2013

When More Is Less: The Effect of a Third Language on a Second Language

Jamile M. Forcelini

THE FLORIDA STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

WHEN MORE IS LESS:

THE EFFECT OF A THIRD LANGUAGE ON A SECOND LANGUAGE

By:

JAMILE M. FORCELINI

A Thesis submitted to the
Department of Modern Languages
and Linguistics in partial fulfillment of
the requirements for the degree of
Master of Arts

Degree Awarded:
Spring Semester, 2013

Jamile M. Forcelini defended this thesis on March 25, 2013.

The members of the supervisory committee were:

Gretchen Sunderman
Professor Directing Thesis

Michael Leeser
Committee Member

Peggy Sharpe
Committee Member

The Graduate School has verified and approved the above-named committee members.

ACKNOWLEDGMENTS

I would like to thank Dr. Gretchen Sunderman for being an outstanding mentor and for guiding me throughout this process. I would like to thank her for all the support and guidance I have received from her that enabled me to succeed. The topic of this thesis was generated in my first class on Psycholinguistics with Dr. Sunderman in my first semester as a graduate student at Florida State University. She showed me enthusiasm and encouraged me to engage in developing my MA thesis. Her patience while guiding me through difficult moments has certainly played a key role towards my academic achievements. In addition, her enthusiasm when seeing me evolve in this process has also provided me with strength to continue what I have committed to accomplish.

I am also truly grateful for the support I have received from my other professors and committee members that assisted me to develop academic skills and knowledge to tackle this challenge: Drs. Leeser, Sharpe, Reglero and Galeano.

I also would like to thank my fellow classmates and co-workers Raquel Prieta, Silvia Sollai, Eileen Fancher, Jose Vidal, Kate Wesolek, Kristina Tulak, Vivianne Asturizaga, Alberto López, Doris Gilliam, Jeff Giere, Riccardo Lisi, Jeremy Kasten, Christine Michelle, Liset Cruz Garcia, Daphne Browning, Maria Elena Villagrana and Elena Belkin that assisted me with programming, recruiting participants, participating in the study and analyzing information that I would not have had the chance to do on my own.

Finally I must thank my brother Diogo, my mother Elisabete, my aunts Iara and Elza and my close friends for all their kind support and encouragement that allowed me to accomplish one more project in life and succeed in graduate school.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
ERP	Event Related Potential
L1	First/Native Language
L2	Second Language
L3	Third Language
L4	Forth Language
LHQ	Language History Questionnaire
LDT	Lexical Decision Task
RPOR	Real words in Portuguese
RSPN	Real words in Spanish
NIPOR	Near identical words in Portuguese
NISPN	Near identical words in Spanish
NWSPN	Nonce words in Spanish
NWPOR	Nonce words in Portuguese
NWG	Non words from German
NWB	Non words from Basque
RSWL	Real words in Spanish Word Length
RPWL	Real words in Portuguese Word Length
NISWL	Near identical words in Spanish Word Length
NIPWL	Near identical words in Portuguese Word Length
NWSPWL	Nonce words in Spanish Word Length
NWPWL	Nonce words in Portuguese Word Length

WGWL Non Words from German Word Length

WBWL Non Words from Basque Word Length

ABSTRACT

Previous research (Van Heste, 1999; Van Hell & De Groot, 1998; Van Heuven, Dijstra & Grainger, 1998) has shown word comprehension behaves in a non-selective fashion and that bilinguals show sensitivity to one language's word features during word processing in another language. The majority of the previous studies have focused on investigating how lexical processing occurs among bilinguals. The present study explores how trilinguals process words in comparison to bilinguals. In addition it focuses on observing how trilinguals process words in typological similar languages such as Spanish and Portuguese.

In this study, a group of bilingual speakers (n=54) (First Language (L1) English and Second Language (L2) Spanish) and a group of trilingual speakers (n=66) (L1 English/Spanish, L2 Spanish/English, L3 Portuguese) completed a lexical decision task in Spanish. The stimuli in the experiment were manipulated to appear similar to words in various languages. The logic was to test whether the presence of a third language would affect processing in a second language. Participants were exposed to real and pseudo words in 8 different categories divided by 4 languages (Spanish, Portuguese, German and Basque) and their task was to decide whether the words presented were real Spanish words. Reaction times and accuracy were analyzed among both groups and across word type.

It was predicted that trilingual participants would show sensitivity to words in Spanish and Portuguese (real and pseudo words) and would present longer reaction times and less accurate results to process words in Portuguese or resembling Portuguese because of the parallel activation of the L3. The results indicate that the activation of Portuguese affected the ability of trilinguals to judge words in Spanish. Moreover, the additional language activation of Portuguese affected trilinguals' ability to simply accept words in Spanish as real words. In other

words, the L3 affected the L2 in a detrimental way. Additional analysis investigating language learning factors (such as heritage speaker status and polyglot status) shed some light on the complexity of the L3 effect present in the trilingual population. The present findings are analyzed in light of Van Heuven and Dijkstra's (1998) model of Bilingual word recognition (BIA).

CHAPTER 1

INTRODUCTION

It is commonly known today that when bilinguals read in either their first language (L1) or their second language (L2), words from both languages are unconsciously and automatically activated in their mind. The cross-language activation in the bilingual mind is then something that must be negotiated in the psycholinguistic sense. How do bilinguals successfully recognize words from different languages? What cues help a bilingual distinguish words from different languages? At a basic level, De Groot (2011) describes word recognition as a two-stage process. In the first stage, one must find a single match between a written/spoken word and its orthographical/phonological features stored in memory. In the second stage, one must match syntax and morphology and, finally, retrieve meaning. Indeed, various psycholinguistic models capture word recognition processes in monolinguals and bilinguals.

The BIA Model

De Groot's (2011) description of word recognition can be combined with Van Heuven and Dijkstra's (1998) bilingual interactive activation model (BIA). The BIA model is used to demonstrate how the process of bilingual word activation and retrieval takes place, and it has been able to account for the major findings that relate to processing costs that cause delay in word recognition while bilinguals encounter words such as interlexical homographs. Interlexical homographs are words found in different languages that share the same form but carry different meanings (e.g., Portuguese *pasta* "file", and English *pasta*).

There are four different levels of representation units present in the BIA model that demonstrate, in a bottom-up direction, what specific components get activated when bilinguals process words in different languages. First, the features that compose each letter present in a word will be activated and,

subsequently, they will stimulate the activation of full letters that do not yet belong to one single language. When full words get activated in a bilingual brain, language subsets of each language host their words but do not prohibit similar words belonging to different languages to compete for activation. Finally, phonological and morphological characteristics[1] dictate what language a word belongs to, thereby suppressing other languages.

Figure 1, below, which was adapted from Van Heuven and Dijkstra's (1998) BIA model, attempts to show the steps a Portuguese-English bilingual speaker would go through when processing the word *sand* in English. The first step in visual word recognition starts with the activation of the features of each letter that composes the word *sand*. In other words, as a bilingual sees the letters *s, a, n* and *d,* the features that form each letter will excite possible matching letter features pre-stored in a bilingual's mind. Following feature activation, the next step is letter activation. A similar process of previous feature activation takes place as a bilingual processes the letters seen and matches them with pre-stored letter nodes. At this point bilinguals will not yet have distinguished any letters or letter features as belonging to one specific language and not the other. This occurs later, as bilinguals move forward into processing of whole words and start dealing with substantial competition between languages in the lexicon. So, when the word *sand* is activated in English, not only neighbors of the word *sand* in English will be activated, such as *hand*, *sane* and *sank*, but also cross-language neighbors[2] in Portuguese such as *banda* "band", *santo* "saint" and *tanto* "so much". Finally when cross-language neighbors of the English word *sand* are excited, a bilingual's last step in word processing is to associate the word *sand* to the language to which it belongs. Thus, the language the bilingual does not wish to activate (Portuguese in

[1] The BIA model does not specify how semantic, orthographical and phonological features are specifically activated, for more information on how these types of activation occur during word processing see the models BIA+ and SOPHIA from Van Heuven and Dijkstra (2001) and Van Heuven and Dijkstra (2002).

[2] Neighbors are considered words that display common orthographical and phonological characteristics within the same language. Cross-language neighbors share the same common orthographical and phonological characteristics across different languages.

this case) is suppressed and so are all the cross-language neighbors that belong to that language. A bilingual is now fully capable of processing the English word *sand* and its meaning.

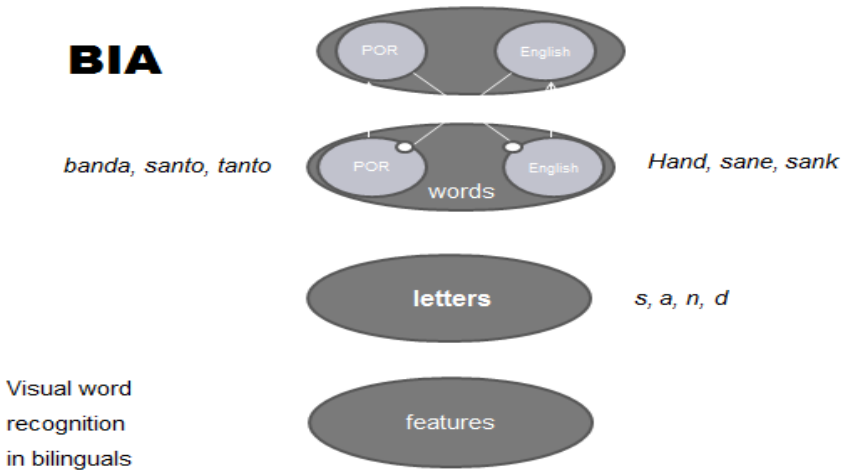

Figure 1. Adapted from the bilingual interactive activation model (BIA) from Van Heuven and Dijkstra (1998)

Some of the studies that support the BIA model were conducted by Grainger and Dijsktra (1992) with French-English bilinguals who reacted to three different sets of words in a lexical decision task. A lexical decision task is a task that asks a participant to judge a string of letters and decide whether the string of letters is a real word or not. Participants presented longer reaction times when processing words that had a higher number of lexical neighbors in the non-target language. A neighbor is generally defined as a word that is similar in spelling to another word, except for one letter, respecting position. In addition, a study by Bijeljac-Babic, Biardeau and Grainger (1997) that also analyzed French-English bilinguals performing a masked priming task[3] with target words in French preceded by primes in English. A priming technique investigates possible connections between a bilingual's lexicon and how the activation of a semantic, orthographical or phonological related word (prime) would interfere on the activation of a subsequent word in a different language. Results show longer reaction times for target

[3] Masked priming task: According to De Groot (2011), a masked priming task consists on the presentation of a target word after a semantically related word, a neutral or unrelated word.

words preceded by English similar orthographical primes and demonstrate the impact one language can cause on another due to their closely intrinsic cognitive connections.

Language Selective versus Non-Selective Access

In order to better understand how word recognition takes place it is important to account for how a bilingual's lexicon is organized, and how words in different languages are stored, retrieved and activated. The field of psycholinguistics has focused on investigating whether bilinguals organize and store words in their lexicon in a shared fashion or whether words that belong to different languages are stored separately.

Several comparisons between both monolingual and bilingual language processes have been carried out in order to verify if bilinguals are capable of isolating only one lexicon, the one composed by vocabulary of the language the speaker desired to use in a specific monolingual speech act. In these cases, bilinguals should not present any interference from the language they do not wish to activate because isolation of only one language would prevent interference of the non-target language, causing vocabulary retrieval to be selected depending on the language to which it belongs. This is known as language selective access.

Evidence that language-selective access is possible comes from studies developed by Gerard and Scarborough (1989), with English-Spanish bilinguals compared to English monolinguals while performing a lexical decision task that contained high and low frequent cognate and non-cognate words in both languages. Cognates serve as a key tool to investigate the interaction between the lexicon of bilinguals because most, if not all, phonological, semantic and orthographical features are shared between both languages. This allows scholars to verify if simultaneous word activation is possible based on the word features described above. Results did not demonstrate significant differences between

bilinguals and monolinguals. In other words, there was not a processing cost while bilinguals activated cognates due to a possible simultaneous activation.

