UNIVERSIDADE FEDERAL DE SANTA CATARINA
CENTRO DE COMUNICAÇÃO E EXPRESSÃO
PROGRAMA DE PÓS-GRADUAÇÃO EM INGLÊS

Luiza de Melo Carvalho

INVESTIGATING COGNATE EFFECTS ACROSS DIFFERENT WRITING SCRIPTS: THE CASE OF BRAZILIAN PORTUGUESE-ENGLISH-KOREAN MULTILINGUALS

Florianópolis
2023

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Dissertação submetida ao Programa de Pós-Graduação em Inglês: Estudos Linguísticos e Literários da Universidade Federal de Santa Catarina para a obtenção do grau de Mestre em Inglês: Estudos Linguísticos e Literários.

Orientadora: Prof.ª Dra. Mailce Borges Mota.

Florianópolis
2023

Ficha de identificação da obra elaborada pela autora, através do Programa de Geração Automática da Biblioteca Universitária da UFSC.

Carvalho, Luiza de Melo
Investigating cognate effects across different writing scripts : The case of Brazilian Portuguese - English - Korean multilinguals / Luiza de Melo Carvalho ; orientadora, Mailce Borges Mota, 2023.
114 p.

Dissertação (mestrado) - Universidade Federal de Santa Catarina, Centro de Comunicação e Expressão, Programa de Pós-Graduação em Inglês: Estudos Linguísticos e Literários, Florianópolis, 2023.

Inclui referências.

1. Inglês. 2. acesso lexical. 3. sistemas de escrita. 4. produção lexical. 5. multilinguismo. I. Mota, Mailce Borges. II. Universidade Federal de Santa Catarina. Programa de Pós-Graduação em Inglês: Estudos Linguísticos e Literários. III. Título.

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O presente trabalho em nível de mestrado foi avaliado e aprovado por banca examinadora composta pelos seguintes membros:

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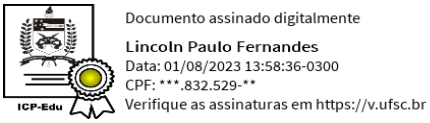

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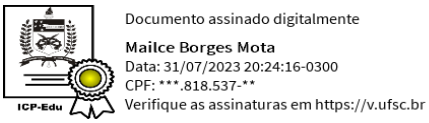

Profa., Dra. Mailce Borges Mota Orientadora

Florianópolis, 2023.

To my mother,

Valéria Cardoso de Melo Carvalho (*in memoriam),*

the woman who taught me knowledge is our most valuable possession.

ACKNOWLEDGMENTS

It is impossible to measure how much has changed since the first draft of my research project until today. It is even more difficult to measure how much I have changed during these two years. We had a global scale pandemic that took millions of lives and had us all isolated in our homes. Therefore, most of this study has been elaborated during the days of social isolation and distance learning, which made the research process feel lonely and challenging. However, even in the hardest times of isolation, I knew I had people I could reach out to when things got rough. This work is about changing, growing and learning, and it is dedicated to all of you who supported me through it all.

My advisor, Prof. Dr. Mailce Borges Mota, thank you for your trust and for giving me the honor to be your advisee one more time. You are an example of both a scientist and a woman that I look up to every single day.

My father, Yves Miceli de Carvalho, thank you for supporting every choice I make, and encouraging me to go beyond. My family, thank you for your love and support, for making my days brighter and happier. Everything that I have accomplished is dedicated to you.

My partner in science, and in life, João Vitor Chiella Santin. Thank you for your unconditional love, support, and friendship. I am looking forward to exploring the world by your side while writing the next chapter of our lives. I love you from Connecticut to Enschede, to the moon and back.

Pietra Cassol Rigatti and Danielle dos Santos Wisintainer, your guidance, advice, support and friendship were paramount to the completion of this work. Pedro Ricardo Bin, Natalia Pinheiro de Angeli, João Luiz Coelho, and Luiz Fernando de Carvalho, thank you for reading my work, assisting me from stimuli elaboration to data collection, and discussing my ideas with me. You made me feel confident in moments of self-doubt.

My shared brain cell, Beatriz Moriya Baptistotti and Bruna Leticia Climaco, thank you for making me laugh 24/7. You always know how to make me feel better, and I thank the stars every day for giving me our friendship.

Ana Paula dos Santos, Bruna Carolina, Camila, Cesar, Daniela, Dmitria, Eliani, Giovanny, Júlia, and Solange, thank you for your support and friendship through all these years. You never cease to amaze me.

Ana Paula Saquetti and Mariana Dias, thank you for our coffee breaks and Sunday talks. Your friendship got me through the most difficult moments.

To my friends of a lifetime, Ana Helena, Anna Laura, Carolina, Laura, and Luiza. Thank you for being with me here, there, and everywhere in the past 18 years. Wherever I go, I know I can count on you.

To my students, thank you for challenging me and making me a better teacher.

Carlos Henrique Lima Melara, thank you for your friendship and assistance with the programming of my experiment once again.

To the participants who dedicated part of their time to help me in my study, thank you for your collaboration and participation. This work is also product of your passion for learning Korean.

To all LabLing members, thank you for the support during the last three years. With you I learned that scientific development is only made possible through collaborative work.

Finally, I would like to thank the Universidade Federal de Santa Catarina (UFSC), for being my home in the past 6 years. Thank you to the Graduate Program in English and its faculty for all the doors opened. To Conselho Nacional de Desenvolvimento Cientifico e Tecnológico (CNPq), thank you for financially supporting this work.

One child, one teacher, one book, and one pen can change the world.

— Malala Yousafzai

ABSTRACT

The investigation of the multilingual mental lexicon through lexical access is a heated topic in the field of psycholinguistics, and it has been investigated through a variety of tasks, across a wide range of participants. Although research in the area has progressed, there are still questions to be asked, such as how do the multilinguals' languages interact in the brain with recently learned language? How do they visually recognize a word in a new language, specially one with no orthographic similarities to their previously acquired languages? The cross-linguistic form overlap of cognates has been used to investigate if words from different languages are co-activated during the reading, listening, and speaking of bilinguals. In psycholinguistic experiments, cognates have been shown to be visually recognized faster than non-cognates or pseudo-words – a phenomenon called cognate facilitation effect. This facilitation effect indicates that bilingual individuals activate lexical items in their L1 and their L2, simultaneously, and it is one of the most robust bilingual effects. With these questions in mind, the present study investigated cognate facilitation effect in visual word recognition and naming, in unbalanced multilingual speakers of Brazilian Portuguese-English-Korean. In an experimental task, 31 participants were asked to name double cognates, triple cognates, and non-cognate words in Korean. The results did not show cognate facilitation effect of neither double nor triple cognates in comparison to control words. In fact, an inhibition effect was observed. Additionally, double cognates were named faster than triple cognates, thus, the cognate effect did not seem to accumulate over languages. Still, language proficiency in the L3 was shown to influence cognate naming. These findings indicate that the cognate effect can be modulated by multiple factors and that for orthographically distant languages, the cognate effect might arise only when lexical links are strengthened, as learners achieve higher levels of proficiency in their L3.

Keywords: writing systems, lexical access, lexical production, multilingualism

RESUMO

A investigação do léxico mental multilíngue através do processo de acesso lexical é um tópico altamente discutido na área da psicolinguística, e tem sido investigado em um diversas populações através de diferentes tarefas experimentais. Apesar do progresso das pesquisas na área, ainda há perguntas a serem respondidas, como por exemplo, como as línguas de indivíduos multilíngues interagem com um novo sistema adquirido? Como estes indivíduos reconhecem visualmente palavras em uma nova língua, principalmente aquelas que não compartilham informações ortográficas com as línguas previamente adquiridas? A sobreposição de forma interlinguística dos cognatos tem sido utilizada para investigar se palavras de diferentes idiomas são coativadas durante a compreensão e produção linguística em falantes bilíngues. A psicolinguística experimental identificou um reconhecimento visual mais rápido de palavras cognatas em comparação a não-cognatos ou não-palavras – um fenômeno intitulado efeito de facilitação de cognatos. Este efeito facilitador indica que falantes bilingues ativam itens lexicais de forma simultânea em ambas L1 e L2, e é um dos efeitos bilíngues mais robustos já identificados. Assim sendo, o presente estudo investigou o efeito de facilitação de cognatos no reconhecimento visual de palavras por falantes multilíngues de português brasileiro-inglês-coreano. Em nossa tarefa experimental, 31 participantes nomearam, em coreano, cognatos duplos, triplos e palavras não cognatas. Os resultados não indicaram efeito de facilitação de cognatos em comparação com a condição controle. Na verdade, um efeito inibitório foi observado. Ademais, cognatos duplos foram nomeados mais rapidamente do que cognatos triplos, dessa forma, o efeito não acumulou através das línguas. Apesar de não termos identificado facilitação entre as condições experimentais, a proficiência na L3 pareceu influenciar a nomeação dos cognatos. Estes resultados indicam que o efeito de facilitação de cognatos pode ser modulado por diversos fatores e para línguas mais distantes ortograficamente, o efeito de cognatos possivelmente só se manifestaria com o fortalecimento dos elos lexicais, na medida em que os aprendizes atingem níveis mais altos de proficiência na L3.

Palavras-chave: sistemas de escrita, acesso lexical, produção lexical, multilinguismo

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LIST OF ABBREVIATIONS AND ACRONYMS

ASCII – American Standard Code for Information Interchange

BIA – Bilingual Interactive Activation model

BIA+ - Bilingual Interactive Activation Plus model

BP – Brazilian Portuguese

CEFR – Common European Framework Reference for Languages

CEPESH/UFSC – Human research ethics commitee

DRC – Dual Route Cascaded model

ENG – English

ERP – Event-related potential

fMRI – Functional magnetic ressonance imagin

GPC – Grapheme-to-phoneme correspondence

IA – Interactive activation model

KR – Korean

L1 – First language

L2 – Second language

L2WS – Second language writing systems

L3 – Third language

LabLing – Language and Cognitive Processes Laboratory

LHQ – Language History Questionnaire

LHQ3 – Language History Questionnaire 3

MIA – Multilingual interactive activation

RHM – Revised hierarchical model

RQ – Research Question

RT – Reaction time

SLA – Second language acquisition

TIA – Trilingual interactive activation

TOPIK – Test of Proficiency in Korean

TTMIK – Talk to me in Korean

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1 INTRODUCTION

In August 2019, the National British Library hosted an exhibition which the objective was to map the history of one of the human beings' most extraordinary inventions: the writing systems. Entitled *Writing: Making your mark,* the exhibition held more than one hundred objects, spanning 5,000 years of history of the written language through the seven continents (CLAYTON, 2019). Clayton (2019), the curator, highlights that complete writing systems seem to have been invented, independently, at least four times throughout history. Beginning in the ancient Mesopotamia, between 4000 and 3500 B.C., the cuneiform writing is considered the first writing system to represent a systemic phoneticism, thus, being considered a complete writing system (FISCHER, 2003). Its impact is such that the cuneiform writing has inspired neighboring regions to adopt systems to represent the written language. Therefore, Afro-Asian, East Asian, and American written traditions all have Sumerian origin.

Since then, three main writing systems prevailed, namely, logographic, syllabic, and alphabetic writing systems, with many variations and transitional combinations (FISCHER, 2003). For instance, the Japanese language makes use of more than one writing system for its graphic representation – the syllabic hiragana, katakana, and the logographic kanji. Therefore, it is not uncommon for a person to master identifying written language in different systems, either in their first language (L1) or additional ones.

It is important to highlight that even in languages represented by different writing systems, there is still the possibility of sharing phonological information. An example of this sharing is the presence of cognates in languages with distinct writing systems, which are defined as words from different languages that share phonological form and similar meaning (MUYLLE; ASSCHE; HARTSUIKER, 2019). Languages such as Japanese and Korean, for example, have in their lexicons cognate words shared with the English language, despite their differences in written representation.

In experimental Psycholinguistics, a way of investigating the mental lexicon and the bilingual lexical storage is through observing the processing of cognate words. Cognates are words that share form and meaning across different languages. Cognates' interlingual overlap in form has been adopted by researchers to investigate whether or not words from different languages are co-activated during bilingual reading, listening, and speaking (DIJKSTRA et al., 2010). The visual word recognition of cognate words occurs more rapidly than non-cognates or non-words. More

specifically, an L2 cognate word also activates the lexical representation of its L1 cognate, which accelerates the recognition of such words – an effect known as cognate facilitation (DIJKSTRA et al., 2010; DIJKSTRA; VAN HEUVEN, 2002; OTWINOWSKA et al., 2020; VAN ASSCHE, EVA et al., 2012). The cognate facilitation effect is an indicator of simultaneous activation of both L1 and L2 in the bilingual mental lexicon, during the selection of a word for language processing or production (VAN ASSCHE, EVA et al., 2012). The non-selectivity in accessing these words indicates a shared mental lexicon across languages. However, it is still necessary to investigate more deeply the organization and storage in the multilingual mental lexicon.

One way of investigating cognate effects is through word naming tasks, in which participants are asked to read a presented word aloud, as quickly and accurately as possible. In this task, their reaction times (RT) are measured as the time from which the target word was presented and the onset of their oral production. Even though word naming is a way of investigating lexical access, the oral production implies lexical production, which requires first choosing the meaning for the intended concept, then recovering its phonological or orthographic representation, and finally converting it into a series of motor actions (SZUBKO-SITAREK, 2015).

