazza y Costa, 2000; Costa y Caramazza, 2002; Glaser y Düngelhoff, 1984; Glaser y Glaser, 1989; La Heij, 1988; Lupker, 1979; Meyer, 1996; Roelofs, 1992, 1993; Schriefers et al., 1990; Starreveld y La Heij, 1995, 1996; sin embargo, véanse Costa, et al., 2003; 2005; Rosinski, 1977, para una explicación alternativa).

En resumen, estas investigaciones han permitido aumentar el conocimiento sobre el funcionamiento del sistema de producción del lenguaje. Sin embargo, la mayoría se ha limitado a la caracterización del funcionamiento de un sistema monolingüe, mientras que los trabajos dedicados al estudio de las representaciones y los procesos cognitivos de los bilingües han sido escasos.

En lo que respecta al bilingüismo, uno de los aspectos más consensuados en los modelos bilingües de producción del lenguaje es el que postula la existencia de una representación semántica común para las dos lenguas del bilingüe (e.g., Finkbeiner, et al., 2002; Kroll y Stewart, 1994; Li y Gleitman, 2002; Potter, et al., 1984). Sin embargo, a nivel léxico se postula que esta representación semántica común está representada mediante dos entradas léxicas diferenciadas, una para cada lengua. Además, existen evidencias experimentales que muestran que el sistema semántico activa en paralelo los dos lexicones del hablante bilingüe (Colomé, 2001; Costa et al., 2000; 2003; Hermans et al., 1998; aunque véase Costa, La Heij y Navarrete, 2006, para una reevaluación de esta evidencia), lo cual ha llevado a los modelos actuales a presuponer la presencia de co-activación léxica de ambas lenguas (Costa, Miozzo y Caramazza, 1999; Green, 1998). Sin embargo, si las representaciones léxicas de las dos lenguas del bilingüe están activadas, ¿Cuáles son los mecanismos cognitivos que permiten a los bilingües seleccionar las palabras en la lengua que desean producir mientras evitan la interferencia de las palabras de la otra lengua? Es en este punto donde finaliza el acuerdo entre los diferentes modelos de producción del habla en bilingües.

El principal objetivo de la presente tesis es ahondar en nuestro conocimiento sobre el funcionamiento de estos mecanismos cognitivos. A continuación presentamos en más detalle los principales modelos de selección léxica en bilingües.

9.1 Selección léxica y bilingüismo

Una de las más extraordinarias habilidades de los hablantes bilingües es la de mantener sus dos códigos lingüísticos separados durante la producción del lenguaje. Sin embargo, existe cierta divergencia respecto a la naturaleza de los mecanismos cognitivos que permiten a los bilingües hablar en la lengua que desean mientras previenen la interferencia de la otra lengua. Según algunos investigadores los bilingües acceden a la lengua de respuesta mediante un *mecanismo de selección léxica que es específico de lengua* (Costa y Caramazza, 1999; Costa, Miozzo y Caramazza, 1999; Roelofs, 1998), es decir, mediante un mecanismo que tan solo considera el nivel de activación de las palabras de la lengua que se desea producir, ignorando la activación de las palabras de la otra lengua. Por el contrario, otros investigadores argumentan que este *mecanismo de selección es no-específico de lengua*, ya que considera el nivel de activación tanto de las palabras de la lengua de respuesta como de las palabras de la lengua de no-respuesta (Green, 1986; 1998; Hermans et al., 1998). Los máximos exponentes de ambas posturas son (1) el modelo de selección específica de lengua (Costa et al., 1999); y (2) el modelo de control inhibitorio (modelo CI; Green, 1986; 1998), respectivamente.

9.1.1 El modelo de selección específica de lengua (Costa et al., 1999)

De acuerdo con este modelo, la *selección léxica es específica de lengua* (Costa y Caramazza, 1999; Costa et al., 1999; Roelofs, 1998). Es decir, el mecanismo encargado de seleccionar la palabra correspondiente al concepto a expresar tan sólo considera la activación de las palabras pertenecientes al léxico en el que el hablante ha elegido emitir el mensaje. Esto implica que los dos léxicos del bilingüe están arquitectónicamente segregados y que el mecanismo de selección léxica es sensible a tal segregación. Así pues, no existiría interferencia entre lenguas (a nivel léxico) dado que las únicas representaciones consultadas durante la selección léxica serían aquellas correspondientes a la lengua en uso. En otras palabras, según este modelo, la activación de las palabras de la lengua de no-respuesta *no compiten* con las de la lengua de respuesta en el proceso de selección. Esta propuesta es similar a la realizada en varios modelos monolingües de acceso al léxico, en los que se presupone que la selección de una palabra viene guiada, no sólo por su nivel de activación, sino también por su pertenencia a una categoría gramatical concreta (Caramazza, 1997; Dell, 1986). Esto es, en el momento en el que un hablante tiene que seleccionar, por ejemplo, un nombre, el mecanismo de selección léxica sólo consideraría como posibles candidatas aquellas representaciones correspondientes a los nombres. En este sentido, el modelo de selección específica de lengua simplemente extiende este mecanismo al caso de la pertenencia o no de una palabra a una lengua en concreto.

La principal evidencia a favor de este modelo proviene de una versión bilingüe del paradigma de interferencia dibujo-palabra. En este estudio se pidió a bilingües competentes de catalán-español que denominaran dibujos en su L1 (catalán) mientras ignoraban palabras distractoras presentadas tanto en catalán (L1, lengua de respuesta) como en español (L2, lengua de no-respuesta; Costa et al., 1999). La condición experimental crítica de esta serie de experimentos es aquella en la que junto al dibujo que se ha de denominar (e.g., taula, "mesa" en catalán) se presentó la traducción de la palabra objetivo (e.g., "mesa"). En este contexto, se presupone que la activación de la traducción de la palabra objetivo ("mesa") estará altamente activada, puesto que recibe activación tanto de la representación semántica del dibujo como del propio distractor. Por lo tanto, si las palabras de la lengua de no-respuesta entran en procesos de competición léxica para la selección, las latencias de respuesta deberían ser mucho mayores cuando el distractor es la traducción de la palabra objetivo ("mesa") que cuando es una palabra no relacionada (e.g., "perro"). Sin embargo, los resultados contradicen este presupuesto, ya que se encontraron latencias de respuesta más rápidas en el primer caso que en el segundo. Es decir, este efecto (conocido como efecto de facilitación de identidad) muestra que la mayor activación de la traducción de la palabra que se ha de producir no solo no interfiere, sino que facilita su selección (véanse Costa y Caramazza, 2000; Hermans, 2000, 2004 para una réplica de estos resultados con diferentes tipos de bilingües).

9.1.2 El modelo de control inhibitorio (Green, 1998)

En contraste con el modelo anterior, este modelo asume que la selección léxica en la lengua deseada se lleva a cabo mediante un mecanismo atencional inhibitorio (Green, 1986; 1998). Según este **modelo de control inhibitorio**, las representaciones léxicas de la lengua de no-respuesta son inhibidas, de manera que, a pesar de que podrían competir durante la selección léxica, difícilmente serán escogidas para su producción. En este caso, el modelo CI postula un mecanismo inhibitorio externo al sistema lingüístico que aseguraría la producción de una sola lengua.

La evidencia que apoya más convincentemente la existencia de mecanismos inhibitorios en el acceso al léxico es la <u>asimetría en el coste de cambio de lengua</u> observada por Meuter y Allport (1999). Estos autores pidieron a aprendices de L2 que denominaran números arábigos en sus dos lenguas de manera aleatoria y secuencial. Cuando los números aparecían en rojo los hablantes tenían que denominarlos en su L1 y cuando aparecían en azul en su L2. Existían dos tipos de ensayos diferentes: a) ensayos en los que el número se tenía que denominar en la misma lengua que en el ensayo inmediatamente anterior (ensayos de no-cambio de lengua), y b) ensayos en los que el número se tenía que denominar en una lengua diferente a la del ensayo inmediatamente anterior (ensayos de cambio de lengua). Esto es, en algunos ensayos la denominación requería un cambio de lengua y en otros no. De esta manera, se puede calcular el coste (en tiempo de reacción y errores) que supone cambiar de una lengua a otra, tanto para la L1 como para la L2. Sorprendentemente, el coste de cambio de lengua fue mayor cuando éste se producía hacia la L1 que cuando se producía hacia la L2, es decir, era más costoso cambiar de la tarea difícil (denominar en L2) a la tarea fácil (denominar en L1), que viceversa. Los autores interpretaron esta asimetría como evidencia de la existencia de mecanismos inhibitorios en la producción del habla en sujetos bilingües aprendices de L2. La lógica de esta interpretación es la siguiente: denominar en la L2 requiere una gran inhibición de las representaciones léxicas de la L1. Por lo tanto, si se tiene que denominar un ensayo en la L1, tras la previa denominación de un ensayo en la

L2, se precisa de un tiempo extra para reactivar aquellas representaciones que han sido fuertemente inhibidas. Por el contrario, cambiar a la L2 sería relativamente fácil, dado que la denominación anterior en L1 no requeriría de tanta inhibición de las representaciones de L2. En resumen, cambiar a la L2 sería menos costoso que cambiar a la L1, y de ahí la asimetría en el coste de cambio de lengua (véase también Lee y Williams, 2001).