Later on, Jared and Szucs (2002) developed an overt word naming task with English-French bilinguals. They discovered that English word naming did not suffer language (French) interference if a French overt reading session was preceded by the actual English word naming. Such findings support the idea of a bilingual's lexicon being organized in a non-integrative way, allowing bilinguals to properly access and select words from one language without the interference of the other, regardless of its nature (cognate, neighbors) or source (language).

On the other hand, language-nonselective access claims that words in both languages within the bilingual's mental lexicon are activated in parallel fashion. That is to say, bilinguals are unable in some sense to shut off the activation of the other language, even if it is not necessarily needed at that moment. Depending on the nature of the word (cognate, cross-language neighbors and interlingual homographs), other potential interference factors such as phonological and morphological features of each word might come into play during word recognition, causing bilinguals to excite multiple words from different languages at the same time.

Evidence that language nonselective access is possible comes from studies developed by De Moor (1998) and Van Heste (1999) with Dutch-English bilinguals performing a lexical decision task. Longer RTs were observed in instances where English homographs proceeded Dutch words. Because homographs share form and have identical spelling but have different meanings across languages, a delay in word processing shows that both and different meanings attached to the homograph in two different languages are active and competing for selection.

Grainger & Dijkstra (1992) analyzed how French-English bilinguals reacted to three different types of words on a lexical decision task. There were words referred to as "patriots" that presented more instances of neighbors, such as the words *band* and *land* which share most of their morphological and

phonological characteristics in English. Words referred to as "traitors" presented more instances of cross-language neighbors in French. Finally a third group composed by "neutral" words that did not present any neighboring effects was also included in the experiment. Bilinguals presented longer RTs in the "traitors" condition showing that there is a processing cost in one language (English) caused by cross-language neighbors in the non-target language (French).

Thus, if a bilingual's mental lexicon is organized non-selectively, it is important to verify to what extent one language can influence another in a bilingual brain. In what direction does this influence take place and what are the factors that promote or hinder language influence?

According to De Groot (2011), when bilinguals are immersed in both comprehension and production tasks, both language subsystems are triggered. As a result, bilinguals engage in a constant process of activating the language they choose to speak in a predetermined environment and suppressing the language they don't wish to use at that time. This allows bilinguals to successfully function in a monolingual setting while speaking only one language.

The constant juggling process bilinguals engage in is supported by the notion of language subsets in a bilingual brain. Such rather automatic change is only possible based on the idea that all languages are subdivided in organized settings called language subsets. Each language subset is related to only one language and therefore is responsible for holding all distinct sources of linguistic knowledge (syntactical, morphological, semantic, phonological and lexical). Such *standardized* ordered devices allow bilinguals to successfully utilize their languages separately and systematically.

Word Activation Factors

There are several factors that may contribute to a bilingual's lexicon activation. Some of the elements that may play a crucial role in this activation process are the degree of proficiency a bilingual

presents in an L2 that might also be directly correlated with the degree of interference and activation a L1/L2 has. The nature of one word and more specifically its relationship to a bilingual's L2/L3 can also cause a word to be highly activated. If languages share words composed by similar or identical morphological and/or phonological features such as cognates or neighbors, parallel activation might take place in both languages (Van Hell and Dijkstra, 2002). Pseudo cognates that share written or spoken features in a different language but do not share the same meaning (De Groot, 2011) may also activate similar words that belong to different languages (Spanish *éxito,* "success", and English *exit*). Alternatively, words that do not share the same meaning might also be activated due to orthographical and phonological features they share with words that belong to another language (Spanish *playa* and English *plier*).

Diaz, Kroll & Schwartz (2007) analyzed a group of Spanish-English bilinguals while naming visually presented cognates and non-cognates out loud that shared orthographical and phonological similarities. Such similarities delayed cognate recognition and naming, showing that simultaneous activation of cognates in both Spanish and English can be the reason for the delay of the word retrieval and access in both languages and the final selection of only one language. This presents positive evidence for language non-selective access.

According to De Groot(2011), research on bilingual word processing has evolved from monolingual studies that once focused on lexical ambiguity whose ultimate goal was to define the nature of word retrieval (selective versus non-selective), as we have seen. Grainger & Beauvillain (1987) analyzed interlexical homographs by applying a cross-language primed lexical decision task in English with words primed beforehand in French. Their results suggested that interlexical homographs facilitate processing of the later English word (French primed word: *coin*, corner; subsequent English word *money).* Although the word corner in French (*coin*) does not share semantic features with the word

money in English, lexical access of the target word was still facilitated because the word *coin* in French triggered *coin (nickel)* in English, which is semantically related to the word money.

Conversely, Kerkhofs et al. (2006) focused on semantic priming within the same language while analyzing behavioral and brain responses (ERPs). Both unprimed interlexical homographs and unilingual control words were used, proving existence of interference of non-target language homograph activation without any source of priming.

After examining the major findings in the literature in regards to word processing and activation in monolinguals and bilinguals, a series of questions can be addressed and extended to a trilingual population. Do trilinguals face a similar task when processing words? Do they process words differently depending on the order in which they acquired different languages, or depending upon which language a specific word belongs to? Does the degree of language influence (facilitative or inhibitive) affect languages learned subsequently and occur only from an L1 influence towards L2 or L3 processing? Or, can a trilingual's L2/L3 language become influential during L1 language processing? Do trilinguals benefit from language typological similarities in order to process cognate and non-cognate words?

Few studies have been conducted that attempt to investigate the degree of effect a non-target language lexicon imposes on the target language in trilinguals and polyglots. Lemhöfer, Dijkstra and Michel (2004) studied a group of Dutch-English-German trilinguals performing a lexical decision task (LDT) with "double" cognates (cognates in only two languages) in Dutch and German, "triple" cognates in all three languages as well as control words in German. Results displayed faster RTs for double cognate recognition and even faster RTs while trilinguals were processing "triple" cognates. Therefore, Lemhöfer, Dijkstra and Michel (2004) were able to confirm that not only a trilingual's L1 influences L2 word processing, but that a non-target language (L2/L3) may also influence the processing of target words. Lemhöfer, Dijkstra and Michel's (2004) findings also corroborate the results of Flynn et al.

(2004), who claim that all previously known languages can influence the processing and acquisition of subsequent languages.

The present investigation is based on a study developed by Van Hell and Dijkstra in 2002 that attempted to explore the impact of L2/L3 language knowledge on language performance in specific native language contexts.

Dutch (L1), English (L2), and French (L3) trilinguals with different levels of proficiency were analyzed while performing association and lexical decision tasks composed of English and French cognates and noncognates (experiment 1) and pseudo words (experiment 2 and 3). A total of 58 learners participated in the study. The learners participated in three different experiments: 19 students in experiment 1; 18 students in experiment 2; and 21 students in experiment 3. The first experiment required students to perform a word association task. Participants had to say the first word they could retrieve that resembled the word seen on the computer screen. During the second and third experiment, participants were asked to perform a lexical decision task in which they would see a word on the screen and either reject or accept the given word as being a word in English, French or Dutch. Participants completed a language proficiency test after performing the word association and lexical decision task.

Two key characteristics of this study are related to participants' exposure to a third language and their proficiency in their L3. Participants in Van Hell and Dijkstra's study were not recruited based on the knowledge they had in their L3 (French), but participants were still exposed to the stimuli in L3 (French) without being consciously aware that the main goal of the experiment was to specifically verify if L3 was active. In addition, Van Hell and Dijkstra also attempted to verify if the level of activation in L3 would depend on the trilinguals' proficiency in French (L3).

The results from Experiment 1 revealed that trilinguals were faster in associating Dutch (L1) words to their English cognates. Experiment 2 revealed shorter reaction times when trilinguals encountered L1

Dutch and English cognate words which were compared to noncognates. Finally Experiment 3 revealed shorter reaction times when trilinguals encountered L1 Dutch words that were cognates with French if compared to noncognates.[4] In sum Van Hell and Dijkstra (2002) concluded that a trilinguals' L2/L3 can influence word processing in L1 regardless of the level of proficiency trilinguals have in their L2 and L3.

Table 1. Van Hell and Dijkstra's (2002) Summary of Materials' Sample

Experiment 1	Number of Words	Translation Similarities	Examples Dutch/ English,/French
Dutch	20	Resemble English	**Appel, apple,** cadeau
Dutch	20	Resemble French	**Muur**, wall, **mur**
	40	Non-cognates	Tuin, garden, jardin
TOTAL	80		
Experiment 2 and 3	60	Pseudowords	

The main goal of this study is to observe the degree of language influence trilinguals experience while processing words that share numerous morphological characteristics such as words in Spanish and Portuguese. Portuguese and Spanish can be considered sister languages, since both are Romance languages that share 85% of their lexicon as well as morphological and syntactical structures derived from Vulgar Latin. Therefore, they can be considered two typologically related languages.

Based on the studies presented above, we might predict that trilinguals would utilize the similarities in L1/L2 to process cognates in L2/L3. However previous analyses concerning syntactical processing of typological similar languages claim that the opposite takes place.

[4] Experiment 3 from Van Hell and Dijkstra (2002) was tested on a group of Trilinguals that were more proficient in French if compared to participants from Experiment 2 that were less proficient in French.

According to Montrul (2004), transference or convergence between two languages is a common phenomenon when both languages are in contact. Montrul (2004) specifies the meaning of languages in contact by saying that *being in contact* is not only related to geographical proximities between languages. *Being in contact* also refers to language proximity caused by a bilingual's language and the constant *contact* with that language throughout the acquisition process. When investigating the structural similarity influences in language acquisition among Spanish-English-Portuguese trilinguals, Montrul's data supports the idea that structural similarities affect L3 language acquisition in a detrimental way. By demonstrating that acquisition was problematic due to the strong language transfer between both languages, these new findings contradict previous claims suggesting that knowledge of typological similar languages, such as Spanish, would contribute to the acquisition of subsequent ones, in this case Portuguese.

The Present Study

The current research investigates the process of word recognition in trilinguals. Its ultimate goal is to verify first of all if there are differences in word processing between trilinguals and bilinguals and, second, if trilingualism has an overall facilitative or inhibitory effect on word processing. In addition, it seeks to determine the possible influences that can cause word recognition for trilinguals to be less or more effortful than for bilinguals. In other words, if there are differences in the processes of trilingual and bilingual word recognition, to what can these differences be attributed? When trilinguals perform a task in L2 (Spanish), what are the effects of having a typological similar L3 (Portuguese)? Previous research on bilingualism has shown that an L2 can affect L1 language processing. Can previous findings be extended to possible L3 effects on L2 or even L1?

The nature of trilingualism will also be taken into consideration in order to investigate the process of word recognition in trilinguals. Therefore, the next question focuses on exploring if native and heritage speakers of typologically similar L2 languages would process words in L3 differently than non-native/non-heritage speakers. Finally, the present study aims to verify whether there are differences in word processing between multilinguals and trilinguals, and if multilingualism has a similar facilitative or inhibitory effect on word processing. Is there a direct correlation between the number of languages one knows and an increasing facilitation or inhibition language process?

CHAPTER 2

RESEARCH DESIGN AND METHODOLOGY

The following chapter describes the design of the experiment. A detailed description of how the materials were constructed, the procedures used in the experiment, and information regarding the participants will be presented in this chapter.

The primary focus of the present study is to explore the effects of language proximity in lexical processing in bilinguals (L1 English and L2 Spanish) and trilingual speakers (L1 English/Spanish, L2 English/Spanish and L3 Portuguese). Online sensitivity to word type was measured via a Lexical Decision Task in order to investigate the degrees of activation of Portuguese while trilinguals attempt to process words in Spanish.