In this context, the present study aims at better understanding the effects that the co-existence of different writing systems has in the multilingual mind. More specifically, the main objective of this study is to investigate cognate facilitation effect across languages that do not share orthographic information, in learners of Korean as an L3 that had already acquired Brazilian Portuguese (BP) as their L1 and English as their L2. The first specific objective is to investigate if the presence of double cognates (English-Korean) facilitates word naming in BP-ENG learners of Korean as L3. The second specific objective is to investigate if triple cognates are named faster than non-cognate Korean words. The third and final specific objective is to investigate if triple cognates are named faster in comparison to double cognate words. These goals and their respective hypotheses will be further explored in Chapter 3, while the theoretical framework will be detailed in the following chapter.

The research questions that guided the work were the following:

RQ1: How do native speakers of BP, who have English as L2 and are at low proficiency in Korean as L3 recognize double cognates in comparison with non-cognate words?

RQ2: How do native speakers of BP, who have English as L2 and are at low proficiency in Korean as L3 recognize triple cognates in comparison with non-cognate words?

RQ3: How do native speakers of BP, who have English as L2 and are at low proficiency in Korean as L3 recognize triple cognates in comparison with double cognate words?

1.1 SIGNIFICANCE OF THE STUDY

Opposed to the common belief that bilingualism is a rare phenomenon, most of the world's population is non-monolingual. Language diversity within nations and communities has always existed, however, with modern technological development, migration, and globalization, there is a growing need for communication between individuals with different L1. With its consolidation as a lingua franca, English is currently the most spoken L2 in the world (GROSJEAN, 2018). However, it is not the only language people aspire to learn in the 21st century.

Internet and media have made it possible for cultures to connect across the globe in a matter of seconds. In this context, the Korean culture has captivated millions of fans around the world. Korean movies, TV shows, music, and food have provoked the curiosity and gained admiration of people from different nationalities and cultures. The expansion of the Korean culture is called *Hallyu* – the Korean wave, and it has not only promoted a keen interest in Korean pop culture and media, but also encouraged many people across the globe to learn the Korean language (CHAN et al., 2011). In fact, in 2021, Korean was Duolingo's 7th most popular language to study globally—and the number of users learning the language has increased 29% in monthly active users from June 2021 to June 2022 (BLANCO, 2021, 2022a; BURT, 2022).

In Brazil, this phenomenon has also been observed. Ko and colleagues (2014) have observed that with vast majority of the Brazilian Hallyu fans were of non-Asian descent and that the fans were characterized by a high level of education in addition to a low economic status. Their contact with the Korean culture has motivated Brazilian Hallyu fans to learn the Korean language. Therefore, the population of native speakers of Brazilian Portuguese learning Korean has been increasing drastically, being the fastest-growing language in Brazil – which accounts for the purpose of the present study (BLANCO, 2021, 2022a, 2022b).

The participants were native speakers of BP, who had previously acquired L2 English and were, at the time of the study, learning Korean as L3. This specific group of participants was selected for multiple reasons. First, the English language holds the status of an international

language and the most common second language in the world. Thus, it not only influences the Korean language through lexical borrowing, but Portuguese as well. Additionally, more and more Brazilians are seeking to learn the Korean language. However, for this specific population, learning Korean includes learning to visually recognize words in a new form of writing, in a language that does not have a lot of similarities to their L1 nor their L2. In light of that, it becomes clear that in order to paint a detailed picture of how the multilinguals' languages interact in the brain when a new language is being learned, specially one with no orthographic similarities, this population should be accounted for.

As Szubko-Sitarek (2015) argues, the larger the number of different languages in the mental lexicon, the greater is its complexity. In other words, the more languages we add to an individual's mental lexicon, the more complex is its organization and access. Moreover, considering the complexity involved in generalizing bi- and multilingual individuals, given the intricate nature of their individual differences in learning experiences, contexts, and particularities of their L1, there is still a lot to be explored in terms of the organization and processing in the multilingual mental lexicon. On this note, the present study can offer significant contributions to the areas of psycholinguistics and second language learning and contribute to the discussion of language selectivity in lexical access.

Albeit with caution, implications for the field of L2 teaching can also be drawn from the results of the present study. For instance, knowing how Brazilian learners of Korean identify visual word representation, may illuminate Korean teachers and curriculum designers on how to better approach these learners' particularities in the classroom.

Additionally, the on-going debate regarding the nature of the multilingual lexical storage will also be benefited by the results presented here. The investigation of the multilingual mental lexicon through lexical access is a hot topic in the field of psycholinguistics, and it has been investigated through a variety of tasks, across a wide range of participants. However, it was not until recently that non-European languages and communities were looked at. Finally, this study also contributes to a family of lexical access studies conducted at LabLing (CARVALHO; MOTA; RIGATTI, 2021; DE RESENDE; MOTA; SEUREN, 2019; TOASSI, 2012, 2016; TOASSI; MOTA, 2018, 2021; TOASSI; MOTA; TEIXEIRA, 2020). Together, these studies support the

view that multilingual language processing is language nonselective, and that it is affected by participants' level of proficiency.

1.2 ORGANIZATION OF THE THESIS

The present thesis is motivated by a genuine interest in learning to read in a second language. Chapter 1 was an introduction to the multilingual lexical storage, with a special focus on cognate facilitation effect in lexical access and language nonselective lexical access. More than that, chapter 1 also presented the general objective of the present study, research questions, the significance of study and the organization of this thesis.

Chapter 2 presents the theoretical and empirical foundation of the study. Section 2.1 explains the definitions of bilingualism and multilingualism, and its importance in the psycholinguistic literature. Section 2.2 introduces mental lexicon and lexical access, while its subsection 2.2.1 presents and discusses lexical storage and language selectivity in lexical access. After introducing these concepts, in subsection 2.2.2, the interactive activation model for monolingual word recognition is presented, in order later introduce the models of lexical access in bilinguals in subsection 2.2.3, as well as Multilingual Interactive Activation model in subsection 2.2.4. In subsection 2.2.5, Dijkstra and colleagues' (2019) Multilink model, a computational model for bilingual word recognition and word translation, is discussed. Section 2.3 defines writing systems, scripts, and orthographies, while its subsection 2.3.1 further details Brazilian Portuguese, English, and Korean writing systems. Moving towards the main topic of the present study, visual word recognition and cognate facilitation effect are discussed in section 2.4. Subsection 2.4.1 is dedicated to discuss visual word recognition, while subsection 2.4.2 presents word naming task. Cognates and cognate facilitation effect are discussed in subsection 2.4.3. Finally, the relationship between English and Korean languages is discussed in subsection 2.4.4.

Chapter 3 presents the method of the study conducted. First, in section 3.1 I present my research questions, hypotheses, and rationale. Then, in section 3.2 the experimental design is presented followed by the experimental stimuli on section 3.3. The participants are introduced in section 3.4 and the instruments are presented in section 3.5, which is divided in subsections 3.5.1 Language History Questionnaire (LHQ), 3.5.2 English proficiency test, 3.5.3 Korean level test, 3.5.4 word naming task, and 3.5.5 meaning recognition task. In section 3.6 the procedures of the

study are described. The ethics review board process is explained in section 3.7, and the pre-pilot and pilot studies are explained in section 3.8.

Chapter 4 contains the results of the study conducted. First, I explain the data organization procedures in section 4.1. The results of the LHQ are presented in section 4.2, while the results of the meaning recognition task are presented in section 4.3. The descriptive statistic for the word naming task is presented in section 4.4 and the inferential statistics is approached in section 4.5. The exploratory analyses are discussed in section 4.6.

Chapter 5 discusses the results. The research questions are answered throughout section 5.1, which is divided in three subsections – one for each RQ. Subsection 5.1.1 answers RQ1, comparing double cognates and non-cognates' RTs. Subsection 5.1.2 answers RQ2, comparing triple cognates and non-cognates' RTs. At the same time, subsection 5.1.3 answers RQ3, comparing double cognates and triple cognates' RTs. Lastly, in subsection 5.1.4, I present general comments regarding the results of the word naming task.

Chapter 6 concludes the present thesis with some final considerations and section 6.1 discusses some limitations and implications for future research.

2 REVIEW OF LITERATURE

This chapter presents definitions for the concepts involved in this study and reviews studies related to mental lexicon, lexical access, and the cognate facilitation effect across a variety of languages. It is divided into five sections, which are further subdivided. The first section of this chapter (2.1) defines bilingualism and multilingualism, eliciting the definitions adopted by this study. Section 2.2 presents mental lexicon and lexical access, as well as different models of lexical access for monolinguals, bilinguals, and multilinguals. Then, in section 2.3. I explain the cognate facilitation effect and review studies that investigated this phenomenon. In section 2.4 I present the main definitions of writing systems, scripts, and orthographies. Finally, in section 2.5, I present the history of English-Korean cognates in order to better understand the stimuli that will be used in this study.

2.1 BILINGUALISM AND MULTILINGUALISM

Contrary to the common belief that bilingualism is a rare phenomenon, most of the world's population is bilingual (GROSJEAN, 2010, 2018). According to the latest count, there are more than 7,000 living languages in the world (EBERHARD; SIMONS; FENNIG, 2023). With such large number, contact between people of different language groups becomes inevitable. As a consequence of this language contact, bilingualism arises as members of one group will learn the language of another in order to establish communication (GROSJEAN, 2010). The constant movement of people, through immigration or for commercial purposes, have long given rise to bilingualism – a worldwide phenomenon found on all continents and in the majority of the countries of the world. Despite the large number and variety of languages spoken in the world, English is the language that has the most speakers around the world. Notwithstanding, the number of non-native English speakers surpasses the native speakers, as it has been adopted as a lingua franca used for business, commerce and online communication across the globe. Over

1,200,000,000 people are speakers of English, but only 373,000,000 are native speakers (EBERHARD; SIMONS; FENNIG, 2023).

As bilingualism grew, so did the interest of researchers in understanding how languages are learned and acquired in different contexts and by different populations. One of the most dynamic areas of bilingualism research involves the psychological processes related to language function (GROSJEAN, 2010). The field of second language acquisition (SLA) as well as the field of bilingualism/multilingualism have emerged as a result of the interest in understanding how more than one language is acquired, stored, and accessed in the brain.

However, as Jessner (2008) points out, researchers of SLA and bilingualism have conducted investigations of similar phenomena almost totally independent of each other. In particular, researchers of bilingualism and multilingualism have challenged some of the leading major premises and approaches that have been widely subscribed to in SLA research. One of the major repeated criticisms is the assumption that bilinguals' language competencies are qualitatively the same as monolingual users of the target language – the monolingual bias. This criticism is based on the fact that many SLA studies have compared L2 learners' performance with those of monolingual native speakers of the target language. At the same time, another issue within the SLA research is the bilingual bias, which is the assumption that language acquisition and processing among multilinguals are fundamentally the same as with bilinguals. While we still have only limited research on multilinguals' language acquisition, there is growing evidence that this assumption is not assured (BUTLER, 2012).

Thus, even though scholars, such as Grosjean (1982, 2010, 2018), define bilingualism as the use of two – or more – languages, this definition of bilingualism generates confusion in the field (SZUBKO-SITAREK, 2015). In the same line as Grosjean, Cook (2004) refers to bilinguals as L2 users – individuals who know or use an L2 in any level. The author adopts the term L2 user instead of bilingual considering that "the term bilingual (…) has so many contradictory definitions and associations in popular and academic usage that it seems best to avoid it whenever possible" (COOK, 2004, p. 4). According to the author, most people in the world are multi-competent users of two or more languages. He also draws a distinction between L2 users and L2 learners. The former would have real life purposes when using an L2, while the latter would have no immediate purpose for learning a language and would only be acquiring it for later use. This distinction between L2 learners and users is entrenched in the distinctions made between SLA and

bilingualism/multilingualism research. It is relevant to comment that the view of L2 learners appears to be quite outdated. With the internet extremely entrenched in our daily lives, being an L2 learner does not mean an individual will not make immediate use of the language. Indeed, it will not be in the same proportion as an L2 user inserted in an L2 dominated environment, but with the flexibility to connect across the globe with speakers of countless languages, an L2 learner could easily become an L2 user – which makes this distinction seem unnecessary nowadays. Jessner (2006) also comments on this distinction, stating that using and learning can also together form part of bilingual or second language development, which is the case, for instance, in bilingual children whose parents speak two languages or in immigrants who need to learn the new language and at the same time are already forced to make use of it in order to survive.

What we know is that bilingualism is a dynamic and interactive experience characterized by not only individual, but also contextual factors (SURRAIN; LUK, 2019). As Mackey (1962) wrote, "the point at which a speaker of a second language becomes bilingual is either arbitrary or impossible to determine. ... We are forced to consider [bilingualism] as something entirely relative" (p. 52). Thus, in the same way bilingual experience is different from monolingual experience, multilingual experience should also be considered substantially different from bilingual experience.

Although bilingualism and multilingualism have been used interchangeably, they are far from being identical. There are qualitative differences between the two phenomena. Moreover, there is a wide variety of factors affecting third or additional language acquisition that are "much more complex than those involved in the process of L2 learning" (SZUBKO-SITAREK, 2015, p. 8). As Szubko-Sitarek (2015) elicits, these factors include age and sequence of acquisition of all non-native languages, proficiency level in all languages, as well as context and manner of acquisition. Furthermore, it is important to highlight that L2 is taught to monolinguals, while L3 to bilinguals – who have already incorporated a second language into their linguistic system.