9.1.3 Principales diferencias entre ambos modelos

Estos dos modelos difieren en dos puntos concretos en base a si éstos postulan o no la existencia de (1) competición léxica entre lenguas, y (2) un mecanismo atencional de control inhibitorio independiente de los procesos puramente lingüísticos encargado de evitar interferencia de la lengua de no-respuesta. A este respecto, mientras el modelo CI asume ambos postulados, el mecanismo de selección específico de lengua no asume ninguno de ellos.

Como hemos podido observar, la evidencia empírica disponible hasta ahora es mixta y, por tanto, no concluyente. Por un lado, el efecto de facilitación de identidad mostrado por Costa y colaboradores (1999) sugiere que la lengua de no-respuesta no compite en los procesos de selección léxica, mientras que el patrón asimétrico de cambio de lengua observado por Meuter y Allport (1999) sugiere que la lengua de no-respuesta es inhibida. Por consiguiente, podemos decir que la evidencia empírica de la que disponemos en la actualidad para poder decantarnos hacia una u otra de estas propuestas es aún limitada. Siendo así, resulta imprescindible realizar un estudio exhaustivo de los procesos de selección léxica de los bilingües.

9.2 Objetivos

El principal objetivo de esta tesis es conocer la naturaleza de los mecanismos cognitivos que permiten a los bilingües prevenir una interferencia masiva de la lengua de no-respuesta durante la producción del habla. Con este objetivo, en la presente tesis ponemos a prueba el modelo CI, testando la veracidad de su postulado principal: la existencia de procesos inhibitorios durante la producción del habla en bilingües. Para ello adoptamos el paradigma experimental que más convincentemente apoya la existencia de mecanismos inhibitorios en el acceso al léxico: el paradigma de cambio de lengua utilizado por Meuter y Allport (1999). Así, asumiendo que el patrón de cambio de lengua asimétrico revela el uso de mecanismos inhibitorios durante la producción del habla, realizamos un estudio exhaustivo del patrón de cambio de lengua de diferentes grupos de bilingües.

9.2.1 Implementando los objetivos: El paradigma de cambio de lengua.

En los experimentos que presentamos a continuación, para poder comparar los resultados de nuestro estudio con los reportados por Meuter y Allport (1999), mantenemos en la medida de lo posible el mismo diseño experimental utilizado por estos autores. Sin embargo, realizamos tres cambios principales: 1) testamos poblaciones de participantes lingüísticamente homogéneas; 2) utilizamos un número menor de ensayos (950 en lugar de 2000), y 3) con el fin de controlar mejor el estado cognado de las palabras, utilizamos dibujos de objetos comunes en lugar de dígitos. En cada uno de los experimentos se manipulan diferentes variables independientes, incluyendo siempre la lengua en la que se da la respuesta (L1 vs. L2) y el tipo de ensayo (Ensayo de cambio vs. Ensayo de no-cambio). Las variables dependientes registradas y analizadas son las latencias de respuesta y la tasa de errores de los participantes en cada condición experimental. La pista que indicará en qué lengua se tiene que denominar un dibujo será el color en el que éste aparezca. Un ensayo en el que el dibujo es denominado en la misma lengua que en la que ha sido denominado el dibujo anterior se considera un ensayo de no-cambio, y cuando es denominado en una lengua diferente se considera un ensayo de cambio. Sustrayendo el tiempo de respuesta de los ensayos de no-cambio a aquellos de cambio se obtiene la magnitud del coste de cambio para cada lengua. Si la magnitud del coste de cambio de lengua es significativamente diferente entre las dos lenguas diremos que el coste es asimétrico, si no lo es diremos que es simétrico. En cada uno de estos experimentos se incluyen 950 ensayos experimentales, divididos del siguiente modo por condición experimental: 70% de ensayos de no cambio de lengua (35% en cada lengua) y 30% de cambio (15% en cada lengua). En esta tesis, realizamos 11 experimentos de cambio de lengua, en la que testamos la actuación de varios grupos de bilingües en diferentes contextos lingüísticos.

9.3 Sección Experimental

9.3.1 El patrón de cambio de lengua de aprendices de L2 y bilingües competentes

El objetivo del primer experimento es replicar los resultados reportados por Meuter y Allport testando dos poblaciones de hablantes bilingües poco competentes en su L2 (aprendices de L2). Los participantes del primer grupo eran hablantes nativos de español aprendices de catalán, mientras que los del segundo grupo eran hablantes nativos de coreano aprendices de español. Los resultados obtenidos en este experimento replican aquellos reportados anteriormente por Meuter y Allport (1999): (1) los dos grupos de aprendices de L2 muestran un claro coste de cambio (son más lentos en los estímulos de cambio que en los de no-cambio); y (2) para ambos grupos, el coste de cambio de lengua es asimétrico, siendo más costoso realizar el cambio de L2 a L1 que de L1 a L2 (véase Figura 1).

Por lo tanto, los resultados de este experimento se adaptan perfectamente a las predicciones realizadas por el modelo de control inhibitorio (Green, 1998), en el que se asume que la cantidad de inhibición aplicada sobre una lengua depende del nivel de competencia adquirido en la misma (a mayor competencia, mayor inhibición). De este modo, los costes de cambio asimétricos estarían mostrando que los aprendices de L2, al hablar en su segunda lengua, aplican gran cantidad de inhibición sobre su lengua más

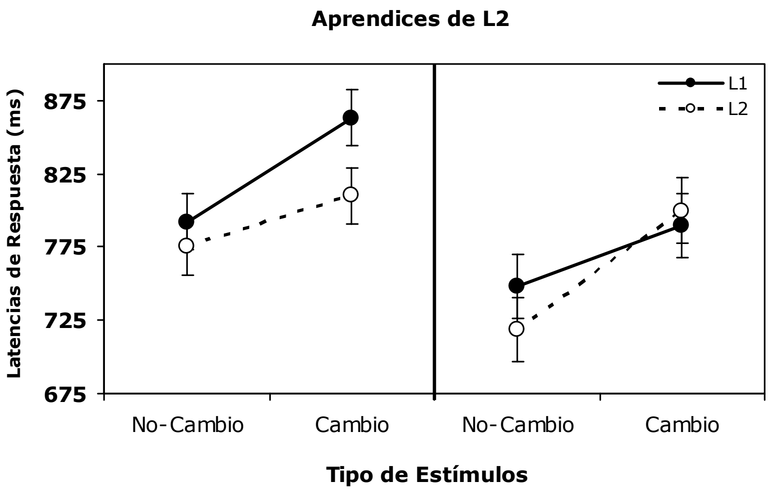


Figura 1. Patrones de cambio de lengua de españoles aprendices de catalán (derecha) y coreanos aprendices de español (izquierda) (Experimento 1).

fuerte (su L1), mientras que para la producción de L1, la L2 ha de inhibirse en menor medida. Sin embargo, en el caso de los hablantes bilingües competentes, el modelo de control inhibitorio predice un patrón de cambio simétrico. En este caso, si asumimos que es el nivel de competencia en una lengua lo que determina la cantidad de inhibición que se aplica sobre ésta, un hablante bilingüe (competente en ambas lenguas) debería aplicar la misma cantidad de inhibición sobre sus dos lenguas. Por lo tanto, el coste de cambio a L1 y a L2 debería ser similar.

Para testar estas predicciones, en el Experimento 2 pedimos a un grupo de bilingües tempranos y altamente competentes en español y catalán que realizaran la misma tarea que los aprendices de L2.

Los resultados de este experimento muestran que: (1) los bilingües competentes de español-catalán muestran un coste de cambio general (los estímulos de cambio son denominados más lentamente que los de no-cambio); (2) el patrón de coste de cambio es simétrico, es decir, los bilingües competentes sufren el mismo coste al cambiar de L2 a L1 que de L1 a L2; y (3) las latencias de respuesta son menores en L2 que en L1 (véase Figura 2).