There were several reasons to use a lexical decision task to investigate language proximity in lexical processing. According to Sunderman & Schwartz (2008), the use of a lexical decision task to investigate word recognition and competition prompts learners to engage in a lexical search that might correspond to the visual lexical stimuli presented. Therefore, when the lexical search takes place all orthographical, phonological and semantic aspects of the word are retrieved regardless of the type of visual or auditory exposure (Dijkstra & Van Heuven, 2002). As a result, shared similarities among words belonging to different languages may elicit similar orthographical, phonological or semantic representation during lexical retrieval delaying and/or compromising accurate word recognition. Thus, a LDT task is very useful in measuring online sensitivity to words that share features with Portuguese in trilinguals.

Given that the participants in the study varied with respect to their language skills (particularly in Portuguese), a Language History Questionnaire was also included in the present study as one of the main measurement instruments of students' proficiency. I used the LHQ to associate the number of

languages each participant has been exposed to, associate the duration of such exposure(s), and relate that language experience with participant's performance on the LDT task.

Participants

A total of 120 learners participated in the study. There were two groups of participants recruited for the study: one group of bilingual participants (English native speakers learning Spanish); and trilingual participants (English-Spanish speakers learning Portuguese). All participants were recruited from undergraduate and graduate language programs in the Department of Modern Languages and Linguistics, and 96% of the participants were currently enrolled in university language courses in either Spanish or Portuguese at the Florida State University. All students were informed about the study through classroom announcements and were invited to voluntarily participate in the research. Although students were not compensated financially for their participation, they were offered an opportunity to earn extra credit points in their language class.

There were 54 bilingual participants in the first group described above. All students were currently enrolled in third semester Spanish courses, the third and final semester of their university foreign language requirement. In the bilingual group there were 35 female and 19 male students with a mean age of (21.41) (18-27).

There were 66 participants in the trilingual group described above: 20 participants were enrolled in first semester of a three-semester sequence of Portuguese for nonnative Spanish speakers; and 10 participants were enrolled in the third semester of the same three-semester sequence. Finally, 31 participants were enrolled either in the first or second semester of an intensive two-semester sequence of beginning Portuguese courses designed specifically for native and advanced speakers of Spanish. Thus, students enrolled in these courses were native speakers of English or Spanish, or heritage speakers of

Spanish engaged in learning a third language (Portuguese). 5 students reported having previous instruction in Portuguese at either different times or different institutions. In the trilingual group there were 32 female and 34 male students whose mean age ranged from (21.68) (19-39). A total of 67 female and 53 male students participated in the study and formed the bilingual and trilingual group.

All participants were required to complete a Language History Questionnaire (LHQ).The questionnaire was composed of 23 questions that requested information from each participant in regards to their age, gender, country of origin, native language, and language spoken at home. Participants were asked to rate their proficiency levels in all four language abilities: speaking, listening, reading and writing in English, Spanish, Portuguese, or any other foreign language they might have been exposed to in which they received formal instruction previously. Finally, participants rated their overall ability to express themselves in the foreign languages listed above. The language proficiency rating present in the questionnaire varied from a scale of 1 (least proficient) to 10 (extremely proficient) (See Appendix A for a copy of the LHQ used). Tables 1, 2, and 3, which follow, present the proficiency means of all participants in English, Spanish, and Portuguese, respectively.

TABLE 2

Language Proficiency Ratings for Language Groups in English

	Bilinguals Means	Std Dev.	*Trilinguals* Means	Std Dev.	F	P.
Reading	9.52	.818	9.53	.932	.005	.942
Writing	9.15	1.18	9.21	1.06	.097	.756
Speaking	9.52	1.07	9.62	.837	.345	.558
Listening	9.67	.801	9.62	.760	.101	.751
Overall expression	9.81	.646	9.56	.914	2.96	.088

In terms of language proficiency, self-reports in English proficiency, based on a one-way ANOVA, did not reveal a significant on effect reading proficiency at the p<.05 level [F(1, 118) = .005, p>.05], writing [F(1, 118) = .097, p>.05], speaking [F(1, 118) = .345, p>.05], listening [F(1, 118) = .101, p>.05] or overall expression in English [F(1, 118) = 2.96, p>.05] among both bilingual and trilingual participants.

TABLE 3

Language Proficiency Ratings for Language Groups in Spanish

	Bilinguals		*Trilinguals*			
	Means	Std.Dev.	Means	Std. Dev.	F	P.
Reading	5.41	1.31	5.35	3.10	.017	.897
Writing	5.06	1.54	4.55	3.02	1.26	.264
Speaking	4.30	1.51	4.70	3.27	.688	.408
Listening	4.72	1.79	5.27	3.23	1.25	.266
Overall expression	3.94	1.60	4.41	3.36	.865	.354

In terms of language proficiency self-reports in Spanish, a one-way ANOVA did not reveal a significant effect on reading proficiency at the p<.05 level [F(1, 118) = .017, p>.05], writing [F(1, 118) = 1.26, p>.05], speaking [F(1, 118) = .688, p>.05], listening [F(1, 118) = 1.25, p>.05] or overall expression in Spanish [F(1, 118) = .865, p>.05] among both bilingual and trilingual participants.

Finally, in terms of language proficiency, self-reports in Portuguese which were based on a one way ANOVA revealed a significant effect on reading proficiency at the p<.05 level [F(1, 118) = 412, p<.05], writing [F(1, 118) = 259p<.05], speaking [F(1, 118) = .209, p<.05], listening [F(1, 118) =

241, p<.05] or overall expression in Portuguese [F(1, 118) = .160, p<.05] among both bilingual and trilingual participants.

TABLE 4

Language Proficiency Ratings for Language Groups in Portuguese

	Bilinguals		*Trilinguals*			
	Means	Std. Dev.	Means	Std. Dev.	F	P.
Reading	.52	.540	5.20	1.61	412	.000
Writing	.50	.505	4.38	1.70	259	.000
Speaking	.52	.540	4.21	1.81	209	.000
Listening	.56	.691	5.18	2.09	241	.000
Overall expression	.50	.505	3.92	1.93	160	.000

Materials

A total of 328 words included in the experiment were divided into 8 distinct conditions. A total of 163 Spanish words, which were included in the first two conditions were later categorized into two distinct subcategories. As it is seen on Table 4 below, conditions 1 and 2 were composed by tokens in Spanish. In condition 1, there were 44 tokens in Spanish that did not resemble words in Portuguese, such as the word *manzana*. In condition 2, there were 117 tokens in Spanish that did have an equivalent similar *example* in Portuguese (*habitación, habitação*). The majority of the Spanish words selected to be included in the experiment were extracted from the Spanish textbook *Sol y Viento* (VanPatten, B., Leeser, M., & Keating, G. D., 2012), used in the Spanish classes of all participants. Therefore, the degree of familiarity students had in regards to the words present in the experiment could be controlled in order to minimize error effects (misleading results) that could be caused by word unfamiliarity.

The second variety of words included in the experiment formed by words in Brazilian Portuguese corresponds to conditions 3 and 4 (See Table 4). A total of 62 tokens in Portuguese were included in the experiment. They were also subdivided into two different categories. The first category corresponds to condition 3 in Table 4 and refers to words in Portuguese that did not present an equivalent and similar formation in Portuguese, such as in the example *chaleira "*kettle." There were a total of 33 tokens in Portuguese included in condition 3. In condition 4, there were 29 tokens in Portuguese that resembled the formation of synonyms in Spanish such as *aflição*, *aflicción,"affliction."* Cognate words in either Portuguese or Spanish were not included in the experiment. Since participants were exposed only to the written form of each word and did not engage in listening activities, the insertion of cognates in one of these languages could mislead participants in regards to which language they belonged (Spanish or Portuguese).

Pseudowords in Spanish and Portuguese were also included in the experiment through conditions 5 and 6 in Table 4, respectively. Condition 5 consisted of pseudo words in Spanish, such as in the example *"borridor"*, and condition 6 consisted of pseudo words in Portuguese, such as *"valdade".* All nonce words in both Spanish and Portuguese were generated based on morphological possibilities and constraints in these languages. Real words in Spanish and Portuguese were selected as a reference for pseudo word formation. The multilingual pseudo word generator *Wuggy* (Keuleers, E., &Brysbaert, M. 2010) was also used to generate nonce words for the experiment. Finally 5 native and 3 nonnative speakers of Spanish and Portuguese were asked to judge the words in order to verify the degrees of resemblance each pseudo word might have to a real Spanish or Portuguese word. They were also asked to state if each pseudo word could be considered a real word based on their knowledge of each language, and using a scale of 1 to 5 (1 least likely and 5 most likely to resemble a real word). Overall, out of 56 pseudo words the participants judged 33 pseudo words to be acceptable in both languages with respect

to their degree of resemblance to real words. Pseudo words that were rated 1 on their resemblance to real words were discarded and not included in the materials.

According to De Groot (2011), the insertion of well-formed nonce words decreases the possibility of a lexical decision to be performed based on superficial characteristics of the word formation by itself. Table 4 presents samples of each category of stimuli along with their lexical characteristics.

TABLE 5

Stimuli Sample and Lexical Categorization

	Word Category	Code	Number of tokens	Examples	Meaning
1	Real SPN	RSPN	44	Manzana	Apple
2	Near SPN	NISPN	117	Habitación	Residence
3	Real POR	RPOR	62	Chaleira	Kettle
4	Near POR	NIPOR	33	Aflição	Distress
5	Nonce SPN	NWSPN	30	Borridor	
6	Nonce POR	NWPOR	25	Valdade	
7	German	NWG	23	Gürtel	Belt
8	Basque	NWB	23	Orain	Now

Prior to inclusion in the experiment, tokens that are real words in Spanish and Portuguese were verified by 5 native and 3 non-native speakers of each language (Spanish and Portuguese). In regards to real words in Spanish in Portuguese, speakers were asked first to state whether they knew the meaning of the words in Spanish and Portuguese and, then, to state the meaning (See appendix C). Out of 58 real

words, native speakers were able to recognize 56 words while non-native speakers recognized 46 words. Words that were not recognized by more than 5 participants were excluded from the experiment.

The seventh and eighth conditions of words have been formed by 46 words in German (23) and Basque (23). All Basque and German words present in the experiment have been generated as well as verified by two native speakers. Condition 8 corresponds to words in German *(gürtel,* "belt") and the last condition presented in Table 4 refers to words in Basque as in (*orain,* "now"). The motivation for inserting words in Basque and German into the present experiment lies in the orthographical characteristics of both languages that present distinct patterns of word formation when compared to romance languages such as Spanish and Portuguese. The participants were required to say 'no' to these words (since they are not words in Spanish), but they were in fact real words and not nonce words.

TABLE 6

Two sample *t-test* for Word Length in each Word Condition

		N	M (SD) Length	Std. Deviation	*t*	P
1	RSWL	44	6.18	1.16	0.00	p>.05
2	RPWL	33	6.18	1.23		
3	NISWL	117	6.40	1.45	-0.04	p>.05
4	NIPWL	29	6.41	.9826		
5	NWSPWL	30	6.16	.9855	0.02	p>.05
6	NWPWL	25	6.16	1.14		
7	WGWL	23	6.04	1.18	0.00	p>.05
8	WBWL	23	6.04	1.18		

In all of the 8 conditions, care was taken to control the length of the word. Table 6 below shows the mean length of each condition. Two sample *t*-tests reveal no significant difference among the length of words in all 8 conditions. For example, there was no significant difference in word length for real words in Spanish and real words in Portuguese: Real Words in Spanish (RSWL) (M= 6.18, SD= 1.16)

and Real words in Portuguese (RPWL) (M= 6.18, SD= 1.23). No significant differences were noted between near identical words in Spanish or near identical words in Portuguese: NISWL (M= 6.40, SD= 1.45) and NIPWL (M= 6.41, SD= .9826). There were no differences between pseudo words in Spanish or Portuguese: NWSPWL (M= 6.16, SD= .9855) and NWPWL (M= 6.16, SD= 1.14). Finally, there was no significant differences in word length for real words in German and real words in Basque: WGWL (M= 6.04, SD= 1.18) and WBWL (M= 6.04, SD= 1.18). Table 6 displays a summary of results for a paired sample *t*-test for word length in each word condition included in the experiment.