Even though bilingualism and multilingualism have a lot in common, research on the acquisition and processing of two languages cannot explain specific processes that result from the interaction between the languages in the multilingual's mind. Thus, the need to use the term 'multilingualism' to carry out specific research with individuals who know three or more languages have a theoretical and empirical basis (CENOZ; HUFEISEN; JESSNER, 2003). Considering all the aforementioned factors, there is a demand in the field for a differentiation between bilingualism and multilingualism (DE ANGELIS, 2007). Jessner (2006) affirms that the

term multilingualism has been recently used to refer to the acquisition of more than two languages and/or to the product of having acquired two or more languages. Consequently, the definition of bi- and multilingual individuals must also differ.

With this purpose, Hammarberg (2001) defines bilinguals as individuals who know only two languages, while multilinguals are individuals who know three or more languages (HAMMARBERG, 2001). For the purposes of investigating the learning of a third language's (L3), with focus on learning to read in an L3, the present study will follow Hammarberg's definitions. Here, multilinguals being speakers of three or more languages, and bilinguals being speakers of two languages.

Within the psycholinguistic field, much research has been dedicated to bilingualism. More recently, a steady group of studies dealing with more than two languages has risen. Even though the body of multilingual literature written in the last few decades has been growing fast, further extensive studies are still needed (SZUBKO-SITAREK, 2015).

Taking into account that studies with non-monolingual individuals seek to understand the cognitive processes underlying non-native language acquisition, two crucial features investigated in the area are the mental lexicon and lexical access, which will be explained in the following subsection.

2.2 MENTAL LEXICON AND LEXICAL ACCESS

It is estimated that an adult native speaker of English knows approximately 20,000 words (WARREN, 2012). But how are words stored in our minds? Where are they stored? How do we access them for production and/or comprehension of language? These are some of the questions psycholinguists have been trying to answer, considering multiple contexts.

The idea of a mental dictionary that stored lexical units seems to have been first introduced by Treisman (1961 apud. COLTHEART et al., 2001, p. 208). Her initial idea was of a single channel for recognizing words, presumably encompassing the matching of signals with "some kind of 'dictionary' … some of whose units have their thresholds for activation permanently or temporarily lowered." Moreover, the term mental lexicon was first introduced by Oldfield in 1966 and since then it has been the focus of attention of psycholinguists around the world (RICHARDS; SINGLETON; LONG, 1999). According to Slabakova (2016), the study of the mental lexicon is one of the most vigorously developing areas of bilingualism, as psycholinguists are interested in

understanding the way words are organized and accessed in the bilingual and multilingual lexicon. Several findings have been made in the last 30 years about the way words are organized and accessed in the non-monolingual minds. The mental lexicon has not only been extensively researched, but also re-defined many times (SZUBKO-SITAREK, 2015).

One of the first definitions of mental lexicon was proposed by Fay and Cutler (1977) as a mental dictionary or a listing of words in the head, consisting of pairings of meanings and sound representations. Later on, in 1987, Aitchinson defined the mental lexicon as the human word-storage and a mental dictionary. However, defining the mental lexicon by comparing it to a dictionary was not accurate considering that, back then, dictionaries were not as evolved as they are today. In contrast to today's online dictionaries, which can be constantly updated, it was not possible to make frequent updates in printed dictionaries, as the ones available in the 1970s and 1980s. Due to the mental lexicon's flexibility and ability of incorporating new words, a more accurate and modern definition is the one provided by Szubko-Sitarek (2015), who states that the mental lexicon contains a considerable number of lexical entries including all the information on individual words. Additionally, the author also acknowledges that the organization of the mental lexicon occurs according to relations between meanings (e.g. important and essential are synonyms; important and unimportant are antonyms) and according to the morphological similarity of the lexical items (e.g. "govern," "government," "governmental," "governor").

Nonetheless, the foregoing assumptions are based on the L1 lexical storage and processing. Even though they may be true for the bilingual mental lexicon, the complexity of organization (e.g. conceptual links) and processing (e.g. interference, competition for selection) of lexical items, will be multiplied by the complications added by other lexical systems – those of L2, L3, Ln (SZUBKO-SITAREK, 2015; TOASSI, 2016). Given that the larger the number of different languages in the mental lexicon, the greater is its complexity, thus, there is a need for further exploration of organization and processing in the multilingual mental lexicon.

Consequently, in order to understand the interactions between three or more languages in the mental lexicon, researchers investigate lexical access, defined by Szubko-Sitarek (2015) as the search for a word, or for the match of a word and its correspondent meaning. Reichle (2011) defines lexical access as the process of activating a word's meaning so it can be used in further linguistic processing – which can be interpreted as recovering a word's meaning in comprehension and/or production. However, this definition "makes the processes involved in lexical access seem

too simplistic" (TOASSI, 2016, p. 35). Investigation of lexical access seeks to comprehend not only how the meaning of a word is activated, but also how it is possible to find an intended word for production or comprehension.

Thus, a more accurate definition of lexical access – and adopted in this study – is the one given by Warren (2012), who defines lexical access as a process of getting hold of the information about a word that is stored in the mental lexicon (WARREN, 2012). More specifically, lexical access refers to the point at which the properties of stored lexical representations – phonological, syntactic, semantic, pragmatic – become available so they can be used to develop a meaningful interpretation of an utterance (FRAUENFELDER; TYLER, 1987). Concerning lexical access in multilinguals and the multilingual mental lexicon, although the body of literature on multilinguals has been growing fast in the last few decades, extensive studies are still needed (SZUBKO-SITAREK, 2015).

Szubko-Sitarek (2015) explains that the process of language comprehension involves "receiving a perceptual signal, rendering it into the phonological or orthographic representation and then accessing its meaning" (SZUBKO-SITAREK, 2015, p. 52), while language production involves "choosing the meaning for the intended concept, then recovering its phonological or orthographic representation, and finally converting it into a series of motor actions"(SZUBKO-SITAREK, 2015, p. 52). Thus, even though the stages involved in both processes are similar, they can be deemed as opposite processes because of the direction of the stages involved in each of them.

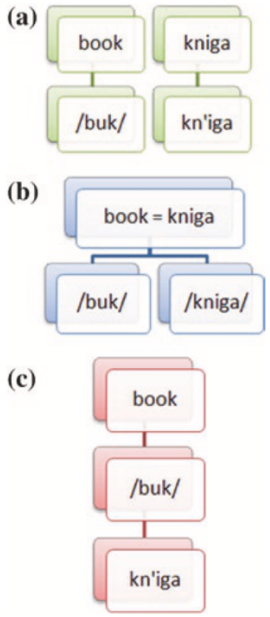
Another issue regarding lexical access in bi- and multilingual individuals is the debate over language selectivity in lexical access, which will be detailed in the following subsection.

2.2.1 Lexical storage and language selectivity in lexical access

A key question concerning non-monolingual lexical storage and access is how are the languages stored and accessed in the mental lexicon – together or separately? In 1953, Weinreich presented his compound-coordinate distinction, the first statement of the shared and separate store hypothesis of bilingual memory (WEINREICH, 2010). According to the author, three types of bilinguals should be considered: coordinate, compound, and subordinative. For the coordinate bilinguals, there are two conceptual representations, one for each word in the L1 and L2. In contrast, the compound bilinguals bear only one conceptual representation for two words (L1 and the equivalent translation in the L2). Concerning the subordinative bilinguals, there is a reliance from

the L2 into the L1. Therefore, access to the conceptual representation of the L2 word is only possible through the L1 word. A depiction of the three types of bilingual representation is presented in Figure 1 (SZUBKO-SITAREK, 2015, p. 69).

Figure 1 - Weinreich's three types of bilingual representation



Source: Szubko-Sitarek (2015, p. 69) Note: a) coordinate, b) compound, c) subordinate.

The coordinate bilinguals are characterized by two separate conceptual systems, thus, a word in the bilingual's L1 and its translation in their L2 are represented in two conceptual forms (DE GROOT, 1993). In contrast to this hypothesis of lexical storage, evidence from studies in cross-linguistic interference and code-switching support the claim that the languages in the mental lexicon do not operate separately – what Weinreich (1953) describes as compound bilingualism. Transfer and code-switching reveal that it is impossible to totally separate the languages in the mind (SZUBKO-SITAREK, 2015). As for subordinative bilinguals, according to De Groot (1993), the level of proficiency will determine the way in which the L2 lexicon will be accessed.

Considering bilingual representation, in relation to lexical storage, Szubko-Sitarek (2015) proposed two hypotheses: the two-store hypothesis, which words from different languages are represented separately; and the one-store hypothesis, in which there is one integrated memory system for both languages. These hypotheses generated heated the debate of whether lexical access is language selective or non-selective. The selective view of lexical access implies that each

language known to an individual is stored in its own independent lexicon. In early studies on lexical access, this position was favored (CARAMAZZA; BRONES, 1979; GERARD; SCARBOROUGH, 1989; SOARES; GROSJEAN, 1984). Notwithstanding, as more studies were conducted, the view of separate lexicons for each language shifted. Now, it is generally agreed that language selective access does not imply in separate lexicons, but it may be the result of different activation patterns for each language (SZUBKO-SITAREK, 2015).

On the other hand, the non-selective view of lexical access implies that language information in all representational levels is stored in one integrated mental lexicon across languages. It is believed that over the last decades, there has been substantial body of research as evidence supporting this view (DE BOT, 2004). Data from eye-tracking and brain-imaging studies are a great source of information supporting this view. Additionally, studies investigating orthographic neighbors (VAN HEUVEN; DIJKSTRA; GRAINGER, 1998), cognates (VAN HELL; DIJKSTRA, 2002), and interlingual homographs (DIJKSTRA; GRAINGER; VAN HEUVEN, 1999; DIJKSTRA; VAN JAARSVELD; BRINKE, 1998) have all provided valuable evidence of interaction between languages known by bilinguals and multilinguals, which leads towards a non-selective, automatic lexical access. Both (or more) languages are simultaneously activated in situations where only one of the languages is required.

In the following subsection, I will discuss the models of monolingual, bilingual, and multilingual lexical access. The question of language selectivity will be further discussed within the presentation of the models.

2.2.2 The interactive activation model for monolingual word recognition

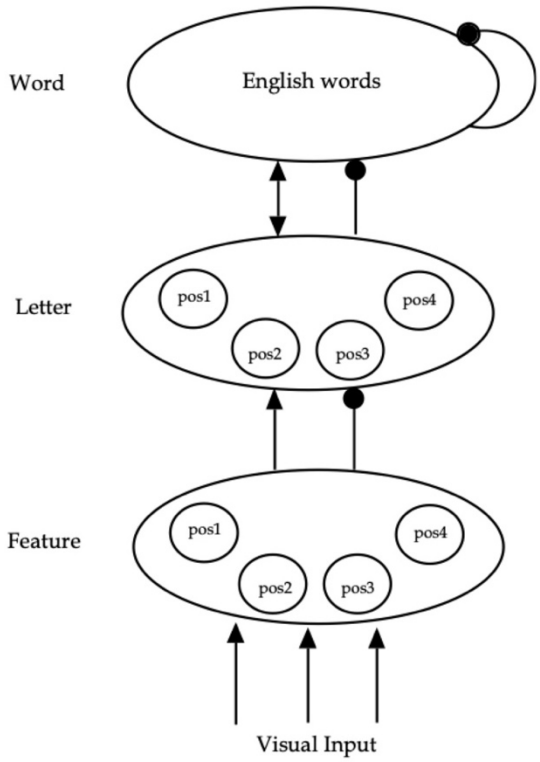
In order to better present the models of lexical access in bilinguals and multilinguals, I will first discuss the Interactive Activation (IA) model proposed by McClelland and Rumelhart (1981), which was the starting point for other models of lexical access in non-monolingual individuals.

The Interactive Activation model is a renowned monolingual model for visual word recognition, and it encompasses units (nodes) corresponding to linguistic representations at three hierarchically arranged levels – features, letters, and words. The first level detects the presence or absence of visual features of letters at different positions in a word. Facilitatory connections happen between nodes and adjacent representation levels and inhibitory connections between nodes at the same level. The input letter string excites particular features at each letter position, which then excite letters that contain them and inhibit letters for which they are absent. Then, in

the second level the selected letters activate, in parallel, words that have that specific letter at the correct position, while all other words and letters in that same position are inhibited. All activated words inhibit each other (lateral inhibition) while they activate their component letters. After some processing cycles, an exact activation value is reached in some word and letter units. When an activation threshold at the word level is crossed, word recognition is assumed to take place. Once the input is turned off, activation decreases towards initial or resting level values, due to activation decay (DIJKSTRA, 2003). An illustration of the IA model is depicted in Figure 2.

In the initial stages of word recognition, multiple word candidates are activated in parallel. The words that differ from the target word in only one letter – called neighbors – become activated because they match the target word in a large extent. These neighbors inhibit other less activated words, helping each other. Afterwards, they start to affect each other's activation and that of the target word negatively through lateral inhibition (DIJKSTRA, 2003).

Figure 2 - The Interactive Activation model of visual word recognition



Normal arrows indicate excitatory connections, lines with ball heads indicate inhibitory connections.