El patrón de cambio de lengua de los bilingües competentes es, por lo tanto, consistente con la noción de que la lengua de no-respuesta es inhibida, y que la cantidad de inhibición aplicada sobre ésta depende del nivel de competencia adquirido en la misma. Dado que el nivel de competencia de estos bilingües en L1 y L2 es el mismo, la cantidad de inhibición aplicada sobre cada una de ellas es la misma, de manera que el patrón de cambio de lengua asimétrico desaparece.[20] Por lo tanto, parece que es el nivel de competencia en L2 el que determina si el patrón de cambio de lengua de los bilingües será simétrico o asimétrico.

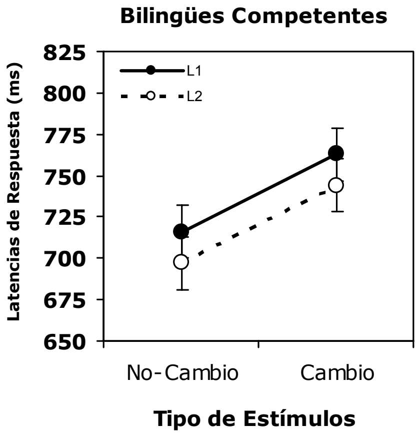


Figura 2. Patrón de cambio de lengua de los bilingües competentes de español-catalán en L1 y L2 (Experimento 2).

Sin embargo, antes de considerar el diferente nivel de competencia en L2 como el origen de los diferentes patrones de cambio de lengua mostrados por aprendices de L2 y bilingües competentes, debemos tener en cuenta dos variables no controladas en el experimento 2: (1) la edad de adquisición de L2: y (2) la similitud entre lenguas.

[20] En este experimento encontramos un sorprendente resultado: las latencias de respuesta de los bilingües competentes son menores en L2 que en L1. Si la cantidad de inhibición aplicada sobre L1 y L2 es similar, uno debería esperar latencias de respuesta similares en ambas lenguas. O, en su defecto, latencias más rápidas en L1 que en L2. Sin embargo, no es éste el resultado observado. Este punto será discutido en el apartado 3.1.3 y en la Discusión General.

9.3.2 El patrón de cambio de lengua en bilingües competentes: el rol de la edad de adquisición y de la similitud entre lenguas

En primer lugar, los aprendices de L2 y los bilingües competentes no solo diferían en el nivel de competencia alcanzado en L2, sino también en la edad de adquisición de esta L2, por lo que el diferente patrón de cambio de lengua pudiera ser debido a cualquiera de estos dos factores. Por ejemplo, se ha mostrado que la edad de adquisición de L2 tiene importantes consecuencias en la adquisición de diversos dominios de la L2 (e.g., Birdsong, 1999; Birdsong y Molis, 2001; Flege, 1999; Flege et al., 1999; Newport, 1990, 1991; Sebastián-Gallés y Bosch, 2002; Sebastián-Gallés et al., 2005; Sebastián-Gallés y Soto-Faraco, 1999; Weber-Fox y Neville, 1996, 1999; véase Sebastián-Gallés y Kroll, 2003, para una revisión). Además, en una reciente investigación, Wartenburger y colaboradores (2003) sugieren que los aspectos semánticos en L2 se ven principalmente afectados por el nivel de competencia en L2, mientras que el conocimiento gramatical se ve principalmente afectado por la edad de adquisición de L2. En consecuencia, parece adecuado estudiar hasta qué punto afecta la edad de adquisición a los mecanismos de control implicados en la producción del habla bilingüe.

En segundo lugar, el patrón de cambio de lengua simétrico se ha encontrado en un grupo de bilingües competentes en dos lenguas tipológicamente muy similares: español y catalán. Estas dos lenguas romances tienen muchas semejanzas tanto a nivel léxico (alrededor del 70% de las palabras son cognadas[21]) como gramatical. Por lo tanto, la similitud entre lenguas pudiera afectar al modo en el que los bilingües controlan los procesos de lexicalización. Asimismo, podría ser que dos lenguas similares provocasen, durante los procesos de acceso léxico, mayores niveles de interferencia entre ellas que la que pudiera haber entre dos lenguas muy diferentes. Por lo tanto, es posible que el mecanismo atencional encargado de mantener las dos lenguas separadas estuviera mejor establecido en bilingües de dos lenguas

[21] Las palabras cognadas son aquellas que, teniendo el mismo significado, también son fonológicamente muy similares (e.g., "luna" y "lluna", en español y catalán, respectivamente.

similares que en el de los hablantes de dos lenguas muy diferentes.[22]

En los experimentos 3 y 4 exploramos hasta qué punto los factores de edad de adquisición y similitud de lengua afectan al patrón de cambio de lengua mostrado por bilingües competentes. Para ello testamos a un grupo de bilingües tempranos de dos lenguas tipológicamente muy diferentes: bilingües competentes de español y euskara (Experimento 3); y a un grupo de bilingües competentes de español e inglés que adquirieron su L2 en una edad tardía (Experimento 4).[23] Ambos grupos efectuaron la misma tarea de cambio de lengua que la realizada por los bilingües de español-catalán del experimento 2.

Los resultados obtenidos en ambos experimentos muestran exactamente el mismo patrón de resultados encontrado en los bilingües de español y catalán: (1) ambos grupos muestran un coste de cambio general (los estímulos de cambio son denominados más lentamente que los de no-cambio); (2) el patrón de coste de cambio es simétrico, es decir, en ambos casos los bilingües competentes sufren el mismo coste al cambiar de L2 a L1 que al cambiar de L1 a L2; y (3) las latencias de respuesta son menores en L2 (euskara e inglés) que en L1 (español) (véase Figura 3). Finalmente, se realizaron dos análisis conjuntos en los que se compararon los resultados de los bilingües español-euskara vs. español-catalán; y de los bilingües español-inglés vs. español-catalán. Ambos análisis revelaron que tanto los bilingües tardíos de L2 como los bilingües de dos lenguas muy diferentes se comportan de manera similar a como lo hacen los bilingües tempranos de español y catalán.

---

[22] Un segundo factor a tener en cuenta es el contexto sociolingüístico en el que se encuentran los bilingües competentes. En el caso de la sociedad catalana, en la que se encuentran inmersos los bilingües de español-catalán, prácticamente el 100% de la población entiende las dos lenguas (el 97% entiende y el 85% de la población habla ambas lenguas; Vila y Moreno, 2004), de manera que los bilingües pueden utilizar ambos idiomas en la misma conversación indistintamente. Es posible, por lo tanto, que estos bilingües hayan llegado a ser extremadamente habilidosos en la realización de cambios de lengua.

[23] Para asegurarnos de la competencia en L2 del grupo de bilingües español-inglés, escogimos como participantes a traductores de inglés.

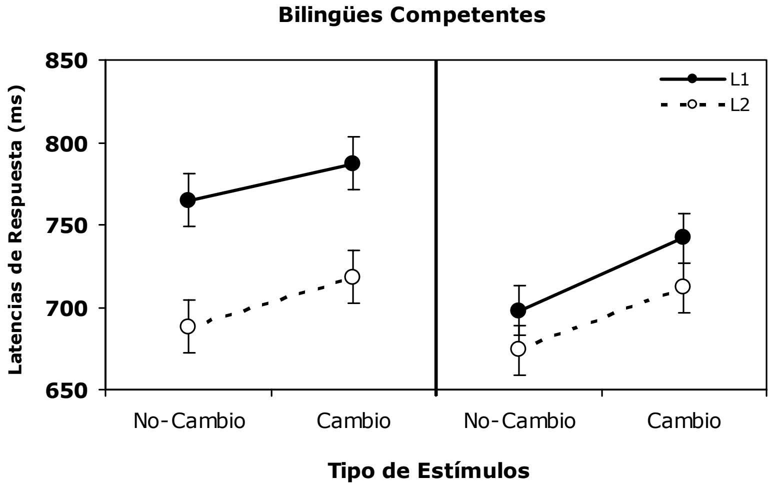


Figura 3. Patrones de cambio de lengua en L1 y L2 de bilingües competentes de español-euskara (derecha) y de español-inglés (izquierda) (Experimentos 3 y 4).

Estos resultados indican que el diferente patrón de cambio de lengua mostrado por aprendices de L2 y bilingües competentes no puede ser debido ni a la edad de adquisición de la L2 ni a la similitud entre las lenguas. Por lo tanto, se puede concluir que el factor que determina la ausencia de asimetría es el nivel de competencia adquirido en L2.