Design and Procedures

Participants completed a total of two separate tasks in the language lab. They performed a lexical decision task followed by a language history questionnaire.

Lexical Decision Task

In this type of experiment a word appears on the screen. Participants are instructed to read each word in order to understand its meaning and then, as quickly as possible, press the green button to confirm if the word is real in Spanish or the red button if it is not a Spanish word. The lexical decision task experiment lasted between 15-20 minutes.

All word stimuli were presented on a computer. The software SuperLab from Cedrus was used in the lexical decision task to record all participants' reaction times and accuracy performance. Participants were tested individually in a laboratory located at the Modern Languages Building at the Florida State University (Diffenbaugh 130). First, participants were required to sign a consent form that contained a description of the task they were about to perform. The researcher asked if they had any questions and assisted them with an overview of the task they were about to complete in the computer. Prior to starting the experiment participants received verbal instructions about the lexical decision task and were given

the opportunity to clarify any information necessary to complete the online task with Superlab. During the instruction period they were told to read each word presented in the screen covertly in order to understand its meaning, and to press the green button as quickly as possible to confirm if the word was a real word in Spanish, or a red button if the word was not based on their knowledge of Spanish. All words presented were screen centered, font Arial and size 12 on a white background. Each word would remain on the screen and new stimuli would be presented only if participants accepted or rejected the present word as being a real word in Spanish. Participants completed a set of three practice items prior to starting the experimental trials. The lexical decision task experiment lasted between 15-20 minutes.

Language History Questionnaire

A language history questionnaire[5] (LHQ) was administered after the main experiment ended to assess each participant's experiences with Portuguese and Spanish as well as other foreign languages. The LHQ was also used to confirm placement of students in either the bilingual or the trilingual groups. All language history questionnaires were administered via paper and pen. Participants took an average of 5-8 minutes to answer the LHQ, and data collection for each participant usually lasted from 35-45 minutes.

[5]Portuguese and Spanish proficiency assessment prior to the experiment was not verified due to the fact that all participants were enrolled in the same language courses at the time the experiment took place.

CHAPTER 3

RESULTS

The present chapter presents the analyses of reaction times and accuracy of both groups of bilinguals and trilinguals when performing a lexical decision task. The results are discussed based on a comparison made between both groups and within the trilingual group.

Data have been divided and analyzed based on the two distinct set of participants in the study. Group one (Bilingual Group) was composed by bilingual native speakers of English whose L2 was Spanish and group two (Trilingual Group) was formed by native speakers of English and Spanish whose L3 was Portuguese. Reaction times (RTs) and accuracy were reported separately. Participant's RTs that were faster than 300 milliseconds (*ms*) and slower than 5000ms have been excluded from the analyses as they were considered to be outliers. After the removal of outliers, all mean RTs for correct trials were calculated for each condition that all participants were exposed to in the experiment. RTs for correct trials that were above or below 2.5 standard deviations of participant's mean RTs were also removed and considered outliers. These data trimming procedures led to an exclusion of 3% of all trials.

Bilingual and Trilingual Speakers

In order to determine whether there were differences between both bilinguals and trilinguals in regards to each word condition, a series of one-way ANOVAS was conducted. The variables were word condition versus language group (bilingual vs. trilingual). The conditions were Real words in Spanish (RSPN), Near identical words in Spanish (NISPN), Real words in Portuguese (RPOR), Near identical words in Portuguese (NIPOR), Nonce words in Spanish (NWSPN), Nonce words in Portuguese (NWPOR), Real words in German (NWG) and Real words in Basque (NWB). See Table 5 above.

Reaction Times and Accuracy Analysis

The first comparison for Real Spanish words (RSPN) revealed a significant effect of language group [$F(1, 118) = 21.68$, $p<.05$]. The bilingual group was faster than the trilingual group at identifying real words in Spanish. The second comparison for Near Identical Spanish words revealed a significant effect of language group [$F(1, 118) = 26.44$, $p<.05$]. Again, the bilinguals were faster than the trilinguals at identifying near identical Spanish words. These two previous comparisons were for the 'yes' trials. We now turn to the 'no' trials where the participants were required to say 'no' to the token. The third comparison for Real Portuguese words reveals a main effect of language group [$F(1, 118) = 8.80$, $p<.05$]. Again, the bilinguals were faster to reject the word as a Spanish word, and the trilinguals suffered interference from their knowledge of Portuguese. The same pattern was found for the Near Identical Portuguese words, a significant effect of language group condition [$F(1, 117) = 6.76$, $p<.05$]. The bilinguals were faster than the trilinguals. In terms of the nonwords in Spanish and Portuguese, we see that the bilinguals were faster. There was a significant effect of language group on NWSPN [$F(1, 118) = 6.73$, $p<.05$], and of language group on NWPOR [$F(1, 118) = 8.43$, $p<.05$]. Finally the analysis revealed a significant effect of language group on the German words [NWG] [$F(1, 118) = 7.28$, $p<.05$], and the Basque words [NWB] [$F(1, 118) = 12.39$,$p<.05$] in the same direction; the bilinguals were faster.

Overall, participants from the bilingual group were faster in processing words in all conditions presented in the experiment in comparison to the trilingual group. The first important fact is that trilinguals took longer to reject any words that were Portuguese in nature (either the real Portuguese words, the near Identical Portuguese words or the Non-words in Portuguese). This confirms that when trilinguals are attempting to complete a task in the L2 (Spanish) and the L3 is activated by the presence of L3 words, the increased activation affects processing. However, the fact that the trilinguals also displayed longer RTs in the German and Basque conditions leads us to be hesitant in claiming that there

was typological similiarity. Instead, we are led to believe that additional global language activation was affecting processing. The second major finding here is that the trilinguals, who were very proficient in the L2, were actually slower than the bilinguals. This finding that the L2 is taking a hit because of the activation of the L3 is similar to work by Meuter & Allport (1982) where the L1 has been found to be affected during L2 production. Table 7 displays all means for lexical decision RTs and means for accuracy distributed in each of its corresponding word conditions.

TABLE 7

Mean Reaction Times *(in ms)* and Accuracy (%) for Language Group for Condition Words

	Bilingual Group			Trilingual Group		
	RT(ms)	M (SD)	Accuracy	*RT(ms)*	M(SD)	Accuracy
Real SPN	927	172	84.5%	1141	300	84.2%
Near SPN	910	167	88.4%	1143	296	86.4%
Real POR	1306	403	63.6%	1568	539	55.4%
Near POR	1296	442	64.3%	1509	445	56.3%
Nonce SPN	1423	498	51.7%	1673	547	57.2%
Nonce POR	1325	431	66.0%	1566	465	62.2%
German	1083	317	91.3%	1240	315	91.8%
Basque	1094	294	89.5%	1298	333	87.5%

In terms of accuracy, the analysis did not reveal a main effect of language group on Real Spanish (RSPN) at the $p<.05$ level for word condition [$F(1, 118) = .017$, $p = .896$], and neither has it revealed an effect of language group on Near Identical Spanish words (NISPN) at the $p<.05$ level for word condition [$F(1, 118) = 1.04$, $p = .310$]. It did reveal a significant effect of language group on Real Portuguese (RPOR) at the $p<.05$ level for word condition [$F(1, 118) = 4.18$, $p = .043$], and an effect of language group on Near Identical Portuguese words (NIPOR) at the $p<.05$ level for word condition [$F(1, 118) = 3.91$, $p = .050$]. There was not a significant effect of language group on NWSPN at the $p<.05$ level for

word condition [F (1, 118) = 1.57, p = .212], or an effect of language group on NWPOR at the p<.05 level for word condition [F (1, 118) = .795, p = .374]. Finally, the analysis did not reveal a significant effect of language group on NWG at the p<.05 level for word condition [F (1, 118) = .075, p = .785], or a main effect of language group on NWB at the p<.05 level for word condition [F (1, 118) = .966, p = .328].

Overall, the bilinguals presented more accurate results to real words in Portuguese (RPOR) and Near Identical words in Portuguese (NIPOR) conditions 3 and 4. When trilinguals are attempting to complete a task in the L2 (Spanish) and the L3 is activated by the presence of L3 words, the increased activation affects processing and trilinguals present a processing cost that causes them to process words in Portuguese (real and near identical) more slowly and less accurately.

The fact that trilinguals did not process pseudo words and words in German and Basque more accurately than bilinguals forces us to think of possible causes that led trilinguals to suffer interference from a typological related language (L2-Spanish) while processing real words but not pseudo words in Portuguese. While words from typologically unrelated languages such as German and Basque would not have a processing cost causing bilinguals and trilinguals to process them similarly in terms of accuracy, the reasons why Portuguese pseudo words were not processed less accurately by trilinguals might also be associated with the nature of pseudo words in Portuguese as being perceived by both trilinguals and bilinguals as derived from unrelated languages such as German and Basque. Table 7 displays all means for lexical decision RTs and means for accuracy distributed in each of its corresponding word conditions.

Native/Heritage and Non-Native Speakers

After a comparison made between bilingual and trilingual groups in regards to their RTs and accuracy when processing real and pseudo words in Spanish, Portuguese, German and Basque; it's now time to take a closer look within the trilingual group to verify if there are other factors present in the trilingual group that may have contributed to the present results. In other words, what other factors (besides the knowledge of Portuguese) could be driving these results?

All participants from the trilingual group were recruited based on their knowledge of English, Spanish and Portuguese. However some participants differ in their L1s, as native speakers of English or Spanish. In addition some participants have also reported being native speakers of English and heritage speakers of Spanish. Therefore, the main goal now is to verify if L2 Spanish proficiency plays a role in L3 Portuguese language processing. In other words, is increasing proficiency in L2 directly associated with higher or lower interference of L3?

Based on the results obtained from the LHQ to which all participants responded after completion of the Lexical Decision Task, a one-way ANOVA was applied to participants in the trilingual group who claimed to be native and heritage speakers of Spanish. The variables present at this time were word condition x native language (native/heritage of Spanish vs. nonnative speakers). No statistical significance was found between both groups in terms of reaction times except for RSPN and NISPN. Native speakers presented significantly faster RTs in these conditions. The analysis revealed a main effect of language group on Real Spanish words (RSPN) at the $p<.05$ level for word condition [$F(1, 64) = 6.96$, $p<.05$], and on Near Identical Spanish words (NISPN) [$F(1, 64) = 6.17$, $p<.05$]. However it did not reveal a significant effect on Real Portuguese words (RPOR) at the $p<.05$ level [$F(1, 64) = 4.80$, $p>.05$], or Near Identical Portuguese words (NIPOR) [$F(1, 63) = 3.58$, $p>.05$]. No significant effect was reported for nonce words in Spanish (NWSPN) [$F(1, 64) = .829$, $p>.05$],or nonce words in Portuguese

(NWPOR) [F(1, 64) = 2.78, p>.05]. Finally, there were no significant effects for words in German (NWG) [F(1, 64) = 3.02, p>.05], or words in Basque (NWB) [F(1, 64) = .992, p>.05].

In sum, native/heritage speakers of Spanish did not benefit from language similarities between Portuguese and Spanish and were not able to process words in Portuguese faster than trilinguals whose native language was English. However, they did present faster reaction times when processing words in Spanish.