Source: Dijkstra (2003, p.13)

The monolingual IA model was extended towards the bilingual domain, resulting in the Bilingual Interactive Activation Model (DIJKSTRA; VAN HEUVEN, 1998) – one of the models of lexical access in bilinguals, which will be explained in the next section.

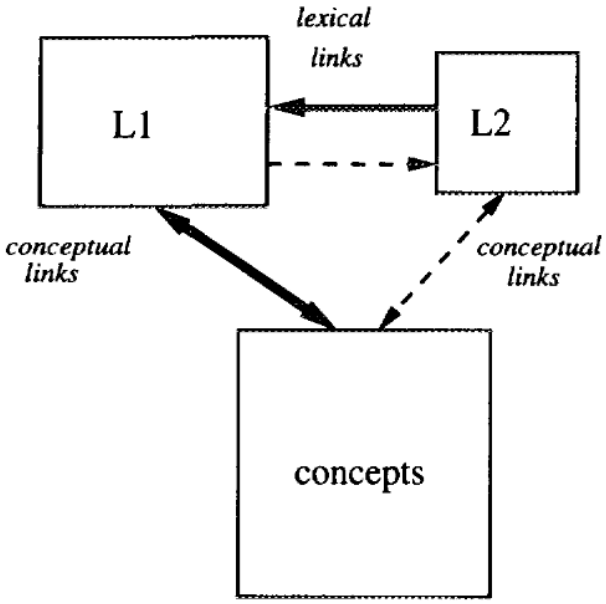
2.2.3 Models of lexical access in bilinguals

Concerning lexical access in bilingual individuals, there are two models widely known in the field, the Revised Hierarchical Model (RHM) and the Bilingual Interactive Activation Model (BIA). Both models will be presented, but the BIA model, will receive more evidence in this section of the review of literature, since it has served as inspiration for multilingual models.

The RHM proposes that the words from bilinguals' two languages are stored in separate lexicons (KROLL; STEWART, 1994). This model was first proposed to account for observed asymmetries in translation performance by late bilinguals who acquired the L2 after early childhood and for whom the L1 remained the dominant language. The model explained longer translation latencies from L1 to L2 (forward translation) than from L2 to L1 (backward translation) as an underlying asymmetry in the strength of the links between words and concepts in each of the bilingual's languages (KROLL; STEWART, 1994). The L1 was hypothesized to have privileged access to meaning, while thought to be more likely to require mediation via the L1 translation equivalent until the bilingual acquired sufficient skill in the L2 to access meaning directly. This model is called hierarchical because it implies the existence of a dominance of the L1 over the L2 (TOASSI, 2016; TOASSI; MOTA, 2015). Furthermore, this model also implies in separate lexicons and a language selective access. The RHM is depicted in Figure 3. Some common tasks to test this model of lexical access in experimental work are: naming task, translation task, ERP

measures, translation recognition paradigm, semantic word detection task, ERP measures and reaction times, and picture naming task.

Figure 3 - Revised Hierarchical Model of lexical and conceptual representation in bilingual memory.



Source: Kroll & Stewart (1994, p. 158)

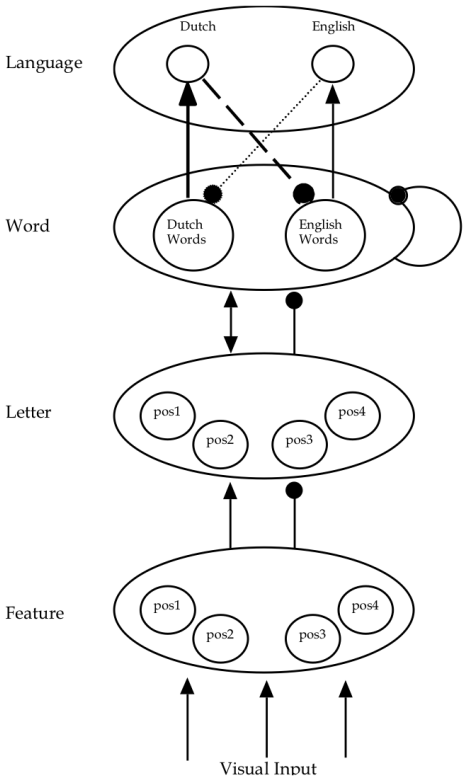
Brysbaert and Duyck (2010) present several challenges to the RHM, such as little evidence for separate mental lexicons and language selective access, the inclusion of excitatory connections between L2 words translation equivalents at the lexical level are likely to impede word recognition. Additionally, the authors claim that connections between L2 words and their meanings are stronger than proposed in RHM, and that, there is enough evidence to make a distinction between language-dependent and language-independent semantic features. They highlight that the RHM cannot easily be adapted to incorporate the aforementioned features. Therefore, the authors suggest that a more fruitful way forward would be to leave the RHM behind and begin from existing monolingual access models and adapt them to bilinguals.

Simultaneously, Kroll and colleagues (2010) commented on Brysbaert and Duyck's (2010) review of the Revised Hierarchical Model arguing that the RHM was not at first a model of word recognition, but of word production (KROLL et al., 2010). Notwithstanding, Kroll and colleagues

(2010) agree that the model needs to be revised, but firmly state that no model should be left behind, as they provide substantial means to problem solving and refining our own thinking.

Contrary to the RHM model, which is a model of word production, Dijkstra and Van Heuven (1998) propose a localist-connectionist model for bilingual language processing as an extension of the Interactive Activation (IA) model – the Bilingual Interaction Activation model (BIA). This model of consists of three levels of representation: letter, word, and language (GRAINGER; DIJKSTRA, 1992). It also assumes that processing is to be initiated bottom-up once input is presented and non-selectively, so that all information resembling the input is activated. The BIA model hypothesizes that all lexical representations from the same language are linked bi-directionally to a single language node at a superior representational level (SZUBKO-SITAREK, 2015). Thus, activation from letters spreads to words and, subsequently, to language nodes – and vice versa. When a string of letters is presented, it activates features, letters, and words in the same way as the monolingual Interactive Activation model does, but this time, across the bilingual's two languages. To allow language selection, the model introduces a separate level of representation within the mental lexicon – the level of language nodes. When processing reaches this level, the non-selected language is inhibited. In Figure 4 it is possible to see the depiction of the BIA model, in which the bold arrows between word and language node levels reflect strong activation flows during word input.

Figure 4 - The BIA model.

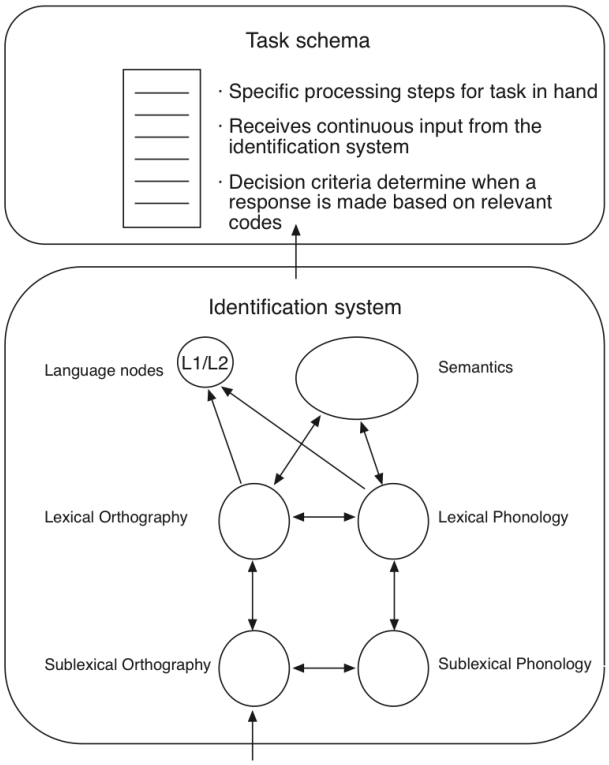


Source: Dijkstra (2003, p.16)

Dijkstra and Van Heuven (2002) point out that the BIA used to be a word recognition model involved with the identification of orthographic representations. The model was highly criticized due to its lack of semantics and phonological representation (SZUBKO-SITAREK, 2015). Thus, due to limitations in its lexical and language representations, its handling of context effects, and its lack of an implemented task structure, the authors proposed solutions that entail significant changes in the BIA. Therefore, in order to solve the above-mentioned issues in the BIA, in 2002 Dijkstra and Van Heuven proposed the BIA+ model (DIJKSTRA; VAN HEUVEN, 2002), which incorporates some changes in relation to the BIA (VAN HEUVEN; DIJKSTRA; GRAINGER, 1998; apud. DIJKSTRA; VAN HEUVEN, 2002), as it refers to the language nodes, as well as to the addition of representations and a task decision component. Furthermore, they state that the BIA+ model makes a distinction between a word identification system and a task decision system. In addition, the model "assumes interactivity within the word identification system and between this system and higher-order systems such as the parser" (DIJKSTRA; VAN HEUVEN, 2002, p.

176). Figure 5 depicts the BIA+ model, with the incorporation of task schema, lexical and sublexical phonology, and semantics.

Figure 5 - The BIA+ model for bilingual word recognition.



Source: Dijkstra & Van Heuven (2002, p. 182)

The BIA+ model proposes nonselective lexical access and an integrated mental lexicon across languages due to the model's three levels of representation, where both languages can compete for selection. Moreover, target word recognition is influenced by orthographic neighbors from both languages. When sub lexical and lexical orthographic representations are activated, they also activate associated phonological and semantic representations (DIJKSTRA; VAN HEUVEN, 2002). Therefore, in orthographically related languages, the number of items activated will be larger than for more distinct languages. Additionally, this model predicts that cognates have an integrated representation across the bilingual's two languages (DIJKSTRA; VAN HEUVEN, 2002; TITONE et al., 2011; TOASSI; MOTA; TEIXEIRA, 2020).

Dijkstra (2003) affirms that the available evidence on multilingual language processing suggests that multilinguals do not require any special processing mechanisms. Therefore, the

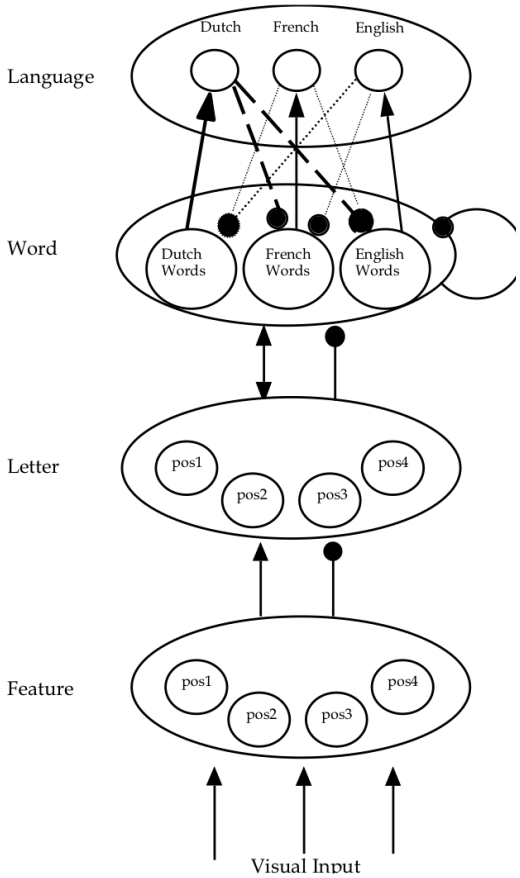
author proposes to extend a bilingual model of word recognition to these individuals. In the following section I will describe a model of lexical access in multilingual individuals – the Multilingual Interactive Activation model (MIA).

2.2.4 The Multilingual Interactive Activation model of lexical access

Considering the differentiation between bilinguals and multilinguals is fairly recent, the majority of models of lexical access limited themselves to the processing of two languages. However, there has been a growing interest related to simultaneous processing of more than one foreign language. Despite this, models of multilingual lexical access are typically extensions of monolingual and bilingual models and hypotheses (SZUBKO-SITAREK, 2015). In the matter of visual word recognition, which is the focus of the present study, the Trilingual Interactive Activation (TIA) model was proposed by Dijkstra (2003) as a trilingual version of the BIA model. Even though the model was first named "Trilingual", the author affirms it can be easily extended further. For this reason, in the same way as Dijkstra (2003), I will refer to it as the Multilingual Interactive Activation Model (MIA).

According to Dijkstra (2003), multilinguals do not require any special processing mechanisms to solve word selection problems they might face. Therefore, a straightforward extension of a bilingual model of word recognition to multilinguals would be enough to represent language processing in these individuals. Characteristics of input items and languages already provide many cues that can be used during selection in multilinguals. Thus, Dijkstra (2003) proposes that the simplest theoretical perspective is to assume that the theoretical frameworks proposed for monolinguals and bilinguals also apply to multilinguals. Additionally, the author states that unless new evidence shows this is not psychologically valid, we should adhere to this view. Multilingual processing is even more complex than language processing in general, therefore, this may be the best research strategy to follow until more evidence is collected (DIJKSTRA, 2003). The depiction of the MIA model is in Figure 6, in which the bold arrows between word and language node levels reflect strong activation flows during Dutch word input.

Figure 6 - The Multilingual Interactive Activation model.