9.3.3 Cambio de lengua y el estado cognado de las palabras

En este apartado se va a considerar un factor que hasta ahora no se había tenido en cuenta a la hora de caracterizar el patrón de cambio de lengua: el estado cognado de las palabras. Este estado tiene efectos positivos importantes en la actuación de los bilingües. Por ejemplo, las palabras cognadas se aprenden más rápidamente y son más resistentes al olvido (e.g., de Groot y Keijzer, 2000; Lotto y de Groot, 1998;), recaen menos en estados de punta de la lengua (Gollan y Acenas, 2004), se producen más rápidamente (Costa, Caramazza y Sebastián-Gallés, 2000), y son más sensibles a efectos de primado entre lenguas (De Groot y Nas, 1991; Van Hell y De Groot, 1998).

Existen tres propuestas respecto al origen del efecto cognado de facilitación. La primera hipótesis, a la que denominaremos *hipótesis semántica*, presupone que el efecto cognado surge como consecuencia del mayor solapamiento semántico entre las palabras cognadas (De Groot y Van Hell, 1998). Según estas autoras, la similitud formal entre las palabras repercute en su representación conceptual, de tal manera que las palabras cognadas compartirían más rasgos semánticos que las no cognadas. Como consecuencia de este mayor solapamiento, la recuperación de la representación semántica correspondiente a una palabra cognada sería más rápida y fiable que la de una no cognada. La segunda hipótesis, la *hipótesis léxica*, postula que el estado cognado de una palabra tiene efectos a niveles léxicos. De acuerdo con Kirsner, Lalor y Hird (1993), las palabras cognadas tienen una sola entrada léxica (o un solo morfema) que es, por tanto, compartida por las dos lenguas. Según esta propuesta, el efecto cognado sería consecuencia, entre otras causas, de la mayor frecuencia de las representaciones cognadas, dado que para estas palabras la misma representación se recuperaría cuando se habla en cualquiera de las dos lenguas. Finalmente, la *hipótesis fonológica* (Costa y cols., 2000; Costa, Santesteban y Caño, 2005), localiza el efecto cognado en el nivel fonológico, presuponiendo que los sonidos de las palabras cognadas se recuperarían de manera más fiable y veloz porque estarían recibiendo activación de dos representaciones (la palabra objetivo y su traducción cognada) mientras que esto no sería así para las palabras no cognadas. En resumen, mientras las hipótesis semántica y fonológica asumen que, a nivel léxico, tanto las palabras cognadas como las no-cognadas se representan mediante entradas léxicas diferentes, la hipótesis léxica considera que las dos lenguas del bilingüe comparten una única representación léxica para las palabras cognadas. Es decir, la hipótesis léxica asume que el estado cognado de las palabras afecta de manera importante al modo de representación de las entradas léxicas.

Por lo tanto, si asumimos los postulados de la hipótesis léxica, el estado cognado de las palabras debería afectar al patrón de cambio de lengua de los bilingües. En primer lugar, la hipótesis léxica predeciría que, dado que al menos parte de los efectos de cambio de lengua surgen de la inhibición aplicada sobre las entradas léxicas de la lengua de no-respuesta, los efectos de cambio de lengua deberían ser menores para las palabras cognadas que para las no-cognadas. Es decir, puesto que en el caso de los cognados los bilingües han de acceder a la misma entrada léxica cuando hablan en L1 y en L2, esta no puede ser inhibida, por lo tanto, el único efecto de cambio encontrado para estas palabras debería ser el resultante de realizar un cambio de tarea, pero no el de inhibir las representaciones de la lengua de no-respuesta. Sin embargo, en el caso de las palabras no-cognadas, puesto que ambas lenguas acceden a entradas léxicas diferentes, al hablar en L2, el bilingüe inhibirá las representaciones de la L1. En resumen, los costes de cambio de lengua deberían ser mayores para las palabras no-cognadas que para las cognadas. En segundo lugar, en base a este razonamiento, la hipótesis léxica predice que el estado cognado de las palabras también afectará al patrón de cambio de lengua de los aprendices de L2. Esto se debe a que el origen del cambio de lengua asimétrico se basa en la diferente cantidad de inhibición aplicada sobre las entradas léxicas de cada lengua. Por lo tanto, si asumimos que las entradas léxicas compartidas por ambas lenguas no pueden ser inhibidas, el patrón de cambio de lengua asimétrico debería desaparecer para éstas. Consecuentemente, el patrón de cambio de lengua de los aprendices de L2 debería ser asimétrico para las palabras no-cognadas, y simétrico para las cognadas.

En el experimento 5 se testan las predicciones de la hipótesis léxica y se estudia si el estado cognado de las palabras afecta al patrón de cambio de lengua de aprendices de L2 y bilingües competentes. Pare ello, se solicitó a un grupo de hablantes nativos de español y aprendices de catalán, y a un grupo de bilingües competentes de español y catalán que realizaran la tarea de cambio de lengua utilizada anteriormente. En esta tarea, se incluyeron palabras cognadas y no-cognadas, por lo que se incluyó una nueva variables independiente: Estado Cognado (no-cognado vs. cognado).

Los resultados obtenidos muestran: (1) un efecto cognado de facilitación para los aprendices de L2 y los bilingües competentes; (2) un patrón de cambio de lengua asimétrico para los aprendices de L2 (mayor coste de cambio para L1 que para L2); y un patrón simétrico para los bilingües competentes (igual coste de cambio para L1 que para L2); (3) ambos grupos muestran la misma magnitud de coste de cambio de lengua para palabras cognadas y no-cognadas (véase Figura 4); y, finalmente, (4) latencias de respuesta menores en L2 (Catalán) que en L1 (Español) para ambos grupos.

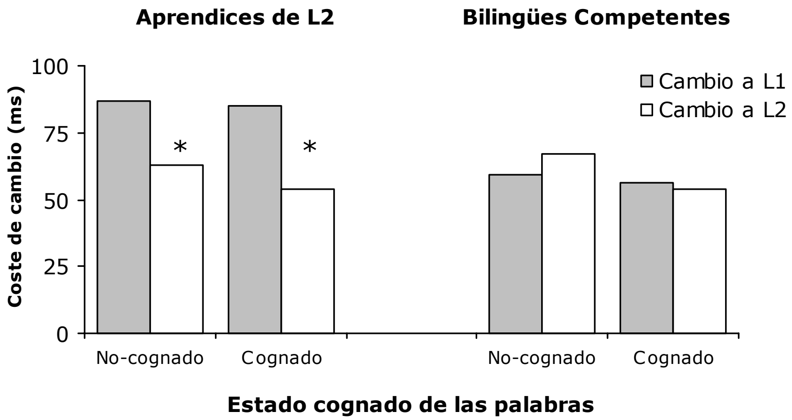


Figura 4: Magnitud de los costes de cambio de lengua en L1 y L2 de los españoles aprendices de catalán y de los bilingües competentes de español-catalán para palabras tanto no cognadas como cognadas. (Experimento 5). Las diferencias significativas (p<.01) entre la magnitud del coste de cambio a L1 y L2 están señaladas mediante un asterisco (*).

Estos resultados revelan que el estado cognado no afecta a la conducta de cambio de lengua de los bilingües. Por lo tanto, podemos concluir que el patrón diferencial mostrado por aprendices de L2 y bilingües competentes es debido al nivel de competencia adquirido en L2, con independencia de la edad de adquisición de L2, la similitud de lenguas, o el estado cognado de las palabras. Estos resultados se adecuan perfectamente a las predicciones realizadas por el modelo de control inhibitorio.

9.3.4 El efecto de ventaja de L2 sobre L1

Antes de examinar hasta qué punto tener niveles de competencia diferentes en ambas lenguas afecta la conducta de cambio de lengua de los bilingües competentes, exploramos el posible origen de un resultado sorprendente observado en los experimentos anteriores: la ventaja de L2 sobre L1.

El experimento 6 explora si la ventaja de L1 sobre L2 se debe al tipo de tarea que han de realizar los bilingües. Así, en este experimento se examinan tres grupos de bilingües competentes de español y catalán: el grupo 1 realiza la misma tarea de cambio de lengua utilizada en los experimentos anteriores, de modo que son situados en un contexto bilingüe en el que han de denominar dibujos en sus dos lenguas. Los grupos 2 y 3 realizan una tarea de denominación de dibujos en tan solo una de sus lengua: español y catalán, respectivamente. Es decir, estos participantes fueron situados en un contexto de denominación monolingüe (Grosjean, 1998).

Los resultados del Grupo 1 revelan que los bilingües competentes muestran nuevamente un patrón de cambio de lengua simétrico, y, lo que es más importante, una clara ventaja de L2 sobre L1. Sin embargo, los dos grupos que realizaron la tarea de denominación en un contexto monolingüe revelan una ventaja de L1 sobre L2. Es decir, el grupo de bilingües realizando la tarea en L1 (español) muestra latencias de respuesta más rápidas que el grupo que realiza la tarea en L2 (catalán). Esto revela que el efecto de ventaja de L2 sobre L1 es consecuencia de las características específicas de la tarea de cambio de lengua, pero no nos indica cuál es el origen de este efecto (véase Figura 5).