TABLE 8

Mean Reaction Times *(in ms)* for Native/Heritage Speakers in Word Condition

	Non Native		**Native**		
Word Condition	Mean	Standard Deviation	Mean	Standard Deviation	P
Real SPN	1192	309	969	184	p<.05
Near Identical SPN	1190	310	983	167	p<.05
Real POR	1645	573	1308	280	p>.05
Near Identical POR	1565	473	1321	271	p>.05
Nonce Words SPN	1707	599	1560	299	p>.05
Nonce Words POR	1617	498	1392	280	p>.05
Words in German	1276	331	1118	221	p>.05
Words in Basque	1320	356	1223	231	p>.05

In regards to accuracy, native speakers were more accurate in all conditions. There was a main effect of language group on Real Spanish words (RSPN) at the p<.05 level for word condition [F (1, 64) = 9.62, p<.05] and on Near Identical Spanish words (NISPN) [F(1, 64) = 10.6, p<.05]. The results revealed a significant effect on Real Portuguese words (RPOR) at the p<.05 level [F(1, 64) = 12.5, p<.05], or Near Identical Portuguese words (NIPOR) [F(1, 64) = 14.6, p<.05]. A significant effect was also reported for nonce words in Spanish (NWSPN) [F(1, 64) = 13.03, p<.05] and nonce words in

Portuguese (NWPOR) [F(1, 64) = 13.5, p<.05]. Finally, there were significant effects for words in German (NWG) [F (1, 64) = 3.86, p<.05] and words in Basque (NWB) [F(1, 64) = 4.52, p<.05].

In sum, native speakers were more accurate in all conditions when accuracy was measured. Moreover, native/heritage speakers of Spanish are able to process words in Portuguese more accurately.

TABLE 9

Means in Accuracy *(%)* for Native/Heritage Speakers in Word Condition

Word Condition	**Non-Native** Accuracy	Standard Deviation	**Native** Accuracy	Standard Deviation	P
Real SPN	81.3%	.1518	93.9%	.0680	p<.05
Near Identical SPN	83.8%	.1290	95.1%	.0569	p<.05
Real POR	50.0%	.2473	73.9%	.1522	p<.05
Near Identical POR	50.3%	.2503	76.7%	.1671	p<.05
Nonce Words SPN	51.5%	.2527	76.8%	.1840	p<.05
Nonce Words POR	56.3%	.2499	82.1%	.1911	p<.05
Words in German	90.5%	.1046	96.2%	.0732	p<.05
Words in Basque	85.8%	.1326	93.3%	.0516	p<.05

Polyglot Speakers

After analyzing the effects of Spanish proficiency on L3 Portuguese, we turn to an analysis within the trilingual group, that is multilingual speakers that report knowing other languages besides English, Spanish and Portuguese. The main goal here is to verify whether or not a fourth language can be associated with a variation in L3/L2 processing, especially given the fact that a third and second language were already associated with L2/L1 differences in language processing. The focus is to account for differences in word processing between multilinguals and trilinguals and to determine if multilingualism has the same facilitative or inhibitory effect on word processing as trilingualism.

A third one-way ANOVA was applied to the Trilingual group, with an emphasis on participants that reported exposure to languages other than English, Spanish, and Portuguese in the LHQ.

No statistical significance was found between trilinguals and multilinguals in terms of reaction times. The analysis did not reveal a main effect of language group on Real Spanish words (RSPN) at the $p<.05$ level for word condition [$F(1, 64) = .847$, $p>.05$], nor on Near Identical Spanish words (NISPN) [$F(1, 64) = 0.16$, $p>.05$]. It did not reveal a significant effect on Real Portuguese words (RPOR) at the $p<.05$ level [$F(1, 64) = .546$, $p>.05$], or Near Identical Portuguese words (NIPOR) [$F(1, 63) = 1.90$, $p>.05$]. No significant effect was reported for nonce words in Spanish (NWSPN) [$F(1, 64) = .013$, $p>.05$], or nonce words in Portuguese (NWPOR) [$F(1, 64) = 0.90$, $p>.05$]. Finally, there were no significant effects for words in German (NWG) [$F(1, 64) = .188$, $p>.05$], or words in Basque (NWB) [$F(1, 64) = .211$, $p>.05$].

TABLE 10

Mean Reaction Times *(in ms)* for Polyglot Speakers in Word Condition

Word Condition	*Trilinguals* Mean	Standard Deviation	*Polyglot* Mean	Standard Deviation	P
Real SPN	1141	328	1141	235	p>.05
Near Identical SPN	1146	310	1136	167	p>.05
Real POR	1535	417	1641	743	p>.05
Near Identical POR	1559	481	1395	335	p>.05
Nonce Words SPN	1707	535	1560	586	p>.05
Nonce Words POR	1577	457	1540	493	p>.05
Words in German	1252	337	1215	270	p>.05
Words in Basque	1311	332	1270	342	p>.05

Inasmuch as accuracy is concerned, multilinguals were no more precise than trilinguals. There was not a main effect of language group on Real Spanish words (RSPN) at the p<.05 level for word condition [F (1, 64) = 2.11, p>.05], nor on Near Identical Spanish words (NISPN) [F(1, 64) = 1.25, p>.05]. The analysis did not reveal a significant effect on Real Portuguese words (RPOR) at the p<.05 level [F(1, 64) = .115, p>.05], or Near Identical Portuguese words (NIPOR) [F(1, 64) = .002, p>.05]. No significant effect was present for nonce words in Spanish (NWSPN) [F(1, 64) = .075, p<.05], or nonce words in Portuguese (NWPOR) [F(1, 64) = .205, p>.05]. Finally, there were no significant effects for words in German (NWG) [F (1, 64) = .396, p>.05], and words in Basque (NWB) [F (1, 64) = .683, p>.05]. Overall, no statistically significance was found among polyglot and trilingual participants in terms of reaction times and accuracy.

TABLE 11

Mean in Accuracy *(%)* for Polyglot Speakers in Word Condition

Word Condition	*Trilinguals* Accuracy	Standard Deviation	*Polyglot* Accuracy	Standard Deviation	P
Real SPN	86.0%	.1216	80.4%	.1877	p >.05
Near Identical SPN	87.6%	.1094	83.9%	.1545	p>.05
Real POR	54.7%	.2323	57.0%	.2883	p>.05
Near Identical POR	56.4%	.2423	56.1%	.2958	p>.05
Nonce Words SPN	56.6%	.2521	58.5%	.2839	p>.05
Nonce Words POR	61.2%	.2596	64.3%	.2668	p>.05
Words in German	92.3%	.0909	90.6%	.1208	p>.05
Words in Basque	88.4%	.1112	85.7%	.1462	p>.05

Language History Questionnaire

As reported previously, data extracted from all participants' Language History Questionnaire (LHQ) was subject to a one-way ANOVA analysis. The results did not present statistical significance among the levels of proficiency in English and Spanish reported by students. Given that the bilingual group had not received any prior instruction in Portuguese, the proficiency levels in Portuguese were significantly different between both language groups.

Summary of Results

In sum, the analysis of reaction times and accuracy to test word conditions revealed the following:

- Bilinguals were faster in processing words in all conditions presented in the experiment in comparison to the trilingual group. In addition, trilinguals presented less accurate results while processing real Portuguese and Near Identical Portuguese words. These results clearly indicate that L3 is affecting L2 language processing, as words in Portuguese are active and competing for selection while trilinguals attempt to process words not only in Spanish but in all word conditions. There seems to be a cognitive cost attached to a third language that slows down processing in any language. Therefore, slower and more inaccurate word processing can be directly correlated to the higher levels of activation promoted by three active languages in the trilingual's mind. Overall, the present findings suggest that knowing three languages means less control over lexical processes, i.e, *More is Less* for trilinguals whose two languages are typologically related.

- Native/Heritage Spanish speakers processed words faster in Spanish (Real Spanish and Near Identical Spanish in comparison to non-native Spanish speakers in the trilingual group. They were also more accurate throughout all word conditions. These results demonstrate that higher proficiency levels in one language benefit not only processing speed but also accuracy in target and relatively unrelated word conditions. Therefore, trilinguals seem to develop a refined categorization mechanism to handle a multilingual lexicon.
- Polyglots did not differ significantly from trilinguals in processing words faster and more accurately throughout all eight different conditions.

CHAPTER 4

DISCUSSION AND CONCLUSIONS

The following chapter discusses the results obtained from both the Lexical Decision Task and the Language History Questionnaire presented in Chapter 3. It also discusses the results in light of the main goals presented in Chapter 1 and confers its outcomes based on previous research on word recognition between bilinguals and trilinguals.

The current research investigates the process of word recognition in trilinguals. Its ultimate goal is to verify whether there are differences in word processing between trilinguals and bilinguals and whether trilingualism has an overall facilitative or inhibitory effect on word processing. In addition, it attempts to determine the possible influences that can cause word recognition for trilinguals to be less or more arduous than for bilinguals. In other words, if both processes of trilingual and bilingual word recognition differ, to what can this be attributed? Namely, when trilinguals perform a task in L2 (Spanish), what are the effects of having a typological similar L3 (Portuguese)? Previous research on bilingualism has shown that an L2 can affect L1 language processing. Can previous findings be extended to possible L3 effects on L2 or even L1?

The nature of the trilingualism was also taken into consideration in order to investigate the process of word recognition in trilinguals. Did native and heritage speakers of typological similar L2 languages process words in L3 differently than non-native/non-heritage speakers? Finally, the present study aims to verify whether there are differences in word processing between multilinguals and trilinguals, and if multilingualism has a similar facilitative or inhibitory effect on word processing. Is there a direct correlation between the number of languages one knows and an increasing facilitation or inhibition language process? In order to account for these inquiries, online sensitivity to word type was measured

via a Lexical Decision Task so that the degrees of activation of Portuguese while trilinguals attempted to process words in Spanish could be investigated.

The first idea focused on the differences in word processing between bilinguals and trilinguals. It attempted to determine the possible influences that cause word recognition for trilinguals to be more or less challenging than for bilinguals. It looked at the language similarities between Spanish and Portuguese in order to hypothesize whether trilingual participants would show sensitivity to words in Spanish and Portuguese (real and pseudo words) and, consequently, would present longer reaction times while accepting or rejecting Portuguese words. In terms of reaction times, this idea is fully supported by the present results, which demonstrate that in terms of reactions times bilinguals were faster than trilinguals in processing words in all conditions.

Bilinguals were faster than trilinguals in processing words in Spanish and Portuguese, we well as words in all conditions presented in the experiment. The results open up for further investigation the nature of the processes of word recognition amongst trilinguals and, more importantly, the nature of the words being processed.

The results of this study indicate that trilinguals take longer to react to real or pseudo words, regardless of their origin. In addition, the research demonstrates that trilinguals pay a higher price than bilinguals when storing three or more languages in their brains. Although trilinguals present longer reaction times when processing words, they actually succeed in processing them correctly. These results present further evidence for a bilinguals/trilinguals non-selective language access, due to the increasing difficulty trilinguals experience juggling a multilingual lexicon and overcoming the competition between all word features, letters, and words excited during word recognition.

This research also analyzed the ability of trilinguals to process words more accurately than bilinguals. The motivation behind such inquiry is extracted from the rich vocabulary knowledge

trilingual speakers present in distinct languages. In terms of accuracy, trilinguals do not process words more accurately than bilinguals in two conditions: Real words in Portuguese (RPOR) and Near identical words in Portuguese (NIPOR). In other words trilinguals do present sensitivity in regards to language typological similarities. In addition, since bilinguals lack knowledge of Portuguese, language competition was not present during word retrieval, which allowed bilinguals to be more accurate while rejecting real words in Portuguese (RPOR) and Near identical words in Portuguese (NIPOR).

The reason why trilingual speakers do not process words more accurately than bilinguals remains open for discussion. According to this research, trilingual speakers might not react faster than bilinguals to process words due to their high level of lexical competition during word retrieval. However, lexical competition does not disable multilinguals from retrieving words accurately. According to Van Heuven and Dijkstra's (1998) BIA model, word recognition occurs in a bottom-up direction while features, syllables, and words are activated to match their corresponding language nodes. As soon as word and language matching takes place, multilinguals can suppress any language that is not required for the retrieval of the word that is taking place. Hence inaccuracy in word recognition by trilinguals is still unclear and unable to be accounted for based on the BIA model.

The results obtained from the present study display important information on trilingualism *per se.* Because trilinguals present not only longer reaction times to process words in different languages but also less accurate results (depending on the nature of the word), trilinguals might have to deal with the fact that knowing more than two languages can compromise their performance in at least one of the two.