Source: Dijkstra (2003, p.17)

As mentioned above, the computational BIA+ model (DIJKSTRA; VAN HEUVEN, 2002) has provided a useful account for bilingual word recognition. Simultaneously, the RHM model (KROLL; STEWART, 1994) has been accounted as a reference framework for bilingual word production and translation. More recently, there has been a strong need for a unified implemented account of bilingual word comprehension, lexical-semantic processing, and word production (DIJKSTRA et al., 2019). Thus, Dijkstra and colleagues (2019) built the Multilink model, which will be explained in the following subsection.

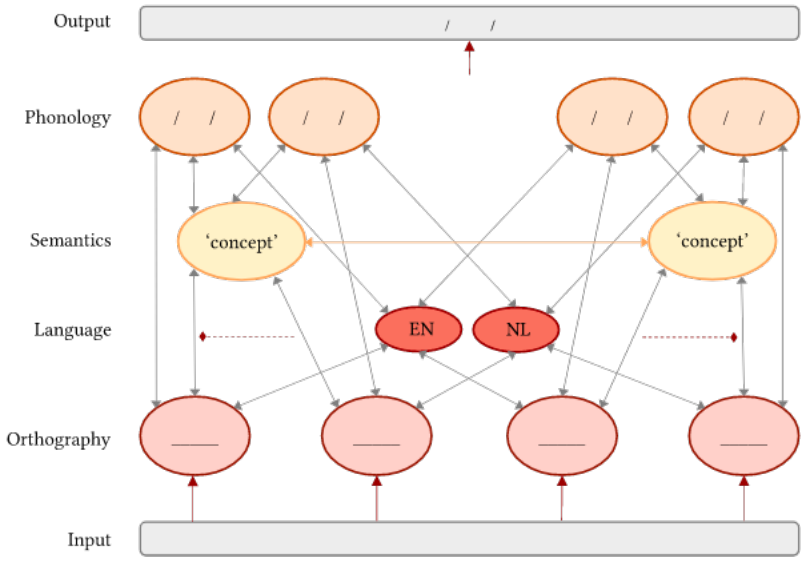
2.2.5 The Multilink model

With the goal of unifying bilingual word comprehension, lexical-semantic processing, and word production, Dijkstra and colleagues (2019) built the Multilink model, a localist-connectionist model which integrates basic assumptions of both the BIA+ and RHM. The Multilink model simulates the recognition and production of cognates – here form-similar translation equivalents –

and non-cognates of different lengths and frequencies in tasks such as, monolingual and bilingual lexical decision, word naming, and word translation production. The model also considers effects of lexical similarity, cognate status, relative L2-proficiency, and translation detection.

The Multilink model has a layered network architecture as shown in Figure 7. First, a written input word activates various lexical-orthographic representations, which in turn activate their semantical and phonological counterparts, as well as associated language membership representations. As this is an interactive model, all activation flows are bidirectional. Using this network, the model is able to recognize, produce, and translate English and Dutch words.

Figure 7 - Standard Architecture of the Multilink model.



Source: Dijkstra *et. al* (2019, p. 06)

Differently from the BIA+ model that only simulates the orthographic recognition of 4 or 5-letter words, the Multilink model has the goal of going beyond, simulating the recognition of 3-8 letter words, including cognates of different lengths. Additionally, even though the model simulates word recognition and production in a variety of tasks, considering the present study assess cognate facilitation effect through a word naming task, I will present this section of the model in more detail.

According to the authors, the Multilink model is not particularly well equipped to simulate word naming results since it does not have any provision for simulating latency differences depending on word onset phoneme. However, simulations have still been run considering it may demonstrate the model's general applicability across tasks and modalities (DIJKSTRA et al., 2019).

Their results of the word naming task simulation have shown that frequency had limited effect on naming latencies for cognates, while non-congates exhibited reduced latencies as frequency increased.

Concerning cognate facilitation effects observed with the Multilink model, the faster responses observed in a variety of experimental paradigms have been attributed to different sources. First, cognates are co-activated due the overlap in input orthography. Second, they share part of their morphosemantics across languages. Third, their phonological representations are co-activated during word production via semantics. Additionally to these observations made by De Groot (2011), Dijkstra *et. al* (2019) also observed an important fourth source for cognate facilitation: lexical activation spreading from orthographic representations to their (same-language) phonological representations.

In word recognition and production, multiple factors interact in a complex way. The computational model of word retrieval and production allow us to make predictions about the time course of word retrieval and translation by a large range of bilinguals in all sorts of tasks. The validation and first testing of the Multilink provided a promising basis for the development of a more general computational model of word retrieval. Moreover, the simulations with Multilink show that domain-specific models using a symbolic, connectionist framework (e.g., IA, BIA, BIA+) can be integrated into a meaningful entity that captures essential underlying aspects and mechanisms of language processing (DIJKSTRA et al., 2019).

Overall, in the bilingual domain, like BIA/BIA+ and RHM models, the Multilink assumes that word retrieval involves language non-selective processing. In addition, it assumes that the bilingual lexicon is integrated, implying there is just one store for words from different languages. Moreover, the Multilink model further assumes that there is a link between translation equivalents only via semantics, which contrasts with the assumption of a word association route proposed by the RHM model. According to Dijkstra and colleagues (2019), this route could easily be implemented in Multilink, but simulation work and theoretical analysis suggest that one can do without it, at least in the case of the more proficient bilinguals whose data the authors simulated. Finally, similar to BIA+, Multilink makes the far-reaching assumption that activation in the word retrieval system flows in the same way in different task situations. Differences in result patterns are considered to originate from differences in task demands, read-out codes (i.e., the specific

representations used for responding in different tasks), parameter settings, and use of linguistic and non- linguistic context.

Considering this study's main experimental task consists of lexical access and word production, the Multilink model seems to be the model that best represents the processes involved in the execution of the word naming task – even though the model does not simulate latency differences depending on onset phonemes for word naming tasks, and has not been tested with multilingual language processing and production.

Having discussed the models of lexical access in monolinguals, bilinguals, and multilinguals, in the next section I will discuss writing systems, scripts and orthographies, considering the present study will assess visual word recognition in multilinguals whose L3 orthography differs in multiple layers from their L2's and L1's.

2.3 WRITING SYSTEMS, SCRIPTS, AND ORTHOGRAPHIES

Writing systems can be defined in two ways: (1) the ways in which written symbols connect to spoken language (e.g., alphabetic, syllabic writing system) (PERFETTI; DUNLAP, 2008) or as (2) the specific rules for writing used in a particular language (e.g., the English writing system, the Chinese writing system) (COOK; BASSETTI, 2005). Additionally, writing systems can differ across languages according to what linguistic units are represented by the graphemes. For instance, a phonemic (or alphabetic) writing system - such as English, Portuguese, and Korean - segments language into phonemes, which are represented by graphemes. There are also consonantal writing systems (e.g., Hebrew); syllabic writing systems (e.g., Thai); and morphemic writing systems (e.g., Chinese). Additionally, according to Bassetti (2005), a second language writing system (L2WS) may differ from a first language writing system by representing different linguistic units. When this happens, it is more difficult to learn the new writing system. Moreover, research in L2WS shows that when the L1 and L2 writing systems encode the same linguistic units, the reading experience previously developed in the L1 facilitates L2 reading (COOK; BASSETTI, 2005). Finally, different writing systems are read differently, and consequently, learners are affected by the strategies designed to use in their L1 writing systems (BASSETTI, 2005).

Besides the differences in writing systems, languages can also diverge in their scripts, which is defined as the systematic expression of visual forms for writing (PERFETTI; DUNLAP, 2008), or the physical implementation of the writing system (COOK; BASSETTI, 2005). As an example,

let us take in consideration English and Korean. Both languages are represented by alphabetic writing systems, their graphemes represent phonemes which are later combined into syllables to form words. However, English is represented by the Roman alphabet, while Korean is represented by Hangul. Nevertheless, the same script can be used to represent different languages and what will determine the way the script is used to represent a specific language will be the orthography.

Perfetti and Dunlap (2008) define orthography as the implementation of a writing system to a specific language (e.g., English and Italian have the same writing system and the same script, but one is different from the other because of their orthography and punctuation). Furthermore, in alphabetic writing systems, orthographies vary in the transparency of mappings between letters and phonemes. For instance, Italian and Finnish are very transparent (or shallow) – which means a speaker can confidently connect a grapheme to a sound when reading. On the other hand, English is relatively nontransparent (deep or opaque), and Danish falls in between. (PERFETTI; DUNLAP, 2008).

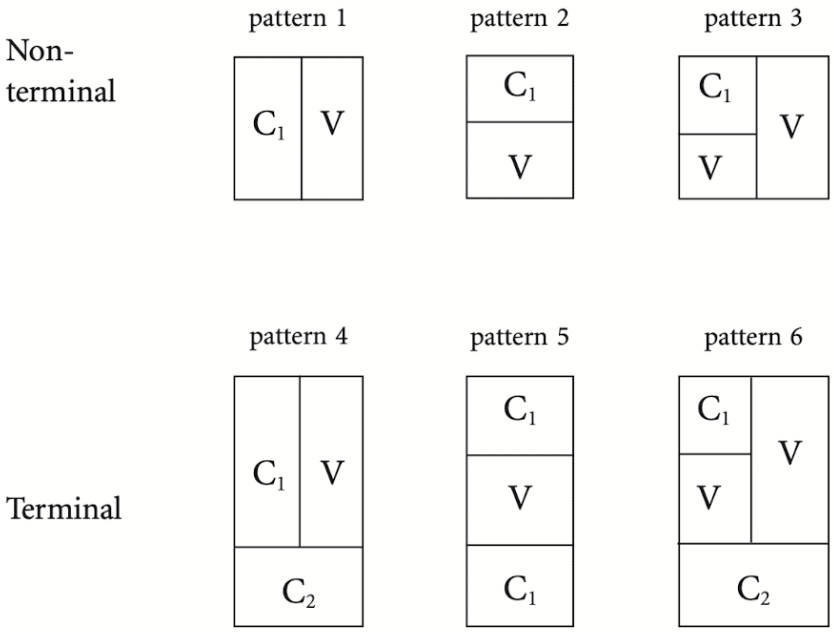
Taking into consideration that the present study involves three languages that diverge in their written representation in varying degrees, I will dedicate the following subsection to presenting the Brazilian Portuguese, English, and Korean writing systems and their singularities.

2.3.1 Brazilian Portuguese, English, and Korean writing systems

It is important to define the types of writing systems, scripts, and orthographies involved in the study. First, Brazilian Portuguese and English are languages that have alphabetical writing systems, both employing the same script - the Latin alphabet. Considering this, even though these languages seem similar to one another in the levels of writing system and script, they diverge in terms of orthography, English having a more opaque orthography than Brazilian Portuguese.

At the same time, the Korean language is also an alphabetical writing system. However, it diverges in two levels – script and orthography – from the previously presented languages. *Hangul*, the Korean alphabet is a non-Latin alphabet, in which each symbol represents a single consonant or a vowel. In contrast to the linear horizontal sequences used in both English and Portuguese orthographies, Hangul symbols are combined into syllable blocks, in order to resemble the form of its predecessor: the Chinese characters. Figure 8 illustrates the 6 possible patterns of Korean syllabic structure.

Figure 8 - The 6 patterns of Korean syllabic structure.



Source: Yoon *et al.* (2002, p. 141)

The grapheme-phoneme correspondence is considered to be highly consistent and reliable at the individual symbol level. Notwithstanding, syllable blocks do not always correspond with spoken syllable boundaries. Some restrictions concern consonant sounds that are not allowed in syllable-final position and consonant clusters (PARK, 2008). It is relevant to highlight that these restrictions reflect into the adaptation of English loanwords into the Korean language, which need to be adapted in order to follow Korean phonological rules and restrictions. The history of English loanwords in the Korean lexicon and their adaptation to follow the phonological rules of the language will be presented in the next section, after the discussion on visual word recognition and cognate facilitation effect.

2.4 VISUAL WORD RECOGNITION AND COGNATE FACILITATION EFFECT

The issue of language selective or non-selective visual word recognition has been addressed in a vast number of research studies based on the belief that the similarity of form and meaning affects word recognition and helps explaining patterns of multilingual storage and retrieval (SZUBKO-SITAREK, 2015). In this sense, interlingual homographs, interlingual neighbors, and cognates have been typically used as stimuli by researchers aiming to assess the issue of language selectivity in lexical access. Considering the present study aims at assessing cognate effect in word naming, this section will focus on visual word recognition, cognates and the cognate facilitation effect.

2.4.1 Visual word recognition

Based on the dual-route theory of reading, Cook and Bassetti (2005) state that there are two possible routes for the recognition of a written word. The dual-route theory proposes the existence of two routes for word reading comprehension: a phonological route, which occurs through the mapping of graphemes into phonemes, that are assembled into larger units; and the lexical route, which recognizes the written word as a whole. The former depends on reliable mappings for shallow orthographies, the latter is needed for irregular or exceptional words, that is, words whose assembled grapheme-phoneme mappings fail to match the target pronunciation (PERFETTI; DUNLAP, 2008).

The computational implementation of the dual-route theory of reading is commonly known as the Dual Route Cascaded (DRC) model, originally proposed by Coltheart and colleagues (2001). The DCR model can perform the 2 tasks most commonly used to study reading: lexical decision and reading out loud. Its goal is to explain how skilled readers perform certain basic reading tasks. The model consists of three routes: (1) the lexical semantic route, (2) the lexical non semantic route, and (3) the grapheme-to-phoneme correspondence (GPC) route. All routes are composed of interacting layers of units. These units represent letters in the letter layer and words in the lexicon layer, which are the most elementary parts in each layer.