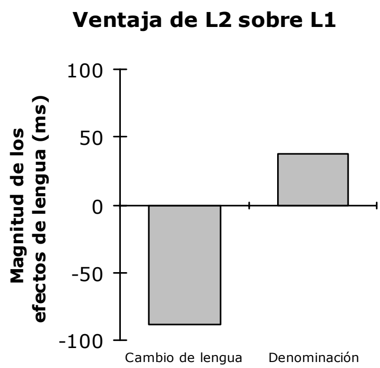


Figura 5: Magnitud de la ventaja de L2 sobre L1 en function del tipo de tarea realizado por los bilingües competentes de español-catalán (Experimento 6).

En el experimento 7 exploramos la posibilidad de que, en una tarea de cambio de lengua, los participantes pudieran estar priorizando la lexicalización de las palabras de la lengua más débil (L2). Es decir, los bilingües pudieran estar preparando siempre las respuestas en L2, facilitando así la denominación de dibujos en esta lengua. Sin embargo, cuando estos han de denominar un dibujo en L1, deberían parar el proceso de lexicalización en L2 y comenzar la lexicalización en L1, retrasando así considerablemente sus latencias de respuesta. Con el objetivo de poner a prueba esta hipótesis testamos la actuación de dos grupos de bilingües competentes de español-catalán en un experimento de cambio de lengua en el que se presenta una marca de lengua antes de la presentación de cada uno de los dibujo (500 ms antes para el grupo 1 y 800 ms antes para el grupo 2). Se considera que esta manipulación de la asincronía entre la presentación de la marca de lengua y el dibujo evitará que los bilingües prioricen la lexicalización en la lengua más débil. Esto se debe a que antes de ver el dibujo objetivo, los participantes ya sabrán en qué lengua han de denominarlo, y, por lo tanto, la lengua en la que han de realizar el proceso de lexicalización. De este modo, la ventaja de L2 sobre L1 debería desaparecer, o al menos disminuir, en base al tiempo de antelación con el que los bilingües conocen la lengua en la que habrán de denominar los dibujos. Adicionalmente, la reducción de la incertidumbre sobre el cambio de lengua también podría reducir la magnitud del coste de cambio (e.g., de Jong, 1995; Meiran, 1996; Rogers y Monsell, 1995).

Para testar esta posibilidad comparamos el patrón de cambio de lengua de estos dos grupos con el de los participantes del experimento 2, en el que la marca de lengua es presentada al mismo tiempo que el dibujo. Los resultados del análisis conjunto de los tres grupos muestran nuevamente que los estímulos de cambio de lengua son denominados más lentamente que los de no-cambio. Además, se observa un efecto de lengua significativo (las latencias de respuesta de los bilingües son menores en L2 que en L1). Por otro lado, la interacción entre las variables tipo de estímulo y grupo de participantes es significativa, mostrando que la magnitud del

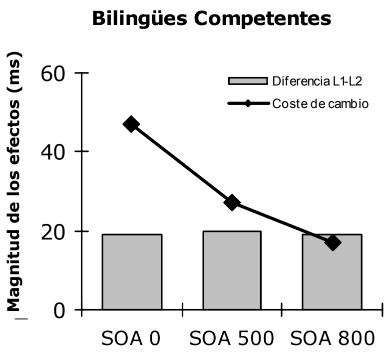


Figura 6: Magnitud del coste de cambio general y de la ventaja de L2 sobre L1 en función de la asincronía entre la marca de lengua y el dibujo objetivo (Experimento 7).

coste de cambio de lengua se modula en base al tiempo de antelación con el que se presenta la marca de lengua (a mayor antelación, menor coste de cambio). Sin embargo, la diferencia de las latencias de respuesta en L1 y L2 no permanece estable para los tres grupos (véase Figura 6). Finalmente, los tres grupos muestran un patrón de cambio simétrico.

En suma, los resultados de este experimento no apoyan la "hipótesis de vía de lexicalización" planteada para dar cuenta de la ventaja de L2 sobre L1. Esto se debe a que, en contra de lo que postularía esta hipótesis, la ventaja de L2 sobre L1 se mantiene estable para los tres grupos. Además, se puede asumir que los bilingües no están ignorando la presentación de la marca de lengua, ya que la presentación de ésta disminuye el efecto de coste de cambio general de estos participantes.

Resumen parcial de resultados

Hasta este momento hemos observado que los aprendices de L2 muestran un patrón de cambio de lengua asimétrico, mientras que los bilingües altamente competentes en dos lenguas muestran patrones de cambio simétricos, independientemente de la edad de adquisición de su L2 o de la similitud entre las dos lenguas adquiridas. Además, también se ha observado que el estado cognado de las palabras no modifica la actuación de ninguno de estos dos tipos de bilingües.

Consecuentemente, todos los resultados presentados hasta ahora dan cuenta del modelo CI. Es decir, como ya se ha indicado, este modelo postula que la cantidad de inhibición que se aplica a una lengua depende del nivel de competencia que se tenga en este idioma y que la magnitud del coste de cambio es proporcional a la cantidad de inhibición aplicada sobre esta lengua. Por lo tanto se esperarían costes de cambio asimétricos para los aprendices de L2 y simétricos para los bilingües competentes, dado que en este último caso, la inhibición aplicada a ambas lenguas es similar. Precisamente estos son los resultados observados. Sin embargo, aunque dicha observación cumple las predicciones del modelo CI, no es concluyente, puesto que estos mismos resultados pueden ser interpretados desde modelos que no necesariamente impliquen procesos inhibitorios. Por ejemplo, es posible que este tipo de bilingües altamente competentes simplemente hayan desarrollado un mecanismo de selección diferente que les permite escoger las palabras de un idioma sin necesidad de inhibir las entradas léxicas del otro.

Una manera de examinar si los bilingües altamente competentes realmente utilizan el mecanismo de inhibición reactivo planteado por el modelo CI es observar la actuación de estos bilingües cuando se les plantea una tarea de cambio de lengua entre dos idiomas en los que tienen niveles de competencia diferentes. Es decir, observar el patrón de cambio de lengua de los bilingües competentes en un contexto lingüístico similar al de los aprendices de L2, como por ejemplo, cuando realizan una tarea de cambio en L1 y L3 (Experimento 8) o en L2 y L3 (Experimento 9). Si realmente se da inhibición reactiva, se han de observar costes de cambio asimétricos similares a los obtenidos en el experimento 1, ya que los bilingües competentes deberían aplicar mayor cantidad de inhibición sobre su L1/L2 que sobre la lengua en la que no son muy competentes, su L3.

Para llevar a cabo estos dos experimentos se seleccionaron dos grupos de bilingües competentes de español y catalán que estaban aprendiendo inglés como L3 (la competencia de la L3 de estos sujetos se puede comparar a la de los aprendices de L2 testados en el experimento 1). Al primer grupo se le pidió realizar la tarea de cambio de lengua entre L1 y L3 (Experimento 8), mientras que el segundo realizó la tarea en L2 y L3 (Experimento 9).

Los resultados obtenidos en estos dos experimentos muestran (1) un claro patrón simétrico de coste de cambio (comparable estadísticamente en ambos casos al obtenido en el experimento 2 para bilingües competentes realizando la tarea en L1 y L2; y, lo que es más importante, diferente al patrón asimétrico obtenido en el experimento 1 para aprendices de L2); y (2) mayor latencia de respuesta en L1 o L2 (español o catalán) que en L3 (inglés) (véase Figura 7).