After comparing bilinguals and trilinguals' RTs and accuracy when processing real and pseudo-words in Spanish, Portuguese, German, and Basque, a closer look can be taken at native/heritage speakers of Spanish and multilinguals and the possible influence their L3 Portuguese had in L2 Spanish

processing. In other words, did native and heritage speakers of typological similar L2 languages process words in L3 differently than non-native/non-heritage speakers?

In terms of accuracy, native/heritage speakers of Spanish are able to process words in Portuguese more accurately. However they only processed words faster than non-native Spanish trilinguals in two conditions: Real words in Spanish (RSPN) and Near identical words in Spanish (NISPN).

Previous data on accuracy results within the trilingual group can now be re-examined. A comparison between bilinguals and trilinguals in terms of accuracy demonstrated that bilinguals are more accurate than trilinguals when processing words in Portuguese. However when native/heritage speakers of Spanish are analyzed, different results are obtained. The data shows that although Spanish native/heritage speakers do not process words faster than non-native Spanish speakers in most word conditions, they are able to process words more accurately throughout all word conditions.

Such results demonstrate that the consequences of trilingualism may be related to two major factors. First, these consequences may be related to the nature of one's L1 and to the languages acquired subsequently. Trilinguals whose native language resembles one of their subsequent languages (L2/L3) can distinguish between languages and process words more accurately. Yet, this advantage does not impact how fast native/heritage speakers process words in most of the conditions presented.

A second interpretation for the current results might be closely related to the level of proficiency native/ heritage speakers reported to have in their LHQ. In order to verify such information a post-hoc analysis of their language abilities in Spanish was conducted.

Based on the results obtained from the LHQ which trilingual participants responded to after completion of the Lexical Decision Task, a one-way ANOVA was applied to participants in the trilingual group who identified themselves as native and heritage speakers of Spanish. The variables

present were receptive skills (listening and reading), productive skills (speaking and writing), overall expression in Spanish and native language (native/heritage of Spanish vs. nonnative speakers).

The statistical results obtained reported a significant difference between the levels of proficiency reported by native/heritage and non-native Spanish speakers in the trilingual group. The analysis revealed a main effect of native language status (native/heritage vs. non-native) on both receptive skills: Reading at the $p<.05$ level [$F(1, 64) = 18.85$, $p<.05$]; and Listening [$F(1, 64) = 35.20$, $p<.05$]. It also revealed a main effect on productive skills; Writing [$F(1, 64) = 21.38$, $p<.05$]; Speaking [$F(1, 64) = 39.47$, $p<.05$]; and, finally, in overall expression in Spanish [$F(1, 64) = 44.00$, $p<.05$].

TABLE 12

Means in Self Proficiency Ratings for Native/Heritage and Non-native Speakers

	Native/ Heritage		*Non-Native*		
Language Skills	Means	Std. Dev.	Means	Std. Dev.	P
Reading SPN	8.64	2.15	4.69	2.84	p<.05
Writing SPN	7.91	2.16	3.87	2.72	p<.05
Speaking SPN	9.18	1.07	3.80	2.78	p<.05
Listening SPN	9.55	.934	4.42	2.82	p<.05
Overall Expression	9.18	.982	3.45	2.81	p<.05

As a result, the higher level of proficiency in Spanish reported by native and heritage speakers can be associated with their performance in processing words more accurately in all word conditions. Their comprehensive language knowledge and high control of Spanish structures and vocabulary enables native and heritage speakers to distinguish among real and pseudo words in Spanish and Portuguese, as well as words in German and Basque. In other words, the degree of control over different

languages seems to increase with the trilinguals' proficiency regardless of the typological differences among languages.

Finally, the present study aimed to verify whether there were differences in word processing between multilinguals and trilinguals, and if multilingualism had a similar facilitative or inhibitory effect on word processing.

Results presented previously from a one-way ANOVA applied to participants in the trilingual group revealed no statistical significance among polyglot and trilingual participants within the trilingual group in terms of reaction times and accuracy. Trilinguals and multilinguals did not present statistically significant differences in reaction times to words faster or more accurately throughout all word conditions present in the experiment.

According to answers from the LHQ, multilinguals reported knowing the following languages: Hebrew, Arabic, Italian, French, Japanese, German, Hindi, and Latin. Since these languages belong to different language groups descending from distinct protolanguages (Afro-Asiatic, Italic Romance, Atlaic, Germanic and Indo-Iranian respectively), their characteristics are diverse. Thus, an analysis concerning the influences these language features play in Spanish and Portuguese word recognition would be challenging. An alternative interpretation of the current outcomes might be closely connected to the level of proficiency multilingual speakers reported in their L4. As a result, further investigation is necessary to verify whether different proficiency levels in L4 or the nature of the language could present different results.

A Comparison to Van Hell and Dijkstra's (2002) Results

As mentioned in the introduction to this study, the present investigation is based upon a study developed by Van Hell and Dijkstra in 2002 that attempted to investigate the impact of L2/L3 language

knowledge on language performance in specific native language contexts. It is now time to compare the results obtained from Van Hell and Dijkstra (2002) with the present study's findings.

While Van Hell and Dijkstra worked with a group of Dutch (L1), English (L2), and French (L3) trilinguals with different levels of proficiency, the present study analyzed a group of English (L1/L2), Spanish (L1/L2), and Portuguese (L3) trilinguals with similar levels of proficiency. There were 58 trilinguals in the first study divided by different levels of proficiency in their L2 and L3. There were 66 trilinguals in the second study whose proficiency varied based on a participant's native language (English and Spanish). The group of trilinguals was compared to a group of 56 English-Spanish bilinguals.

Both studies used a lexical decision task as one source of data collection. However both studies diverge as tasks such as word association were also included in the first study. Language proficiency was also dictated differently as the first study administered a language proficiency exam while the second study administered a language history questionnaire.

Van Hell and Dijkstra's study revealed faster RT's when L1 Dutch speakers processed both cognate words in L2 (English) and L3 (French). In sum, Van Hell and Dijkstra (2002) concluded that a trilinguals' L2/L3 can influence word processing in L1 regardless of the level of proficiency trilinguals have in their L2 and L3.

The present study, on the other hand, demonstrates that trilinguals were not as fast in processing words in all conditions in comparison to bilinguals. In addition, trilinguals were not as accurate while processing Portuguese words. These findings conclude that there seems to be a cost to possessing a third language.

Native/Heritage Spanish speakers were more accurate throughout all word conditions, demonstrating that language proficiency plays a role in accuracy. Trilinguals seemed to develop a

refined categorization mechanism that allowed them to handle a multilingual lexicon. These results might be related to Van Hell and Dijkstra's (2002) native Dutch participant's performance and their ability to process words faster in L2 and L3.

Finally, the influence of a non-linguistic context on language activation needs to be taken into account. More specifically, what importance does the influence the environment and the predominantly spoken language of one setting have on the activation of a non-default/non target language? Grosjean (1998) proposes that the language mode theory might account for this bilingual language control and that, depending upon the context, bilinguals choose to function in one of their language modes. A bilingual would be able to activate only one language (the base language) whereas the other language (the guest language) would remain unused or as deactivated as possible.

The present results are supported by scholars such as Van Hell and Dijkstra's (2002) who do not support the influence of non-linguistic context during lexical activation. Participants in the present study received instructions about the nature of the task itself prior to starting the experiment and were asked to react to words in Spanish. Yet, the present study outcomes are not a result of participants' performance in a single language mode (Spanish), which is influenced by non-linguistic contexts. Hence, neither bilinguals nor trilinguals demonstrate faster RT's or more accurate responses in Spanish.

Green's inhibitory control model (1998) presents a contrasting idea that may account for language control. He proposes the idea that language control may be comprehended in terms of activation of the target language. Consequently, inhibition of the non-targeted language may be responsible for the bilingual's ability to communicate in only one language. As a result, the findings of the present study corroborate Green's views of language activation and inhibition since longer RTs and less accuracy are related to higher levels of language inhibition caused by higher levels of word similarities between Spanish and Portuguese.

Limitations of the Study and Directions for Future Research

Some limitations of the present study are related to participants in the trilingual group. Whereas participants in the bilingual group presented considerably more homogeneous knowledge of different languages and the majority of bilinguals reported only knowing Spanish and English, the trilingual group constituted a more heterogeneous group of participants. Out of 66 participants in the trilingual group, 21 reported knowing more than three languages. In addition, 11 participants were native speakers, and 15 reported being heritage speakers of Spanish. Therefore, the results obtained from an analysis comparing native and non-native trilingual speakers of Spanish could be compromised due to the small sample size of native speakers of Spanish. Perhaps future research with a larger sample size can replicate the present results and verify the reliability of its outcomes.

De Groot (2011) points to possible drawbacks that should be taken into account when analyzing data derived from a lexical decision task. First, she points out the nature of the task itself, which can be considered a rather unnatural task that does not resemble what language users generally encounter. In other words, it is highly unlikely that users of a given language will judge the nature of a real word prior to applying that word in verbal communication. Secondly, De Groot affirms that a lexical decision task does not serve as a pure source of measuring lexical access. Instead, she posits that the participant's lexical decision is influenced by the experimental circumstances as well as the creation of the stimulus set. Moreover, there is no control over the sources of lexical and non-lexical (orthographic, phonological and semantic) retrieving information that participants are using for each lexical decision. Finally, a lexical decision can be purely episodic and might be based upon the sense of familiarity that learners have towards certain lexical items, which would fail to measure whether participants had control over the nature and meaning of a specific word.

Finally, future studies might focus on combining the present results with possible pedagogical implications on the teaching of Portuguese and Spanish as a foreign language. Such results would, hopefully, contribute to the improvement of the L2 language curriculum and, thereby, assist special groups such as Spanish speakers in the acquisition of Portuguese.

Currently, Spanish speakers enrolled in Portuguese language courses are placed in more intensive Portuguese classes that move at a faster pace. This practice is based on the premise that previous Spanish knowledge will assist learners in the acquisition of Portuguese due to the numerous typological similarities between the two languages. However, the present results show that the opposite takes place. Spanish speakers show sensitivity while processing words in Portuguese, hence they constitute a special group of learners whose limitations can be addressed through specific teaching methodologies that might better assist them in learning Portuguese.

Conclusions

This study explores the effects of trilingualism on L2 language processing. More specifically, it investigates whether knowing languages that share a multitude of similarities, such as Spanish and Portuguese, can alter how fast and how accurately trilinguals process words in their L2. The results from this study suggest that knowing three languages affects one's ability to process words faster and more accurately, but perhaps not in the way one might expect. In comparison to bilinguals, trilinguals were not as fast in processing words, which suggests there is a cost to possessing a third language. The degree of proficiency in one language does seem to affect one's ability to process words. Given that Native/Heritage Spanish speakers process words faster in Spanish than non-native Spanish speakers and are more accurate throughout all word conditions, this study demonstrates that there is a correlation between language proficiency and L2/L3 processing capabilities. High proficiency levels in one

language benefits not only processing speed but also accuracy in relatively unrelated word conditions. In the end, this research suggests that more can actually be less when it comes to word recognition in trilinguals with typologically similar L2s and L3s.

APPENDIX A

LANGUAGE HISTORY QUESTIONNAIRE

Subject # _____	Date _____

Date _____

Language History Questionnaire

This questionnaire is designed to give us a better understanding of your experience with other languages. We ask that you be as accurate and thorough as possible when answering the following questions.

General Background Questions:

1. Gender

   - ❑ Female
   - ❑ Male

2. Age: _____ years

3. Do you have any known visual or hearing problems (corrected or uncorrected)?

   - ❑ No
   - ❑ Yes [Please explain] _____

4. Native Country

   - ❑ United States
   - ❑ Other _____

   If other, at what age did you come to the US? _____

Home Language:

5. What is your native language?

   - ❑ English
   - ❑ Other: _____

6. Language spoken at home:
   - ❑ English
   - ❑ Other _____

Education:

7. Please indicate where you have studied Spanish.

Please check all that apply and indicate length of study.