The implementation of this model has shown that the range of variables that influence human latencies have also influenced the DCR model's latencies in the same way, making this model one

of the most successful of the existing computational models of reading. The DCR model was based on monolinguals and, later on, inspired bilingual models.

Harm and Seidenberg (2004) also addressed the debate of whether words are read visually (a direct mapping from orthography to semantics) or phonologically (a direct mapping from orthography to phonology to meaning), by creating a large-scale computational model based on connectionist principles. The main goal was to examine how this model would solve the problem, comparing the model's performance to people's performance. At first, the model relied more on the orthography-phonology-semantics component; later on, with additional training, the contribution of orthography-semantics increased.

Therefore, the authors concluded that skilled reading involves both visual and phonological pathways working together, and the contribution of each one will depend on what the other pathway does. In proficient readers, both routes make contributions in reading to most words. The division of labor depends on the writing systems, and how they represent sound and meaning. One example of this theory in practice can be when Chinese learners of English read English words, they seem to rely more on sight-word knowledge (lexical route), whereas native users of alphabetic writing systems rely more on the phonological route (PERFETTI; DUNLAP, 2008).

One task used to investigate visual word recognition and lexical production is the word naming task, which will be discussed in the following section.

2.4.2 Word naming task

The main experiment of the present study consists of a word naming task, which is widely used in word recognition research. In a word naming experiment, a word is presented visually to a participant who has to read it aloud as quickly and accurately as possible (JIANG, 2013). The reaction time (RT) is usually measured as the duration between the onset of the target on the screen and the time when the word is articulated. This type of task consists not only of a lexical access component but also of a lexical production component. Moreover, in this task phonology is overtly involved in naming, therefore, methodological considerations regarding the test materials have to be made.

First, it is important to highlight some factors that affect visual word recognition, such as frequency effect and age of acquisition can be found in the naming task (FORSTER; CHAMBERS, 1973; MORRISON; ELLIS, 2000). Concerning frequency effect, participants respond faster to

high-frequency words than to low-frequency words in almost any lexical processing task, including lexical decision, reading aloud, semantic categorization, and picture naming. Response times are quicker and error rates are lower in the case of words that are used more frequently. In the bilingual domain, some evidence suggests that the frequency effect might even be larger in the L2 as compared with the L1 (VAN WIJNENDAELE; BRYSBAERT, 2002)

Additionally, word length can have an effect in word naming, as some lexical properties can affect participants' performance in the task – slowing down their responses. Szubko-Sitarek (2015) states that inconsistent results have been found concerning the effects of word length in word recognition. Results ranging from inhibitory (longer words are more difficult) to null effects have been observed (FREDERIKSEN; KROLL, 1976; HUDSON; BERGMAN, 1985; JIANG, 2013).

Word onset and spelling-sound regularity are two variables that have been shown to affect word naming time. The first refers to the initial sound of a word, which affects naming time directly, considering the RT is measured as the duration between the onset of a stimulus and participants' articulation of the name of the stimulus. Considering the time for the vocalization of a word is not constant, phonetic features can affect vocalization. In tasks in which participants' response triggers a voice key, voiceless posterior obstruent consonants have been found to take longer to trigger the voice key, as the vibration of vocal cords is not present in voiceless consonants.

Furthermore, the complexity of the onset may also affect naming time. For instance, a word beginning with a consonant cluster produces shorter naming latencies than words with simple onsets. Thus, the phonetic feature of the second phoneme also affects the measurement of naming latencies, which is why, according to Jiang (2013), both onset complexity and the second phoneme need to be accounted for in material development – even though they are usually ignored in practice.

As mentioned in the beginning of this section, one type of stimulus commonly used to assess visual word recognition are cognate words, which were also chosen to compose the experimental stimuli in this study. These are words that are shared across languages, in form and meaning, and they will be further explained in the following subsection.

2.4.3 Cognates and cognate facilitation effect

Through the years, different definitions have been presented for the term cognate. Traditionally, cognates are defined as two words that share a source and have phonological or orthographic similarities across languages, more specifically, cognates are translation equivalents with the same origin and usually a similar spelling or sound pattern (DUÑABEITIA; PEREA; CARREIRAS, 2010). On the other hand, the definition of cognates for psycholinguistics relates to whether the pair of words have shared aspects of spelling, sound, and meaning (TOASSI; MOTA; TEIXEIRA, 2020). Moreover, cognates can be defined as word pairs that are shared across languages that are similar or the same in form and semantics, regardless of the presence of a common ancestor (DE GROOT et al., 2002; DIJKSTRA et al., 2010; YUDES; MACIZO; BAJO, 2010). According to Rogers et al. (2015), this definition of cognates opens up the discussion to historically unrelated languages that share words through borrowing. This definition includes terms such as loanwords or borrowed words that are associated with a vocabulary that has a semantic and formal overlap between languages but does not have an etymological relationship. Considering the history of Korean-English cognates lies in lexical borrowing, this is also the definition to be followed by the present study.

Among the studies published dealing with language selectivity, many use cognate materials, such as palace – palacio in English-Spanish, pyramid – pyramida in English-Hebrew, or πόρτα /'porta/ – porte ‘door’ in Greek-French. The cross-linguistic form overlap of cognates has been used by researchers to investigate if words from different languages are co-activated during the reading, listening, and speaking of bilinguals (DIJKSTRA et al., 2010). In psycholinguistic experiments, orthographic cognates have been shown to be visually recognized faster than non-cognates or pseudo-words – a phenomenon called cognate facilitation effect (COSTA; CARAMAZZA; SEBASTIAN-GALLES, 2000; OTWINOWSKA et al., 2020). This facilitation effect indicates that bilingual individuals activate lexical items in their L1 and their L2, simultaneously (YUDES; MACIZO; BAJO, 2010), and it is one of the most robust bilingual effects. Moreover, De Groot and Keijzer (2000) have investigated cognate status and word frequency in foreign-language vocabulary learning and forgetting. Their results show that cognates and concrete words are easier to learn and more resistant to forgetting than noncognates and abstract words (DE GROOT; KEIJZER, 2000).

The cognate facilitation effect has been widely investigated in languages represented by the same script. Dijkstra, Grainger, and Van Heuven (1999) tested Dutch-English bilinguals with English words varying in their degree of orthographic, phonological, and semantic overlap with Dutch words. In this way, an English word target could be spelled the same as a Dutch word and/or could be a near-homophone of a Dutch word. If the form similarity was accompanied with semantic identity (translation equivalence) was also varied. In a progressive demasking task and a visual lexical decision task very similar results were obtained. Both tasks revealed facilitatory effects of cross-linguistic orthographic and semantic similarity on response latencies to target words, but inhibitory effects of phonological overlap. Then, a third control experiment involving English lexical decision with monolinguals indicated that these results were not due to specific characteristics of the stimulus material. The authors interpreted the results within the BIA model expanded with a phonological and a semantic component – which would later be implemented in the BIA+ model (DIJKSTRA; GRAINGER; VAN HEUVEN, 1999).

Still investigating Dutch-English bilinguals, Dijkstra and colleagues (2010) examined the effects of cross-linguistic similarity of translation equivalents on bilingual word recognition. Participants performed one of three tasks, and processed cognates with varying degrees of form overlap between their English and Dutch counterparts (e.g., *lamp–lamp* vs. *flood-vloed* vs. *song-lied*). In a lexical decision task, reaction times decreased going from translation equivalents without any cross-linguistic orthographic overlap to very similar but non-identical cognates. Identical cognates showed a large discontinuous processing advantage and were subject to facilitation from phonological similarity. In a language decision task, the effect of orthographic similarity reversed: a cognate inhibition effect arose, the size of which increased with orthographic similarity. Identical cognates were considerably slower than other cognates. In a progressive demasking task, no orthographic similarity effect was found for non-identical cognates, but a semantic similarity effect was observed. Additionally, a facilitation effect for identical cognates of low English frequency was identified. The task-dependent result patterns were interpreted in terms of four accounts of cognate representation and provided evidence in favor of a localist connectionist account (DIJKSTRA et al., 2010).

Yudes, Macizo, and Bajo (2010) assessed cognate effects in late fluent Spanish/English bilingual speakers through event-related potential (ERP) recordings performing two tasks on word pairs. In an association decision task, participants decided if the pairs of Spanish words were

related in meaning. In a translation decision task, participants reported whether English target words were correct translations of Spanish primes. In both tasks, word primes were either cognates or non-cognates. In the translation decision task, faster and more accurate responses were associated with reduced N400 amplitudes in word pairs featuring a cognate. Nevertheless, cognates did not modulate performance or event-related potentials in the association decision task. The results suggest that language coactivation in bilingual speakers is regulated by cognitive context (YUDES; MACIZO; BAJO, 2010).

One relevant aspect to the investigation of the cognate facilitation effect is the orthographic and phonological overlap of cognates. In order to investigate the influence of orthographic overlap in cognate word processing, Comesaña *et al.* (2015) aimed at further exploring the processing of identical and non-identical cognates in balanced Catalan-Spanish bilinguals. Participants performed in a lexical decision task in Spanish, in two experiments. In Experiment 1 identical and non-identical cognates, as well as non-cognates made up the experimental list. On the other hand, in Experiment 2, identical cognates were excluded from the list. Their results revealed modulations in cognate processing as a function of their degree of orthographic and phonological overlap, as the direction of the cognate effects was of facilitation when the list included identical cognates, but of inhibition when identical cognates were excluded. Additionally, response latencies and error percentage were higher when cognates showed greater mismatches between orthography and phonology, especially non-identical cognates. These findings highlight the importance of cognate word type and language context in bilingual processing which, according to the authors, have been neglected by the majority of bilingual word recognition models – with exception of the BIA+ model, which proposes that identical and non-identical cognates are differently organized in the bilingual memory. Finally, they state that their data reinforces that cognate processing varies both as a function of orthographic and phonological overlap and as a function of language context, as their data supports the hypothesis that non-identical cognate processing varies not only as a function of orthographical and phonological overlap, but also as a function of language context (COMESAÑA et al., 2015).

Beyond the investigation with bilinguals, Lemhöfer, Dijkstra, and Michel (2004) used Dutch-English-German cognates to investigate whether the non-selective access hypothesis holds also for trilinguals and three languages. Participants carried out a lexical decision task in German, their L3. The stimuli included purely German control words, double cognates that overlapped in

Dutch and German, but not in English, and triple cognates with the same form (phonological and orthographic) and meaning in Dutch, German, and English. Faster RTs were observed for Dutch-German cognates than for control words. Moreover, triple cognates were processed even faster than double cognates. The triple cognate effect was not influenced by whether the participants had previously read an English text. Additionally, a control experiment was conducted with German monolinguals, which confirmed that the effect was not a result of uncontrolled stimulus. Therefore, independent of context, both the native language and another foreign non-target language influenced target language comprehension in trilinguals. This is evidence of a nonselective access, implying all languages known to an individual may affect word activation and recognition (LEMHÖFER; DIJKSTRA; MICHEL, 2004).

Toassi, Mota, and Teixeira (2020) also investigated the effect of triple cognates in lexical access, but in speakers of English (L3), German (L2), and Brazilian Portuguese (L1). Participants performed a reading task, which contained 60 experimental sentences with triple cognates, double cognates between Brazilian Portuguese and English, and double cognates between German and English. Participants' eye movements were recorded while they performed the task, and the measures of first fixation and first reading pass times were analyzed. The results suggested that triple cognates were processed faster than their respective controls in first fixation and first pass, which was interpreted as evidence of a nonselective lexical access and an integrated lexicon for the multilinguals' languages. Furthermore, these results contribute to the literature of lexical access of multilinguals, favoring the view that all the languages of a multilingual are active even when the speaker intends to use only one language.

Cross-script cognate facilitation effect has also been observed in various languages. With the objective of determining whether cross-language activation is modulated by script differences when the written lexical form is not present, Hoshino and Kroll (2008) investigated cognate facilitation effect in picture naming for Spanish-English and Japanese-English bilinguals. Participants were asked to name cognate and non-cognate pictures in English (L2). The study indicated activation of phonology of the non-target language, even with the absence of the written lexical form. If orthographic and phonological overlap was required for phonological facilitation, cognate facilitation effect would only have been observed in same-script Spanish–English bilinguals. Thus, Hoshino and Kroll (2008) interpreted similar effects for Japanese–English bilinguals as evidence against the role of orthography during speech planning. Their results

provide evidence for cross-language activation of phonology when bilinguals' languages differ in scripts.

Dimitropoulou, Duñabeitia, and Carreiras (2011) investigated the role of the activation of the phonological code in visual word recognition through a masked priming study in Greek-Spanish bilinguals. Participants performed lexical decisions on Greek and Spanish targets, briefly preceded by either phonologically or orthographically related prime words of the non-target language. Their results show significant bidirectional cross-script masked phonological priming effects. However, these effects disappeared under the influence of nearly overlapping orthographic representations, which suggests a fast and automatic language nonselective activation of the phonological code during the initial stages of visual word recognition, but that this is clearly dependent on the orthographic properties of the input stimulus.