Estos resultados contradicen las predicciones del modelo CI. Por lo tanto, revelan que el sistema de lexicalización de los bilingües altamente

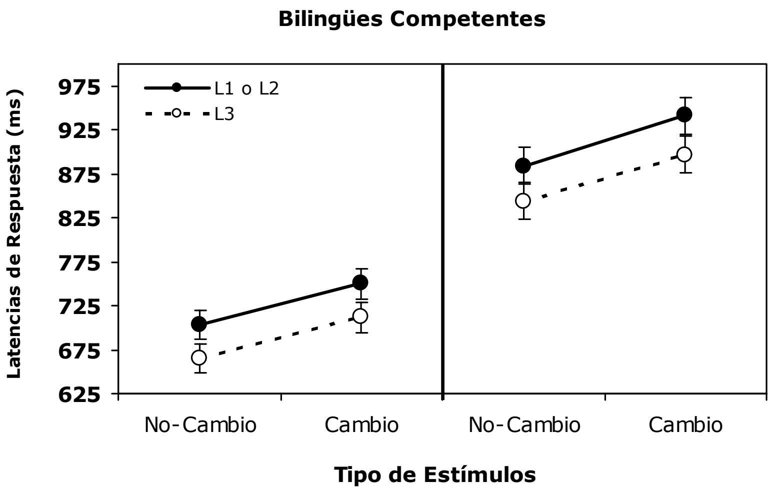


Figura 7. Patrones de cambio de lengua de bilingües competentes de español-catalán realizando la tarea de cambio en L1-español y L3-inglés (derecha) y en L2-catalán y L3-inglés (izquierda) (Experimentos 8 y 9).

competentes no utiliza inhibición, ya que muestran que las diferencias en el nivel de competencia entre los dos idiomas implicados en la tarea no conducen a costes de cambio asimétricos. Por el contrario, el patrón de coste de cambio (simétrico) de estos bilingües es exactamente el mismo independientemente de que la tarea incluya sus dos lenguas dominantes (L1 y L2), o una de estas dos y un idioma en el que su nivel de competencia es mucho menor (L1/L2 y L3). Por lo tanto, la diferencia en la competencia de las lenguas implicadas en la tarea refleja un coste de cambio asimétrico en los aprendices de L2 pero no en los bilingües muy competentes. Tras estos resultados contradictorios es necesario plantearse a qué se debe la conducta diferencial entre bilingües y aprendices de L2.

9.3.5 ¿Cuál es el origen de los diferentes patrones de cambio de lengua en aprendices de L2 y bilingües competentes?

Es posible que, como se ha comentado anteriormente, los bilingües competentes realicen la tarea de selección léxica sin la necesidad de apelar a ningún tipo de proceso inhibitorio. La hipótesis de la selección específica de lengua (Costa et al., 1999; véase el apartado de Introducción), que asume que el acceso al léxico no requiere de control inhibitorio, puede dar cuenta de los resultados obtenidos por este tipo de bilingües. En este marco, se puede plantear una explicación de los resultados en la que se asume que los bilingües competentes han desarrollado un mecanismo de selección léxica que es sólo sensible al nivel de activación de las palabras en el idioma deseado. Dado que las palabras del otro idioma no actúan como competidores, no es necesaria la supresión de la activación (por medio de inhibición) de ese lexicón. Es posible que cuando un hablante no tiene un nivel de competencia similar en ambos idiomas, la selección léxica haga uso del control inhibitorio para asegurar la selección de la lengua deseada. Sin embargo, cuando este nivel pasa a ser comparable, podría plantearse la existencia de un cambio cualitativo en el tipo de procesos de selección léxica utilizados por los bilingües. En este escenario, los bilingües competentes habrían pasado de utilizar procesos inhibitorios a utilizar un mecanismo de selección específico de lengua (Costa et al., 1999). Y, lo que es más importante, uno pensaría que, una vez adquirido el nuevo mecanismo de selección, éste funcionaría tanto sobre las lenguas dominantes del bilingüe (L1 y L2), como sobre su lengua más débil (e.g., L3). Es decir, puesto que los bilingües competentes no utilizan mecanismos inhibitorios en la realización de tareas de cambio de lengua, éstos no deberían mostrar costes de cambio asimétricos en ningún contexto.

Sin embargo, existe un escenario lingüístico en el que el mecanismo de selección específica de lengua podría no ser funcional para los hablantes bilingües. Este contexto se daría cuando en la tarea de cambio de lengua toma parte un idioma cuyo lexicón no se encuentra claramente establecido. Esto se debe a que una de las características de este mecanismo es que asegura la selección léxica focalizando la atención sobre las palabras de la lengua de respuesta. Sin embargo, podría ser que un requisito para poder focalizar la atención sobre la lengua de respuesta fuera que el lexicón de la misma estuviese bien establecido. Sin embargo, si las palabras de la lengua de respuesta no se encuentran aún apropiadamente establecidas, podría ser que la funcionalidad del mecanismo de selección específica de lengua se viera limitada, por lo que los bilingües deberían hacer uso de los mecanismos de control inhibitorio. Para explorar esta posibilidad realizamos dos experimentos en los que la competencia de una de las dos lenguas implicadas es muy limitada, y, por lo tanto, en la que presumiblemente el lexicón aún no está bien establecido.

En el experimento 10 testamos la actuación de un grupo de bilingües de español-catalán realizando la tarea de cambio de lengua en dos idiomas en los que son poco (L3: inglés) y muy poco competentes (L4: francés). Es decir, aprendices de L3 (al igual que los participantes de los experimentos 8 y 9), que recientemente han comenzado a aprender una L4: francés. Varios estudios demuestran que los hablantes bilingües pueden controlar de forma muy eficiente la potencial interferencia de su L1, pero les resulta más difícil cuando se trata de un idioma menos competente (p. ej., los hablantes trilingües muy a menudo presentan interferencia de su L2 (pero no de su L1) mientras hablan en su L3: De Angelis y Selinker, 2001; Ringdom, 2001; Williams y Hammarberg, 1998). Por lo tanto, este contexto en el que el bilingüe denomina dibujos en dos lenguas en las que tiene baja competencia parece un contexto adecuado para explorar qué mecanismos utilizan los bilingües para evitar la interferencia de la lengua no deseada.

Los resultados obtenidos en el experimento 10 muestran que, (1) la magnitud del coste de cambio de lengua fue mayor para la L3 que para la L4 (coste asimétrico); y (2) las latencias de respuesta fueron mayores en L4 (francés) que en L3 (inglés) (véase Figura 8). Por lo tanto, esta es la primera vez en la que se observa un patrón de cambio asimétrico en la conducta de los bilingües competentes al realizar una tarea de cambio de lengua. Siendo así, parece ser que el mecanismo de

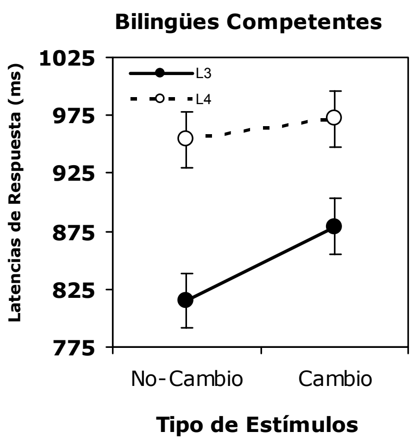


Figura 8. Patrón de cambio de lengua de los bilingües competentes de español-catalán en L3-inglés y L4-francés (Experimento 10).

selección específica desarrollado por este tipo de bilingües tan solo es funcional cuando el lexicón de las dos lenguas implicadas en la tarea de cambio de lengua está bien establecido. Sin embargo, en este experimento, ninguna de las dos lenguas que los bilingües habían de producir era una de sus dos lenguas dominantes. Por lo tanto, la no funcionalidad del mecanismo de selección específica de lengua podría verse afectada por esta especial situación.

En el experimento 11 se solicita a un grupo de monolingües de español y a un grupo de bilingües competentes de español-catalán que aprendan 10 palabras en una "Nueva-Lengua", para, a continuación, pedirles que realicen una tarea de cambio de lengua entre su L1 y la recién aprendida "Nueva-Lengua". De esta manera, investigamos cual es la actuación de los bilingües competentes cuando cambian entre una lengua competente y otra cuyo lexicón no está bien establecido. La actuación de estos bilingües es asimismo comparada con la de un grupo de monolingües aprendices de L2 ("Nueva-Lengua").

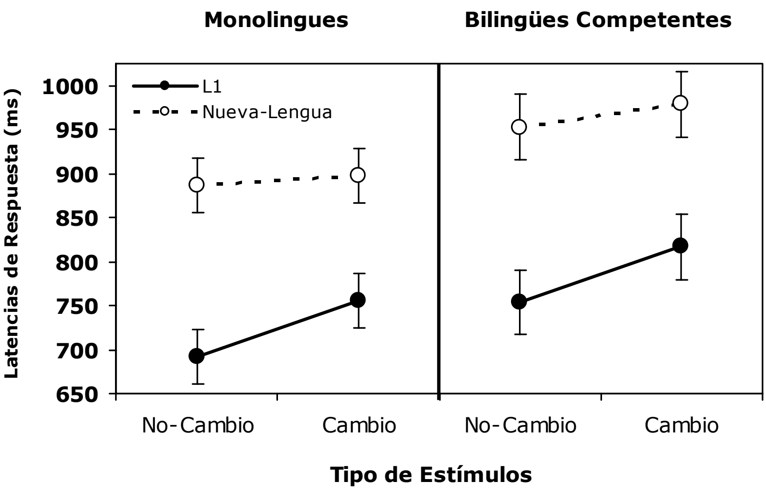


Figura 9. Patrones de cambio de lengua de monolingües de español (derecha) y bilingües competentes de español-catalán realizando la tarea de cambio en L1-español y en la recién aprendida "Nueva-Lengua" (izquierda) (Experimento 11).