- **High School**
  - 1 year
  - 2 years
  - 3 years
  - 4 years
- **College**
  - Less than a one semester
  - 1-2 semesters
  - 3-4 semesters
  - 5-6 semesters
  - 7-8 semesters
  - 8+ semesters

Rate your *Spanish* Skills:

8. Please rate your Spanish *reading* proficiency. (1=not literate and 10 = very literate)

not literate very literate

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

9. Please rate your Spanish *writing* proficiency. (1=not literate and 10=very literate)

not literate very literate

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

10. Please rate your Spanish *speaking* ability. (1=not fluent and 10=very fluent)

not fluent very fluent

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

11. Please rate your Spanish speech *comprehension* ability. (1=unable to understand conversation and 10=perfectly able to understand)

unable to perfectly able

understand to understand

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

12. Rate how comfortable you feel expressing yourself in Spanish:

Not comfortable at all Very Comfortable

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

---

13. Please indicate where you have studied Portuguese.
Please check all that apply and indicate length of study.

High School

- ❑ 1 year
- ❑ 2 years
- ❑ 3 years
- ❑ 4 years

- ❑ **College**
  - ❑ Less than a one semester
  - ❑ 1-2 semesters
  - ❑ 3-4 semesters
  - ❑ 5-6 semesters
  - ❑ 7-8 semesters
  - ❑ 8+ semesters

Rate your *Portuguese* Skills:

15. Please rate your Portuguese *reading* proficiency. (1=not literate and 10 = very literate)

not literate very literate

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

16. Please rate your Portuguese *writing* proficiency. (1=not literate and 10=very literate)

not literate very literate

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

17. Please rate your Portuguese *speaking* ability. (1=not fluent and 10=very fluent)

not fluent very fluent

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

18. Please rate your Portuguese speech *comprehension* ability. (1=unable to understand conversation and 10=perfectly able to understand)

unable to perfectly able

understand to understand

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

19. Rate how comfortable you feel expressing yourself in Portuguese:

Not comfortable at all Very Comfortable

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

If you have studied and/or know another language (besides English), please rate your skills in _____ below:

20. Please rate your *reading* proficiency. (1=not literate and 10 = very literate)

not literate very literate

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

21. Please rate your *writing* proficiency. (1=not literate and 10=very literate)

not literate very literate

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

22. Please rate your *speaking* ability. (1=not fluent and 10=very fluent)

not fluent very fluent

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

23. Please rate your speech *comprehension* ability. (1=unable to understand conversation and 10=perfectly able to understand)

unable to perfectly able

understand to understand

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

24. Rate how comfortable you feel expressing yourself in this language:

Not comfortable at all Very Comfortable

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

Is there anything else that we should know about your language abilities? Other languages you may speak, etc. Please explain:

_____
_____
_____
_____

Thank you for participating!

APPENDIX B

INFORMED CONSENT FORM

The study "Lexical Processing in Spanish and Portuguese" is part of research intended to provide information about the way people learn and process these languages. This research is being conducted as part of my Master's research under the supervision of Dr. Gretchen Sunderman. If you agree to participate in this study, you will be asked to perform 2 different tasks in one session (approximately 40 minutes). The first task will be conducted on a computer. You will read a series of words. The computer will record the data, and your confidentiality will be protected by entering a participant code instead of your name. Afterwards, you will complete a questionnaire asking about your past experience learning languages. You may decline to answer specific questions.

Your participation is totally voluntary, and you may stop participation at any time. No financial compensation is offered for your participation, however you will receive the opportunity to receive a total of three points that will be include in your final exam (Portuguese and Spanish). If you decide not to participate in the study, you will be provided with an extra activity that you may wish to complete in order to be able to receive the same extra credit as well. There is no expected risk during the session. However, you have the right to terminate the session at any time without any penalty.

Your performance and any information obtained will remain confidential, to the extent allowed by law. Your name will be replaced with a number for the purpose of coding and analysis of data. Only the primary researchers will have access to the codes and the data, and all data will be stored electronically on a flash drive, which will be kept in a locked file drawer in Diffenbaugh 302B when not being analyzed. In accordance with standard procedure, all data will be destroyed by February 1, 2022

You are encouraged to ask any questions that you might have about this study before, during and after your participation in the study. However, answers that could influence the results of the experiment will be deferred to the end of the experiment. You will also receive a debriefing form upon completion of the study, fully explaining the goals of the research.

There are benefits for participating in the research project. First, you may increase your awareness of your second language abilities. Also, you will be providing second language acquisition researchers with valuable information about how individuals process a foreign language. This knowledge will assist researchers to improve second language learning methods.

If you have any questions about this research or your rights as a participant in this study or if you feel you have been placed at risk please contact me Jamile Forcelini at [redacted] or Dr. Gretchen Sunderman [redacted] Florida State University, Dept. of Modern Languages and Linguistics. You may also contact her at [redacted].

You can also contact the Chair of the Human Subjects Committee, Institutional Review Board, through the Vice President for the Office of Research at (850) 644-8633 or at humansubjects@magnet.fsu.edu

---

I understand the above information and voluntarily consent to participate in this study of my own free will. I am 18 years of age or older and a student and/or employee at Florida State University.

I understand that I am free to discontinue participation at any time without explanation. I understand that this form will not be used in conjunction with the results of the study so that my identity will be protected to the extent allowed by the law. I understand that I will receive a signed copy of this consent form.

Signature _____ Date _____

APPENDIX C

CONDITION WORDS

GC: Grammatical Category: 1- noun, 2 - verb

1. Spanish 1 (Real Words in Spanish)

	Real SPN	# of letters	GC	MEANING
1	Película	8	1	Movie
2	Temprano	8	1	Early
3	Sombrero	8	1	Hat
4	Aburrido	8	1	Boring
5	Desayuno	8	1	Breakfast
6	Galletas	8	1	Cookies
7	Frijoles	8	1	Beans
8	Cuchara	7	1	Spoon
9	Manzana	7	1	Apple
10	Viernes	7	1	Friday
11	Autobus	7	1	Bus
12	Lechuga	7	1	Lettuce
13	Postres	7	1	Dessert
14	Dibujar	7	0	To Draw
15	Empezar	7	0	To start/To begin
16	Navidad	7	1	Christmas
17	Tarjeta	7	1	Card
18	Corbata	7	1	Tie
19	Pelota	6	1	Ball
20	Nevera	6	1	Fridge
21	Martes	6	1	Tuesday
22	Regalo	6	1	Present
23	Cajero	6	1	Cashier
24	Abuelo	6	1	Grandfather
25	Pastel	6	1	Cake
26	Tijera	6	1	Scissors
27	Anillo	6	1	Ring
28	Sandía	6	1	Sand
29	Sábana	6	1	Sheet
30	Lunes	5	1	Monday
31	Lejos	5	1	Far
32	Madre	5	1	Mother
33	Cenar	5	0	To have dinner
34	Mirar	5	0	To look/To see
35	Perro	5	1	Dog

36	Coche	5	1	Car
37	Silla	5	1	Chair
38	Tapón	5	1	Plug
39	Tapiz	5	1	Tapestry
40	Chica	5	1	Girl
41	Jamón	5	1	Ham
41	Echar	5	1	To cast
43	Maíz	4	1	Corn
44	Zumo	4	0	Juice
45		6,1818		

2. Portuguese 1 (Real Words in Portuguese)

	Real POR	**# of letters**	**GC**	**MEANING**
1	Grisalho	8	1	Gray Hair
2	Chaleira	8	1	Kettle
3	Costurar	8	0	To sew
4	Arranhar	8	0	To scratch
5	Apressar	8	0	To rush
6	Abranger	8	0	To include
7	Moqueca	7	1	A typical brazilian dish
8	Finesse	7	1	Classy behavior
9	Afastar	7	0	To devia-te
10	Músculo	7	1	Muscle
11	Recreio	7	1	Break
12	Foguete	7	1	Rocket
13	Espinho	7	1	Thorn
14	Carente	7	1	Needy
15	Algema	6	1	Handcuffs
16	Coruja	6	1	Owl
17	Espora	6	1	Spur
18	Caixão	6	1	Coffin
19	Guichê	6	1	Window/Cashier
20	Sertão	6	1	Desert
21	Curtir	6	0	To enjoy
22	Sonho	5	1	Dream
23	Folha	5	1	Sheet of paper/leaf
24	Molho	5	1	Sauce
25	Botão	5	1	Button
26	Sanga	5	1	Stream
27	Morro	5	1	Mountain
28	Ninho	5	1	Nest
29	Ficar	5	0	To stay/ to remain

30	Sumir	5	0	To disappear
31	Garça	5	1	Egret
32	Jóia	4	1	Jewel
33	Unha	4	1	Nail
		6,18182		

3. Spanish 2 (Near Identical Words in Spanish)

	Near Ident SPN	# of letters	GC	MEANING
1	Habitación	10	1	Residence
2	Medianoche	10	1	Midnight
3	Respuesta	9	1	Answer
4	Solamente	9	1	Only
5	Izquierda	9	1	Left
6	Ejercício	9	1	Exercise
7	Selección	9	1	Selection
8	Correción	9	1	Correction
9	Corriente	9	1	Current/ Stream
10	Pendiente	9	1	Pending/Earring
11	Concierto	9	1	Concert
12	Cuestión	8	1	Question
13	Cubierto	8	1	Covered
14	Trabajar	8	0	To Work
15	Invierno	8	1	Winter
16	Estación	8	1	Station
17	Desierto	8	1	Desert
18	Fruteria	8	1	Fruit Market
19	Montañas	8	1	Mountains
20	Amarillo	8	1	Yellow
21	Escuchar	8	0	To listen
22	Negación	8	1	Negation
23	Langosta	8	1	Lobster
24	Deportes	8	1	Sports
25	Natación	8	1	Swimming
26	Chaqueta	8	0	Jacket
27	Proyecto	8	1	Project
28	Almuerzo	8	1	Lunch
29	Ensalada	8	1	Salad
30	Prójimo	7	1	Next
31	Alguién	7	1	Somebody
32	Persona	7	1	Person
33	También	7	1	Also, too
34	Escuela	7	1	School

35	Iglesia	7	1	Church
36	Derecha	7	1	Right
37	Pequeño	7	1	Small
38	Hermano	7	1	Brother
39	Abrazar	7	0	To hug
40	Naranja	7	1	Orange
41	Porción	7	1	Portion
42	Limpiar	7	0	To clean
43	Monedas	7	1	Coins
44	Conocer	7	0	To know
45	Reunión	7	1	Meeting
46	Aceptar	7	0	To accept
47	Lámpara	7	1	Lamp
48	Cazador	7	1	Hunter
49	Colchón	7	1	Mattress
50	Cerveza	7	1	Beer
51	Apagón	7	1	Blackout
52	Barrio	6	1	District
53	Debajo	6	1	Under
54	Fútbol	6	1	Soccer
55	Marrón	6	1	Brown
56	Dinero	6	1	Money
57	Llegar	6	0	To arrive
58	Azúcar	6	1	Sugar
59	Hombre	6	1	Man
60	Gustar	6	0	To like
61	Ningún	6	0	Nobody/no one
62	Fuerte	6	1	Strong
63	Ayudar	6	0	To help
64	Lengua	6	1	Language/tongue
65	Ciudad	6	1	City
66	Vecino	6	1	Neighbor
67	Cocina	6	1	Kitchen/cuisine
68	Zapato	6	1	Shoes
69	Camino	6	1	Path/way
70	Precoz	6	1	Precocious
71	Viento	6	1	Wind
72	Cuñado	6	1	Stepbrother
73	Mañana	6	1	Tomorrow
74	Suegro	6	1	Father-in-law
75	Quince	6	1	Fifteen
76	Verano	6	1	Summer
77	Llover	6	0	To rain