Rogers, Webb, and Nakata (2015) investigated the effects of English-Japanese cognates on vocabulary learning in Japanese learners of English with both decontextualized and contextualized tests. Their results indicated that Japanese learners could successfully recall the L2 forms of cognates than noncognates. However, scoring was sensitive to partial knowledge of written form, which indicated participants gained greater knowledge of non-cognates. Due to higher pretest scores for cognates, non-cognates had greater potential for learning, relative gains were also examined. These relative gains were significantly higher for non-cognates than cognates immediately after the treatment. Despite this, no statistically significant difference existed 1 week after learning. Their results show that L2 cognates may be more easily learned, but harder to be used by learners than noncognates (ROGERS; WEBB; NAKATA, 2015).

As for the Korean language, Lim, Cui, and Ahn (2020) examined how the amount of phonological information manipulates cognate facilitation effect, and to what extent the L2 proficiency modulates priming effect. Korean-English unbalanced bilinguals partook a lexical decision task in L2 to L1 direction, since their languages had no orthographic overlap. Their results showed influence by the amount of phonological information (short or long pronounced words). Moreover, cognate facilitation effect was observed even with different-script languages in backward translation direction. L2 proficiency also played a role on the priming effect.

For an overview of the aforementioned studies, see Table 1.

Table 1 – Overview of the studies included in the review

Study	Participants	Task type	Results
Comesaña *et al*. (2015)	Catalan – Spanish balanced bilinguals	Lexical decision in Spanish with two different experimental lists. **Experiment 1:** Experimental list composed of identical and non-identical cognates, as well as noncognates. **Experiment 2:** Identical cognates were excluded from the list.	Cognate effect modulated by the degree of orthographic and phonological overlap; the direction of the cognate effects was of facilitation when the list included identical cognates, but inhibition when identical cognates were excluded.
Dijkstra, Grainger, and Van Heuven (1999)	Dutch – English bilinguals	**Task 1:** Progressive demasking **Task 2:** visual lexical decision task. English words varying in their degree of orthographic, phonological, and semantic overlap with Dutch words	Both tasks revealed facilitatory effects of cross-linguistic orthographic and semantic similarity on response latencies to target words. Inhibitory effects of phonological overlap.

Study	Participants	Task type	Results
Dijkstra *et al.* (2010)	Dutch – English bilinguals	**Task 1:** Lexical decision Cognates with varying degrees of form overlap between their English and Dutch counterparts.	**Task 1:** RTs decreased going from translation equivalents without any cross-linguistic orthographic overlap to very similar but non-identical cognates. Facilitation from phonological similarity.
		Task 2: Language decision	**Task 2:** Cognate inhibition effect was observed, its size, which increased with orthographic similarity. Identical cognates were considerably slower than other cognates.
		Task 3: Progressive demasking	**Task 3:** No orthographic similarity effect for non-identical cognates. A semantic similarity effect was observed. Also, a facilitation effect for identical cognates of low English frequency was identified.

Study	Participants	Task type	Results
Dimitropoulou, Duñabeitia, and Carreiras (2011)	Greek – Spanish bilinguals	Masked priming in lexical decision on Greek and Spanish targets preceded by either phonologically or orthographically related prime words of the non-target language.	Significant bidirectional cross-script masked phonological priming effects. These effects disappeared under the influence of nearly overlapping orthographic representations, suggesting a fast and automatic language non-selective activation of the phonological code during the initial stages of visual word recognition, dependent on the orthographic properties of the input stimulus.
Hoshino & Kroll (2008)	Spanish – English bilinguals and Japanese – English bilinguals	Picture naming in L2.	Activation of phonology with the absence of written lexical form. Evidence against the role of orthography during speech planning. Cross-language activation of phonology in languages represented by different scripts.

Study	Participants	Task type	Results
Lemhöfer, Dijkstra, and Michel (2004)	Dutch – English – German trilinguals	Lexical decision in L3 with purely German control words, double cognates that overlapped in Dutch and German, but not in English, and triple cognates with the same form (phonological and orthographic) and meaning in Dutch, German, and English	Faster RTs were observed for Dutch-German cognates than for control words. Triple cognates were processed even faster than double cognates. Both the native language and another foreign non-target language influenced target language comprehension in trilinguals.
Lim, Cui, and Ahn (2020)	Korean – English unbalanced bilinguals.	Lexical decision with priming from L2 to L1.	Influence by the amount of phonological information. Cognate facilitation observed. L2 proficiency played a role in priming effect.
Toassi, Mota, and Teixeira (2020)	BP – English – German trilinguals	Reading of 60 experimental sentences with triple cognates, double cognates between Brazilian Portuguese and English, and double cognates between German and English.	Participants' eye movements were recorded while they performed the task, and the measures of first fixation and first reading pass times were analyzed Triple cognates were processed faster than control words in first fixation and first pass.

Study	Participants	Task type	Results
Rogers, Webb, and Nakata (2015)	Japanese learners of English as L2.	Decontextualized and contextualized vocabulary tests.	L2 cognate forms were successfully recalled, but scoring was sensitive to partial knowledge of written form, indicating participants gained greater knowledge of noncognates – which had greater potential for learning. Results indicate that L2 cognates may be more easily learned, but harder to be used by learners than noncognates.
Yudes, Macizo, and Bajo (2010)	Spanish – English late bilinguals	Task 1: Association decision task with cognate and noncognate words as primes. Task 2: translation decision task with cognate and noncognate words as primes.	Task 1: Cognates did not modulate performance or ERPs in the association decision task. Task 2: Faster and more accurate responses were associated with reduced N400 amplitudes in word pairs featuring a cognate.

According to Dijkstra (2003), language distance affects the speed of word recognition. Even though the mental lexicon is integrated across languages, it is not homogenous in terms of lexical density, which has a direct influence on word processing. Moreover, Szubko-Sitarek (2015) highlights that the speed and accuracy of cognate recognition depends, mostly, on their cross-linguistic form similarity. Therefore, in psycholinguistics, the nature of the similarity of form concentrates on orthographic and phonological cognates. The author also highlights that now there is quite some evidence that visually presented words are not recognized solely on a visual basis. Readers rely on the phonological information embedded in the visual orthographic stimulus when they identify written words, and the current debate concerns to what extent phonology is involved in visual word recognition (SZUBKO-SITAREK, 2015).

Besides the research assessing cognate facilitation effect, it is relevant to highlight a previous piece of work that also investigated the multilingual mental lexical, specifically focused on the sharing of phonological information between L2 and L3. More specifically, our previous study investigated selectivity during lexical access in Brazilian Portuguese-English-Korean speakers (CARVALHO; MOTA; RIGATTI, 2021). Participants took part in a word naming task which used L2 (English) primes with targets from the L3 (Korean) at stimulus onset asynchronies (SOA) of 140ms and 250ms. Thus, primes and targets did not share orthographic information – only phonological. The results revealed a significant facilitation effect in word naming when an English prime was presented in comparison with control primes. Additionally, a significant facilitation effect was also seen in trials in which the primes were presented at a 250ms SOA in relation to a 140ms SOA. Taken together, the results seem to indicate that spelling-sound knowledge of L2 English was activated during the reading aloud of words in L3 Korean, also indicating non-selectivity in lexical access and a shared mental lexicon across languages.

Despite the research that has been done on cross-script cognate facilitation effect in bilinguals, not much is known about this effect in multilinguals, and more specifically, multilingual learners of Korean as an L3. From the studies presented above, the ones that dealt with speakers of Korean, the Korean language was subjects' L1. Thus, there are still some questions to be answered. What happens when multilinguals visually recognize words that share phonological information across languages, but do not share the orthographic representation? Is phonological similarity enough to facilitate the recognition of these words without any orthographic similarity? Will the effect accumulate over languages even with no script similarity?

Considering the present study will assess cognate recognition in Portuguese-English-Korean multilinguals, it is important to understand the origins of lexical borrowing and cognate words in the target language.

2.4.4 Konglish: English words in the Korean lexicon

Korean has a long history of lexical borrowing, involving languages such as Chinese and Japanese. The English language was first introduced in Korea in 1882 with the signature of a treaty of amity with the United States and the United Kingdom (BAIK, 1994). Moreover, after the end of the Japanese colonization in 1945, Koreans were intensively exposed to American culture and language with the arrival of soldiers following World War II, and during the Korean War (1950-53). Even though English had limited influence in South Korea until the mid-1960's, from that time on it began to build itself as the most dominant foreign language in the country (AHN, 2018). Modernization also played an important role in lexical borrowing, as it has influenced the infusion of technological vocabulary derived from English into the Korean lexicon (TYSON, 1993)

Thousands of English loanwords are very widespread throughout the Korean lexicon, and the great majority of these words seem to be nouns, although there are loanwords drawn from other syntactic categories. Ahn (2018) analyzed how English has been incorporated into contemporary Korean vocabulary and the examination of data shows that lexical borrowing into Korean is highly complex, involving at least four combinations of source languages: (1) English (only); (2) traditional Korean and English; (3) Sino-Korean and English; (4) English, traditional Korean, and Sino-Korean (AHN, 2018). These findings suggest that lexical borrowings can suffer adaptations – for instance, nouns can be changed into verbs and adjectives by adding suffixes. Moreover, there are many loanwords that undergo hybridized word formation processes, as well as semantic narrowing, semantic widening, or semantic transfer (AHN, 2018; TYSON, 1993).

Additionally, the incorporation of the loanwords must follow the orthographic and phonological rules of the language. For instance, there are no consonant clusters in either syllable-initial or syllable-final positions in Korean. Therefore, since the English lexicon is rich in words that have consonant clusters, especially in syllable-initial position, the transcription of such loanwords in Korean requires an epenthetic vowel (close back unrounded vowel /ɯ/) to break up the consonant cluster (e.g., allergy - /aleɾɯki/). Moreover, this epenthetic vowel is also used to end words that have a syllable-final fricative (e.g., virus - /baiˈrʌsɯ/, bus - /bəːˈsɯ/, and sports - /sɯpoːˈtsʰɯ/) (SHIM, 1994).

Bearing in mind the history of Korean-English lexical borrowing, and the gap of investigation in cross-script cognate facilitation effect on multilinguals, the present study aims to assess cognate facilitation effect in visual word recognition in Portuguese-English-Korean multilinguals in non-cognates, double, and triple cognates.

3 METHOD

Up until this point, the present work has focused on the theoretical basis upon which the study stands. In the review of literature, bilingualism and multilingualism, mental lexicon, lexical access, writing systems, visual word recognition, and cognate facilitation effect were discussed, as well as word naming tasks and the history of lexical borrowing between English and Korean. The following subsections will present the methodological procedures of the study. I will present (i) the research question, hypotheses and *rationale*, (ii) the experimental design, (iii) the experimental stimulus, (iv) criteria for the selection of participants, (v) the instruments that were used to attest for participants' language background and measure their proficiency, (v) the procedures that were carried out during the data collection, and (vi) the relevant ethical considerations.

3.1 RESEARCH QUESTIONS, HYPOTHESES AND *RATIONALE*

First, it is important to remember the definition of lexical access, which is the point at which the properties of stored lexical representations – phonological, syntactic, semantic, pragmatic – become available so they can be used to develop a meaningful interpretation of an utterance (FRAUENFELDER; TYLER, 1987). When assessing visual word recognition in bilingual individuals, experiments in the area are theoretically based on the BIA+ model, which is particularly involved with the identification of orthographic representations (DIJKSTRA; VAN HEUVEN, 2002). Considering this, the present study made use of a word naming task to investigate the cognate facilitation effect (COSTA; CARAMAZZA; SEBASTIAN-GALLES, 2000; OTWINOWSKA et al., 2020), that is the faster recognition of cognates than non-cognates, in multilingual individuals. More specifically, I investigated whether the presence of cognates facilitates the reading of Korean words, by learners of Korean who have English as their L2 and Brazilian Portuguese as their L1. The main objective is to identify if these cognate words originally from English present in the Korean language – namely, double cognates – are more easily processed than non-cognate Korean words. Additionally, with the aim of understanding the role played by multilingualism in this process, I also investigated visual word recognition of English-Korean cognates which are also present in the Brazilian Portuguese lexicon, namely triple cognates. Pursuing these objectives, the research questions and hypotheses for the present study are the following:

RQ1: How do native speakers of BP, who have English as L2 and are at low proficiency in Korean as L3, recognize double cognates in comparison with non-cognate words?

H1: Native speakers of BP who have English as L2 and are at low proficiency in Korean as L3 recognize double cognates faster than non-cognate words.

Bearing in mind that cognates have been shown to be visually recognized faster than non-cognates (DIJKSTRA et al., 2010; VAN ASSCHE, EVA et al., 2012; YUDES; MACIZO; BAJO, 2010), cognate facilitation effect during the recognition of double cognates is expected, considering both languages share phonological information even though they do not share orthographical information. Moreover, taking into account that alphabetical writing systems mostly promote reading through the phonological route (PERFETTI; DUNLAP, 2008), once participants retrieve the phonological information, they will recognize the double cognates faster than words that do not share phonological information across languages, which will result in shorter RT.

RQ2: How do native speakers of BP, who have English as L2 and are at low proficiency in Korean as L3, recognize triple cognates in comparison with non-cognate words?

H2: Native speakers of BP who have English as L2 and are at low proficiency in Korean as L3 recognize triple cognates faster than non-cognate words.

The triple cognate words also activate participants' L1, therefore, faster RT are expected for the recognition of words that are common in the three languages in comparison to non-cognate words. Additionally, concerning the parallel activation of languages in a multilingual's mind when selecting words for linguistic processing, words that are shared among the three languages may exert a facilitation effect when participants perform the naming tasks, as it was observed in Lemhöfer, Dijkstra, and Michel (2004), and Toassi, Mota, and Teixeira (2020).