Los resultados en este experimento son claros: (1) la magnitud del coste de cambio de lengua fue mayor para la L1 que para la "Nueva-Lengua" tanto para el grupo de monolingües como para el grupo de bilingües (coste asimétrico); y (2) ambos grupos mostraron latencias de respuesta más lentas en la "Nueva-Lengua" que en L1 (véase Figura 9). Por lo tanto, en este experimento replicamos el patrón de cambio de lengua asimétrico mostrado por los bilingües competentes en el experimento 10, y, por primera vez, encontramos que, en una tarea de cambio de lengua, tanto aprendices de L2 (monolingües) como bilingües competentes se comportan de la misma manera. En resumen, esta observación parece sugerir la existencia de ciertos límites en el funcionamiento del mecanismo de selección específico de lengua desarrollado por los bilingües.

9.4 DISCUSIÓN GENERAL

El principal objetivo de esta tesis ha sido investigar la naturaleza de los mecanismos de control que permiten a los hablantes bilingües acceder a las representaciones léxicas de la lengua de respuesta mientras evitan la interferencia de las palabras de la lengua de no-respuesta. Para ello, hemos presentado una serie de experimentos en los que se ha explorado el patrón de cambio de lengua mostrado por diferentes grupos de bilingües. Los principales resultados pueden ser resumidos de la siguiente manera:

En lo que respecta a los grupos de **aprendices de L2**, para todos ellos se observan ***patrones de cambio asimétricos***, independientemente del estado cognado de las palabras (Experimentos 1 vs. 5), o de si en la tarea está implicada una lengua en la que se encuentran en los primeros estadios de adquisición (Experimento 11).

Sin embargo, los resultados obtenidos para los diferentes grupos de **bilingües competentes** muestran un cuadro más complejo. Esto se debe a que, en primer lugar, los bilingües competentes muestran ***patrones de cambio simétricos*** cuando...

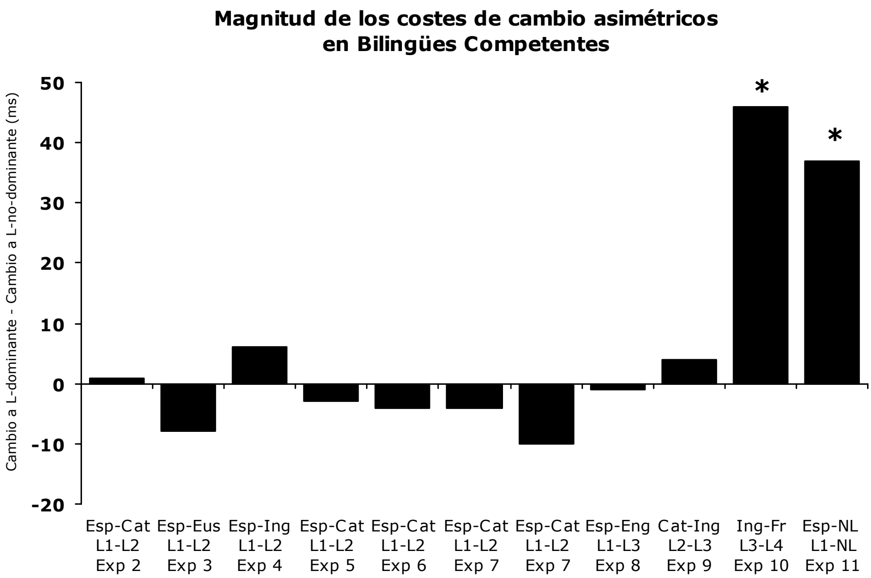


Figure 10: Magnitud de la diferencia de costes de cambio de las dos lenguas implicadas en varios experimentos de cambio de lengua realizados por bilingües competentes. Los datos de cada columna corresponden a los Experimentos 2, 3, 4, 5, 6, 7 (Grupos 1 y 2), 8, 9, 10 y 11, respectivamente.). Las diferencias significativas (p<.01) entre la magnitud del coste de cambio a L1 y L2 están señaladas mediante un asterisco (*).

(a) ...los niveles de competencia adquiridos entre las dos lenguas implicadas en la tarea son similares y cuando son diferentes (Experimento 2 vs. Experimentos 8 y 9)

(b) ... las lenguas implicadas en la tarea son muy similares (español-catalán) y cuando son muy diferentes (español-euskara) (Experimento 2 vs. Experimento 3)

(c) ... la L2 ha sido adquirida en edad temprana y cuando ha sido adquirida en edad tardía (Experimento 2 vs. Experimento 4)

(d) ... las palabras que se han de producir son no-cognadas y cuando son cognadas (Experimento 5)

(e) ... la L1 está implicada en la tarea y cuando no lo está (Experimentos 2, 3, 4, 5, 6, 7 y 8 vs. Experimento 9)

Por el contrario, cuando en la tarea de cambio está implicada una lengua en la que los bilingües competentes se encuentran en sus primeros estadios de adquisición, éstos muestran ***patrones de cambio asimétricos*** (Experimentos 10 y 11) (véase Figura 10).

Finalmente, en aquellos casos en los que los bilingües muestran patrones de cambio simétricos, se observa un resultado extremadamente sorprendente: un efecto de ventaja de L2 sobre L1 en el que se encuentran latencias de respuesta más rápidas en L2 que en L1.

9.4.1 De aprendiz de L2 a bilingüe competente: un paso hacia los mecanismos de selección específica de lengua.

En base al presupuesto de que un patrón de cambio de lengua asimétrico refleja el uso de mecanismos de control inhibitorio durante la producción del habla (Green, 1998), los resultados de este trabajo evidencian el uso de procesos de control inhibitorio por parte de los aprendices de L2. Sin embargo, tal y como acabamos de mostrar, los resultados obtenidos para los bilingües competentes reflejan un cuadro más complejo, puesto que estos bilingües muestran patrones de cambio tanto simétricos como asimétricos. Aparentemente estos resultados plantean un problema para el modelo CI, ya que, aunque éste predice patrones de cambio de lengua simétricos cuando la tarea se realiza en dos lenguas en las que el bilingüe es competente, el modelo CI plantea patrones asimétricos cuando el bilingüe realiza la tarea en dos lenguas de diferente nivel de competencia. Como se ha observado en los experimentos 8 y 9, este último postulado no se cumple. Pero, siendo así, ¿cómo se puede dar cuenta de estos resultados?

9.4.1.1 El cambio de mecanismos de selección de lengua

La actuación de los bilingües competentes al realizar cambios de lengua entre una de sus lenguas dominantes (L1 o L2) y una lengua en la que no son muy competentes (L3) contrasta enormemente con la actuación de los aprendices de L2. Por lo tanto, uno podría asumir que estas diferencias radican en el hecho de que, puesto que los bilingües utilizan con gran frecuencia ambas lenguas, éstos han podido desarrollar mecanismos de control inhibitorio diferentes a los de los aprendices de L2. Por ejemplo, podría ser que utilizaran mecanismos de inhibición no reactivos, es decir, mecanismos que no dependiesen del nivel de competencia adquirido en cada lengua. Por lo tanto, los bilingües competentes inhibirían ambas lenguas por igual, y de ahí los costes de cambio simétricos. Sin embargo, como veremos más adelante, es difícil casar esta propuesta con el efecto de ventaja de L2 sobre L1 encontrado para estos bilingües.

No obstante, otro posible modo de explicar la diferente actuación de aprendices de L2 y bilingües proficientes es asumir que ambos tipos de bilingües hacen uso de mecanismos de selección cualitativamente diferentes. En este sentido, se postula que los bilingües competentes han desarrollado un mecanismo de selección léxica que tan solo es sensible a los niveles de activación de las representaciones de la lengua de respuesta. Es decir, asumimos que los hablantes bilingües desarrollan un mecanismo de control como el propuesto por Costa y colaboradores (1999), según el cual para los bilingües competentes el nivel de activación de las palabras de la lengua de no-respuesta no competiría en los procesos de selección léxica. Por lo tanto, los bilingües competentes no precisan de mecanismos inhibitorios para evitar la interferencia masiva de la lengua de no-respuesta durante los procesos de acceso léxico. En definitiva, en la presente tesis argumentamos que el origen de las diferencias en el patrón de cambio de lengua entre aprendices de L2 y bilingües competentes es que, **mientras los aprendices de L2 utilizan mecanismos de control inhibitorio, los bilingües competentes utilizan mecanismos de selección específicos de lengua**. Sin embargo, los resultados observados en los experimentos 10 y 11 sugieren que, cuando no se cumplen los requisitos mínimos necesarios para que este mecanismo funcione correctamente (por ejemplo, cuando han de hablar en una lengua que aún están aprendiendo y cuyo lexicón no está bien establecido), los bilingües competentes son capaces de utilizar mecanismos de control inhibitorio, mostrando así cierta flexibilidad en el uso de los mecanismos de control atencional.