78	Correo	6	1	Mail
79	Tienda	6	1	Shop
80	Queso	5	1	Cheese
81	Museo	5	1	Museum
82	Novio	5	1	Boyfriend
83	Mano	5	1	Hand
84	Pared	5	1	Wall
85	Melón	5	1	Melon
86	Bañar	5	0	To wash
87	Avión	5	1	Airplane
88	Sueño	5	1	Dream
89	Súcio	5	1	Dirty
90	Punto	5	0	Point
91	Tener	5	0	To have
92	Ocho	5	1	Eight
93	Ahora	5	1	Now
94	Mucho	5	1	A lot
95	Señor	5	1	Mister/sir
96	Estoy	5	0	I am
97	Creer	5	0	To believe
98	Otoño	5	0	Fall
99	Plaza	5	1	Park
100	Salir	5	1	To go out/ to get out
101	Traer	5	0	To bring
102	Playa	5	1	Beach
103	Viudo	5	1	Widow
104	Besar	5	0	To kiss
105	Rueda	5	1	Tire
106	Oreja	5	1	Ear
107	Leche	5	1	Milk
108	Dulce	5	1	Sweet
109	Limón	5	1	Lime/lemon
110	Mujer	5	1	Woman
111	Poco	4	1	A little
112	Rojo	4	1	Red
113	Peor	4	1	Worse
114	Vino	4	1	Wine
115	Taza	4	1	Cup
116	Caja	4	1	Box
117	Suya	4	1	Your, her (feminine)

4. Portuguese 2 (Near Identical Words in Portuguese)

	Near Ident POR	# of letters	GC	MEANING
1	Controle	8	1	Controle/Remote Control
2	Concerto	8	1	Concert
3	Livraria	8	1	Bookstore
4	Aflição	7	1	Distress
5	Colchão	7	1	Mattress
6	Questão	7	1	Question
7	Lâmpada	7	1	Lamp
8	Gravata	7	1	Tie
9	Coberto	7	1	Covered
10	Próximo	7	1	Near
11	Cunhado	7	1	Brother-in-law
12	Cozinha	7	1	Kitchen
13	Jaqueta	7	1	Jacket
14	Caminho	7	1	Way/path
15	Precoce	7	1	Precocious
16	Pêssego	7	1	Peach
17	Parede	6	1	Wall
18	Banhar	6	0	To wash
19	Apagão	6	1	Blackout
20	Sapato	6	1	Shoes
21	Pérola	6	1	Pearl
22	Abelha	6	1	Bee
23	Avião	5	1	Airplane
24	Credo	5	1	Creed
25	Melão	5	1	Melon
26	Couro	5	1	Leather
27	Vento	5	1	Wind
28	Noção	5	1	Notion
29	Nosso	5	1	Our
30		6,41379		

5. Spanish 3 (Nonce Words in Spanish)

	Nonce Words SPN	# of letters
1	Borridor	8
2	Mantilón	8
3	Grasqueta	8
4	Fraqueta	8
5	Deceblo	7

6	Tovillo	7
7	Jallota	7
8	Pebulla	7
9	Cocito	6
10	Hevera	6
11	Merota	6
12	Casano	6
13	Semplar	6
14	Camaño	6
15	Cufado	6
16	Pleado	6
17	Tivera	6
18	Puebro	6
19	Muetro	6
20	Brenaz	6
21	Vuento	6
22	Diento	6
23	Fleido	6
24	Pubrir	6
25	Parid	5
26	Liblo	5
27	Fitro	5
28	Meron	5
29	Ravar	5
30	Mauz	4
		6,1666667

6. Portuguese 3 (Nonce Words in Portuguese)

	Nonce Words POR	**# of letters**
1	Villanco	8
2	Crepúlho	8
3	Lambruto	8
4	Passimbo	7
5	Malheto	7
6	Larinto	7
7	Valdade	7
8	Ásquimo	7
9	Labinto	7
10	Sacalho	7
11	Lipanho	7
12	Vianta	6
13	Quendo	6

14	Tizolo	6
15	Pitolé	6
16	Paição	6
17	Nosto	5
18	Loema	5
19	Promo	5
20	Misso	5
21	Finto	5
22	Bolta	5
23	Dento	5
24	Palam	5
25	Pola	4
		6,16

7. German 1 (Real Words in German)

	Words German	# of letters	GC	MEANING
1	Bedienung	9	1	Operation
2	Tierarzt	8	1	Veterinarian
3	Landwirt	8	1	Farmer
4	Polizei	7	1	Police
5	Spielen	7	0	To Play
6	Klavier	7	1	Piano
7	Kleider	7	1	Clothes
8	Ritter	6	1	Knight
9	Lassen	6	0	To Let, to leave
10	Sessel	6	1	Chair
11	Hemden	6	1	Shirts
12	Gürtel	6	1	Belt
13	Morgen	6	1	Morning
14	Pferd	5	1	Horse
15	Wache	5	1	Guard
16	Ampel	5	1	Traffic Lights
17	Keine	5	1	No
18	Katze	5	1	Cat
19	Dauer	5	1	Duration
20	Anzug	5	1	Suit
21	Kleid	5	1	Dress
22	Bitte	5	1	Please
23	Tisch	5	1	Table

8. Basque 1 (Real Words in Basque)

	Words Basque	# of letters	GC	MEANING
1	Txapeldum	9	1	Champion
2	Lursagar	8	1	Potato
3	Imintzio	8	1	Invention
4	Argazki	7	1	Picture
5	Txalupa	7	1	Boat
6	Belarri	7	1	Ear
7	Oilasko	7	1	Chicken
8	Etorri	6	0	To come
9	Itsaso	6	1	Sea
10	Katilu	6	1	Boot
11	Ilargi	6	1	Moon
12	Askatz	6	1	Freedom
13	Ukondo	6	1	Elbow
14	Anaia	5	1	Brother of a male
15	Aulki	5	1	Chair
16	Amona	5	1	Paternal grandmother
17	Gopor	5	1	Bowl
18	Sudur	5	1	Nose
19	Orain	5	1	Now
20	Hodei	5	1	Cloud
21	Kaixo	5	1	Hello
22	Zaspi	5	1	Seven
23	Mahai	5	1	Table

APPENDIX D

HUMAN SUBJECTS APPROVAL LETTERS

APPROVAL MEMORANDUM

Date: 10/18/2012

To: Jamile Forcelini

Address: [redacted]

Dept.: MODERN LANGUAGES AND LINGUISTICS

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research
The effects of Spanish in L3 Portuguese Language Learning

The application that you submitted to this office in regard to the use of human subjects in the proposal referenced above have been reviewed by the Secretary, the Chair, and one member of the Human Subjects Committee. Your project is determined to be Expedited per per 45 CFR § 46.110(7) and has been approved by an expedited review process.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 10/15/2013 you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the Chair of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is FWA00000168/IRB number IRB00000446.

Cc: Michael Leeser, Advisor
HSC No. 2012.8970

REFERENCES

Ana I. Schwartz, Judith F. Kroll, and Michele Diaz. "Reading words in Spanish and English: Mapping orthography to phonology in two languages" *Language and Cognitive Processes* 22 (2007): 106-129.

Bijeljac-Babic, R, Biardeau, A & Grainger, J. (1997). Masked orthographic priming in bilingual word recognition. *Memory & Cognition*, 25, 447-457.

Camorlinga, R. (1997) A distância da proximidade - a dificuldade de aprender uma língua fácil. *Intercambio* Vol. VI São Paulo.

Crystal, D. (1997). *The Cambridge encyclopedia of language*.Cambridge: Cambridge University Press.

De Groot, A.M.B. (2011). *Language and Cognition in Bilinguals and Multilinguals: An Introduction.* New York*:* Taylor and Francis.

De Moor, W. (1998) Visuele woordherkenning bij tweeta-lige personen [Visual word recognition in bilinguals]. Master's thesis. University of Ghent.

Flynn S, Vinnitskaya I and Foley C (2004).*The cumulative enhancement model for language acquisition: Comparing adults and children patterns in development in first, second language acquistion of relative clauses*. Internation Journal of Multilinagualism 1: 3 – 16.

Gerard, L, & Scarborough, D. (1989). Language-specific lexical access of homographs by bilinguals. Journal of Experimental Psychology: Learning, Memory and Cognition, 15, 305-313

Green, D. (1998a). Mental control of the bilingual lexico-semantic system. Bilingualism: Language and cognition 1, p. 67-81.

Grainger, J., &Dijkstra, T. (1992).On the representation and use of language information in bilinguals.In R. J. Harris (Ed.) *Cognitive processing in bilinguals* (p. 207-220). Amsterdam: Elsevier Science Publishers.

Grosjean, F.(1982). *Life with two languages*. Cambridge: Harvard University Press.

Grosjean, F.(1998). Studying bilinguals: Methodological and conceptual issues. Bilingualism: Language and cognition 1, p. 131-149.

Jared, D., & Szucs, C. (2002). Phonological activation in bilinguals: Evidence fromintelingual homograph naming. Bilingualism, Language, & Cognition, 5, 225-239.

Keuleers, E., & Brysbaert, M. (2010).Wuggy: A multilingual pseudoword generator. Behavior Research Methods *42*(3), 627-633

Kroll, J. F., & Groot, A. M. B. (2005). *Handbook of bilingualism: Psycholinguistic approaches*. Oxford: Oxford University Press.

Lemhöfer, K., Dijkstra, A., & Michel, M. (2004). Three languages, one ECHO: Cognate effects in trilingual word recognition. Language and Cognitive Processes, 19, 585-611.

McDonough, K. & Trofimovich, P. (2009).*Using Priming Methods in Second Language Research. New York: Routledge.*

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.

Montrul, S. (2004).*Subject and object expression in Spanish heritage speakers: a case of morphosyntactic expression*, Bilingualism: Language and Cognition, 7:2, 125-142.

Montrul et al. (2011).*Clitics and object expression in acquisition of L3 Brazilian Portuguese: structure similarity matters for transfer*, Second language Research, 27:1, 21-58.

Rastle, K., & Brysbaert, M.(2006). Masked phonological priming effects in English. Are they real? Do they matter? Cognitive Psychology, 53, 97-145.Journal of Experimental Psychology: Learning, Memory and Cognition, 15, 305-313.

Sanchéz, L. (2004). *Functional convergence in the tense, evidentiality and aspectual systems of Quechua Spanish bilinguals*, Bilingualism: Language and Cognition, 7:2, 147-162.

Schwartz, A., & Sunderman, G. (2008).Using cognates to investigate cross-language competition in second language processing. *TESOL Quarterly*, *42*(3), 527-536. Retrieved from http://www.jstor.org/stable/40264482

StataCorp. (2011). *Stata Statistical Software: Release 12*. College Station, TX: Stata Corp LP.

VanPatten, B., Leeser, M., & Keating, G. D.(2012). *Sol y viento: beginning spanish*. (3rd ed.). New York, NY: McGraw-Hill.

Van Heuven, W. J. B., & Dijkstra, T. (2002).The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Language and Cognition*, *5*(3), 175-197.

Van Heste, T (1999). Visuele woordherkenning bij tweetaligen [Visual word recognition in bilinguals]. Unpublished master's thesis, University of Leuven, Belgium.

Von Studnitz, R. E. (2002). *An investigation of control processes in bilinguals, using visual word recognition tasks. (BL: DXN069311).* University of London, University College London (United Kingdom)). *PQDT - UK & Ireland,* Retrieved from http://search.proquest.com/docview/301623317?accountid=4840. (301623317).

Witzel, N. O. (2010). *How words are represented in bilingual memory.* The University of Arizona). *ProQuest Dissertations and Theses*, 131. Retrieved from http://search.proquest.com/docview/741008844?accountid=4840.(741008844).

BIOGRAPHICAL SKETCH

Jamile M. Forcelini is originally from Passo Fundo, Rio Grande do Sul, Brazil and has lived in the United States for many years. She obtained her B.A. in Languages and Literature (English and Portuguese) from Universidade de Passo Fundo in Brazil. After working as a Fulbright scholar teaching Portuguese at Florida A&M University in Tallahassee, she decided to pursue her graduate studies and received her M.A. from Florida State University in Spanish linguistics. Jamile's research interests include second and third language acquisition, psycholinguistics and neurolinguistics.