9.4.2 El efecto de ventaja de L2 sobre L1

Tal y como hemos mostrado a lo largo de esta tesis, en las tareas de cambio de lengua, los bilingües competentes revelan un efecto inesperado de ventaja de L2 sobre L1 en la denominación. A este respecto, en el experimento 7 exploramos la posibilidad de que este efecto sea debido a una estrategia de preferencia de lexicalización en L2. Sin embargo, los resultados observados no se adecuan a esta interpretación del efecto ya que cuando se les presenta una pista de lengua que antecede cada dibujo a nombrar (y, por lo tanto, saben con antelación cuál será la lengua de respuesta) la ventaja de L2 sobre L1 no desaparece.

A primera vista, uno podría argumentar que el efecto surge debido a que las representaciones de la lengua dominante (L1) son inhibidas en mayor medida que las de la lengua no-dominante (L2 o L3), por lo que las latencias de respuesta para las palabras en L1 son más lentas. Sin embargo, si observamos más atentamente los resultados, la ventaja de L2 sobre L1 tan solo aparece en aquellos casos en los que los bilingües muestran patrones de cambio simétricos, mientras que no aparece cuando muestran patrones asimétricos. Por lo tanto, asumiendo que la asimetría muestra la diferente cantidad de inhibición aplicada sobre las representaciones léxicas de cada lengua, esta explicación no puede dar cuenta de la ausencia de patrones de cambio asimétricos en bilingües competentes. Sin embargo, existe otra posible explicación del efecto de ventaja de L2 sobre L1.

9.4.2.1 La hipótesis de umbral específico de lengua

La accesibilidad de las palabras es uno de los factores determinantes en la velocidad con la que éstas son producidas, por lo que uno esperaría que las palabras de L1 fueran más accesibles que las de L2, y, por lo tanto, fueran producidas con mayor rapidez (al menos en contextos de denominación monolingües). Sin embargo, en tareas de cambio de lengua, los bilingües podrían tratar de igualar el nivel de accesibilidad de ambas lenguas haciendo más accesibles las palabras de la lengua más débil. Por ejemplo, se podría argumentar que, en base al tipo de tarea que los bilingües han de realizar, éstos son capaces de manipular de manera independiente el criterio de selección léxica que cada lengua debe seguir (véanse, Lupker, Brown y Colombo, 1997; Lupker, Kinoshita, Coltheart y Taylor, 2003; Meyer, Roelofs y Levelt, 2003). Por ejemplo, los bilingües podrían determinar que el umbral de activación mínimo necesario para que una palabra sea seleccionada sea más bajo para las palabras de L2 que para las de L1. De esta manera, el tiempo necesario para seleccionar las palabras de L2 sería menor que el necesario para seleccionar las de L1, originando un efecto de ventaja de L2 sobre L1.

Cabe recordar que los efectos de ventaja de L2 sobre L1 tan solo han sido reportados en aquellos casos en los que los bilingües competentes muestran patrones de cambio simétricos. Por lo tanto, uno podría argumentar que en aquellos casos en los que los bilingües utilizan mecanismos de selección específicos de lengua, quizá también sean capaces de establecer diferentes umbrales de selección para cada una de sus lenguas. Indudablemente, esta no es más que una posible explicación de los efectos encontrados que debería ser detalladamente estudiada en futuras investigaciones.

9.4.3 Sobre el origen del efecto cognado

En el experimento 5 hemos investigado si el estado cognado de las palabras modula el patrón de cambio de lengua de los bilingües. Tal y como ya mencionamos anteriormente, existen tres hipótesis principales que pretenden dar cuenta del origen del efecto cognado: las hipótesis semántica, léxica y fonológica. Nuestro experimento no fue diseñado para investigar cuál de estas hipótesis es correcta, por lo que no podemos aportar datos en favor de ninguna de ellas. Sin embargo, los resultados sí que aportan cierta evidencia en contra de la hipótesis léxica. Esto se debe a que, tal y como comentamos en el apartado 3.1.2, de acuerdo con la hipótesis léxica, las palabras no-cognadas tienen representaciones léxicas diferentes, mientras que las palabras cognadas comparten una única entrada léxica. Por consiguiente, de acuerdo con esta hipótesis, en una tarea de cambio de lengua los costes de cambio deberían ser menores para las palabras cognadas que para las no cognadas. Además, dado que las palabras cognadas comparten la misma entrada léxica, ésta no podría ser inhibida, por lo que los aprendices de L2 no deberían mostrar patrones de cambio asimétricos. Sin embargo, los resultados de los grupos de aprendices de L2 y bilingües competentes muestran que el estado cognado de las palabras no modula el patrón de cambio de lengua. Consiguientemente, estos resultados rechazan los postulados de la hipótesis léxica.

Ni la hipótesis semántica ni la hipótesis fonológica asumen diferencia alguna en el modo en el que las palabras cognadas y las no-cognadas están representadas a nivel léxico, por lo tanto, nuestros datos no pueden hacer distinciones en la idoneidad de ninguno de estos dos planteamientos (sin embargo, véase Costa et al., 2005, para una discusión sobre este tema).

9.4.4 Conclusiones

Los hablantes bilingües requieren de un mecanismo de control que les permita realizar el proceso de lexicalización en una sola de sus lenguas mientras previenen la interferencia masiva de sus otras lenguas. Los datos reportados a lo largo de la presente tesis indican que los mecanismos de control utilizados por aprendices de L2 y bilingües competentes son cualitativamente diferentes. Concretamente, se postula que el incremento en el nivel de competencia de L2 permite a los bilingües desarrollar mecanismos de control que no requieren el uso de procesos inhibitorios. Esto es, mientras los aprendices de L2 utilizan mecanismos de control inhibitorios (Green, 1998), los bilingües competentes utilizan mecanismos de control específicos de lengua (Costa et al., 1999). Lo que es más, los bilingües competentes hacen uso de estos mecanismos de selección específica de lengua incluso cuando han de procesar una lengua en la que no son altamente competentes (e.g., su L3). Sin embargo, en aquellos casos en los que los mecanismos de selección específica de lengua no son funcionales (e.g., cuando los bilingües han de hablar en una lengua cuyo lexicón aún no está apropiadamente establecido), los mecanismos de control de los bilingües competentes son capaces de utilizar mecanismos de control inhibitorios. En definitiva, este estudio muestra que el bilingüismo afecta considerablemente al tipo de mecanismos cognitivos utilizados por los hablantes.

En relación a los postulados aquí presentados, existe también un interesante debate acerca de las consecuencias (positivas y/o negativas) que el bilingüismo puede acarrear en un individuo. En este sentido los estudios de Bialystok y colaboradores son especialmente relevantes, ya que han mostrado que el bilingüismo afecta positivamente en el desarrollo y deterioro de los procesos implicados en el control ejecutivo. Esta autora argumenta que los niños bilingües muestran un desarrollo de los procesos de control (atención selectiva, inhibición atencional, cambio de tareas alternativas) más rápido que el de los niños monolingües, mientras que ambos grupos muestran un desarrollo de los procesos de representación (codificación de problemas, acceso a conocimiento relevante, realización de inferencias lógicas) similar (Bialystok, 1999; 2005). Además, Bialystok muestra que el bilingüismo ayuda a contrarrestar el deterioro de ciertos procesos de control ejecutivo relacionados con el envejecimiento, atenuando el decline de la eficiencia de los procesos inhibitorios (Bialystok, Craik, Klein, y Viswanathan, 2004).

Todos estos resultados sugieren que ser un hablante competente de una segunda lengua tiene efectos importantes en los procesos de control atencional generales del individuo. En este trabajo mostramos que, al menos en tareas lingüísticas, estos efectos conllevan cambios cualitativos en el tipo de mecanismos de control utilizados por estos individuos. Sin embargo, ¿son estos cambios cualitativos en los procesos de control generalizables a dominios cognitivos generales? Son las investigaciones futuras las que deberán dar respuestas a este tipo de preguntas.