RQ3: How do native speakers of BP, who have English as L2 and are at low proficiency in Korean as L3, recognize triple cognates in comparison with double cognate words?

H3: Native speakers of BP who have English as L2 and are at low proficiency in Korean as L3 recognize triple cognates faster than double cognate words.

As Lemhöfer, Dijkstra, and Michel (2004) point out, the cognate facilitation effect can accumulate over languages, therefore, the additional cognate status in one additional language can speed up participants' responses (LEMHÖFER; DIJKSTRA; MICHEL, 2004). Therefore, triple cognates are expected to be recognized faster than double cognate words.

In order to answer the aforementioned research questions, a word naming task was administered. In the next section I will explain the experimental design of the task.

3.2 THE EXPERIMENTAL DESIGN

The word naming task of the present study was designed to answer the research questions presented in the previous section. Considering participants are beginner learners of Korean as L3 and are expected to have learned *Hangul* recently, the target words were in Korean, as the new writing script does not share any orthographic information with participants' both L1 and L2. Moreover, with the purpose of investigating cognate facilitation effect in multilinguals, the experimental conditions were be composed of double and triple cognates, whereas the control condition was composed of non-cognate words. This design would allow us to assess whether or not the sharing of phonological information across languages influences cross-script visual word recognition.

As a quantitative study, the independent variables of interest were double cognates (experimental condition 1), triple cognates (experimental condition 2), and non-cognate words (control conditions) as within-subject variables. The dependent variable was the reaction time (RT). Additionally, participants familiarity with the presented words may predict variation in the dependent variable. Therefore, familiarity task was also administered in order to control for this influence.

3.3 THE EXPERIMENTAL STIMULI

The stimuli for the word naming task consist of Korean words, which were extracted from the list of vocabulary words for learning Korean, compiled by the National Institute of Korean Language (2003)[1]. The list is organized in Korean alphabetical order and it has four columns that present the words, their ranking, their definition, which part of speech they belong to, and their class. In the case of foreign words that have been incorporated into the Korean lexicon, their definition is presented in the language where the borrowing came from. An example is depicted in Table 1.

[1]Retrieved from: https://www.korean.go.kr/front_eng/down/down_02V.do?etc_seq=71&pageIndex=1

Table 2 - Example of the organization of the list.

순위	단어	품사	풀이	등급
1195	가게	명		A
898	가격 03	명	價格	B
2986	가구 03	명	家口	C
1530	가스	명	gas	B

Source: National Institute of Korean Language (2003).

Note: Table translation: Column 1- *순위*: ranking. Column 2 - *단어*: word. Column 3 - *품사*: part of speech. Column 4 – *풀이:*definition. Column 5 – *등급*: class.

From this list, I selected the words that had English definitions and were incorporated into the Korean lexicon through lexical borrowing. Second, I compiled these words into a list with their IPA transcriptions alongside their English and Brazilian Portuguese (for triple cognates) counterparts, as it is depicted in Table 2. Then, I ran an automatic cognate judgement and alignment with LexStat (LIST; LOPEZ; BAPTESTE, 2016), a Python program for automatic cognate detection in multilingual wordlists. This program performs feature-weighted linguistic distance calculation, and it is possible to use it to calculate phonetic similarity across languages.

Table 3 - Pre-selection of words for cognate analysis

KR	**ENG**	**BP**	**Pronunciation KR**	**Pronunciation ENG**	**Pronunciation BP**
게임	game	game	keim	geɪm	geimi
골	goal	gol	kol	goʊl	gˈow
골프	golf	golfe	kolpʰɯ	gɑlf	gˈow.fi
그래픽	graphic	gráfico	kɯɾɐpʰik̚	ˈgræfɪk	gɾˈa.fi.kʊ
그룹	group	grupo	kɯɾup̚	grup	gɾˈu.pʊ

Source: own authorship

Finally, cognate pairs were aligned based on the previous judgment analysis. A partial depiction of output of this analysis can be seen in Figure 9.

Figure 9 - Results of the automatic cognate judgments and alignments.

Concept: *announcer* (ID: 1)			
CogID	**Language**	**Entry**	**Aligned Entry**
2	English	əˈnaʊnsər	ə ˈn aʊ n s ə r
2	Korean	anauns^{h}ʌ	a n au n s^{h} ʌ -
Concept: *belt* (ID: 2)			
CogID	**Language**	**Entry**	**Aligned Entry**
3	English	bɛlt	b ɛ l t -
3	Korean	pelt^{h}ɯ	p e l t^{h} ɯ

Source: own authorship

After the final analysis, 40 double cognate words and 40 triple cognate words were selected as stimuli. Then, 80 control words – 40 for each experimental condition – were selected from the list of vocabulary words for learning Korean. In total, 160 words were selected for the word naming task.

In the present study, I aimed at controlling for word length and frequency, as it was mentioned in Chapter 2, they exert influence in visual word recognition. However, controlling for word length additionally to controlling for word frequency and phonological similarity would limit the amount of double and triple cognate words in the Korean language. Since I was aiming at, at least, 80 cognates (double and triple) and 80 control words, controlling for such features would be unfeasible. Thus, I only controlled for word frequency, based on the ranking of the stimuli available on the list of vocabulary words for learning Korean.

Finally, after the selection of all stimuli, I produced four lists of stimuli according to a 4x4 Latin Square, depicted in Table 3. It is important to highlight that the experimental conditions (double and triple cognates) were not presented twice in a row to avoid a possible order effect.

Table 4 - 4x4 Latin Square

List 1	List 2	List 3	List 4
Double Cognate	Control	Triple Cognate	Control
Control	Double Cognate	Control	Triple Cognate
Triple Cognate	Control	Double Cognate	Control
Control	Triple Cognate	Control	Double Cognate

Source: own authorship

Having presented the stimuli selection process, I will proceed to present the participants in the following section.

3.4 THE PARTICIPANTS

At first, I expected the experimental group to be composed of approximately 60 Brazilian Portuguese native speakers, who had English as a second language in B2 or superior level, following the Common European Framework for Languages (CEFRL) classification, and were beginners of Korean as a third language in level 1A, according to King Sejong Institute's [2]leveling. Participants' age range would be from 18 to 50 years old, and they were recruited via email, messages in social networks, groups or private communication. After three months of data collection, a total of 31 participants accepted the invitation and participated in the study.

This specific group of subjects was selected for multiple reasons. First, the English language holds the status of an international language and the most common second language in the world. Thus, it not only influences the Korean language through lexical borrowing, but Portuguese as well. Additionally, there has been a growing interest of Brazilians in Korean culture, as more and more people are seeking to learn the Korean language. However, for this specific population, learning Korean includes learning to visually recognize words in a new form of writing, in a language that does not have a lot of similarities to their L1. In light of that, it becomes clear that in order to paint a detailed picture of how the multilinguals' languages interact in the brain

[2] The institute is a Korean governmental agency responsible for teaching the Korean language in 76 countries, including Brazil.

when a new language is being learned, specially one with no orthographic similarities, this population should be accounted for.

3.5 THE INSTRUMENTS

Five distinct instruments were used in the study: a biographical questionnaire, an English proficiency test, a Korean level test, an online word naming task, and a meaning recognition task.

3.5.1 Language Learning History Questionnaire

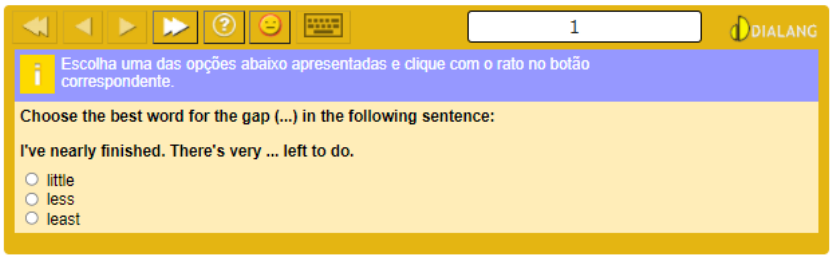
Participants answered a biographical questionnaire, an adaptation of the Language Learning History Questionnaire (LHQ 3.0; LI et al., 2020), and the questions had the objective of collecting basic information, such as age, country, sex, and linguistic information that could help understand the participants' familiarity with the foreign languages involved in the study.

3.5.2 English proficiency test

The DIALANG (ALDERSON, 2005; ALDERSON; HUHTA, 2005) was the test selected to measure participants' L2 proficiency. This test rates proficiency according to the Common European Framework of References for Languages (CEFRL), and was chosen for three main reasons. First, being an on-line diagnostic language assessment system, DIALANG was designed so that students could take it without the presence of an instructor. Since the data collection would be conducted remotely, this feature was definitely important when choosing the assessment tool. Second, DIALANG has specific tests for the skills of reading, listening, writing, vocabulary and structures. Considering the purpose of the present study, participants were asked to take the vocabulary and structures tests. The vocabulary test is a placement test that establishes the level of difficulty of the structure test. Finally, DIALANG has received positive critique regarding its efficiency.

The vocabulary placement test on DIALANG is a test designed to give participants an initial measure of their language abilities. More importantly, the placement test dictates the nature of the following test so that participants with low vocabulary levels are asked to perform tests that are appropriate for them. Figure 10 depicts an example of a question in the structure test.

Figure 10 - Example of a DIALANG question.



Source: DIALANG[3]

After taking the English test, participants were asked to inform their level of proficiency in the questionnaire and proceed to the Korean level test.

3.5.3 Korean level test

Even though participants are beginner learners of Korean, it was necessary to assure that they were able to read in the language. Therefore, besides the English proficiency test, participants took a Korean proficiency exam. The criteria to select the level test was the same as the criteria for the English proficiency test. The test had to allow participants to be able to take it without the presence of an instructor, access it for free, and have positive critique. However, it was not possible to find a free online accessible Korean proficiency test similar to DIALANG. Therefore, I opted for using a Korean course level test, and compare the course content to the Test of Proficiency in Korean (TOPIK) levels with the purpose of controlling the stimuli familiarity.

At first, I chose King Sejong's Institute level test held in King Sejong Institute's website[4]. The tests are designed to evaluate eight levels from King Sejong Institute Beginner level (1A) to Intermediate Level (4B)—according to the Institute's curriculum. However, this test takes almost 30 minutes to be completed and in order to access the results and take the test it is necessary to sign up to the website. Considering participants would have to take this test in addition to completing other four tasks, I ruled out King Sejong's test and opted for Talk to Me in Korean's level test. Talk to me in Korean (TTMIK) is an online platform for learning Korean with more

[3] Available on: https://dialangweb.lancaster.ac.uk/. Accessed on April 25th, 2023.
[4] Available on: https://nuri.iksi.or.kr/front/page/participation/onlineLevelTest/main.do. Accessed on April 25th, 2023

than one million users registered to the website[5]. They provide both free and paid online courses, and the level test is of free access for all, with no need to sign up previously. The results are based on participants' performance in multiple choice tests that evaluates the comprehension of vocabulary and grammar, and the results range from level 1 to 10 in their course curriculum.

As the purpose of the present study was initially to assess beginner learners of Korean, participants who reported having results from level 1 to 4 were classified as low proficiency (beginners), while participants who reported other levels were classified as intermediate proficiency. No participants were classified as high proficiency, considering the curriculum of the last level in TTMIK is still considered to be an upper intermediate level in other coursebooks such as Korean Grammar in Use Intermediate (MIN; AN, 2011).

Similarly to the English proficiency, the Korean level had to be informed during the completion of the LHQ.

3.5.4 Word naming task

The main task in the present study is the word naming task. Participants were asked to read aloud, as fast and accurately as possible, 160 Korean target words. These words were double cognates (English-Korean), triple cognates (Brazilian Portuguese-English-Korean), and non-cognates. In order to avoid any order effects, four lists were created. The stimuli consisted of verbs, nouns, and attributes retrieved from the list of vocabulary words for learning Korean, compiled by the National Institute of Korean Language (2003).

Once participants started the task, the words appeared automatically on the screen and their oral production was recorded in an audio file. The task was composed of two blocks of 80 words, so participants could take a short break of 180 seconds before moving on to the next block, which followed the same design as the first one. In Table 4 it is possible to see detailed information about each condition and examples of stimuli.

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[5] Available on: https://talktomeinkorean.com/. Accessed on April 25th, 2023.

Table 5 - Conditions and examples of stimuli.

Condition	Stimuli
Double cognate English-Korean	버스 (/bʌsʰɯ/ - bus)
Triple cognate Brazilian Portuguese-English-Korean	라디오 (/radio/ - radio)
Control (non-cognate word)	도서관 (/tosʰʌgwan/ - library)

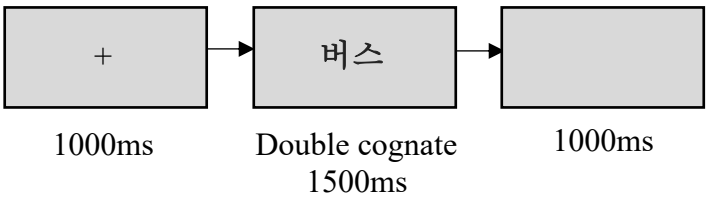
Source: own authorship

In the following subsection, I present a detailed experimental design.

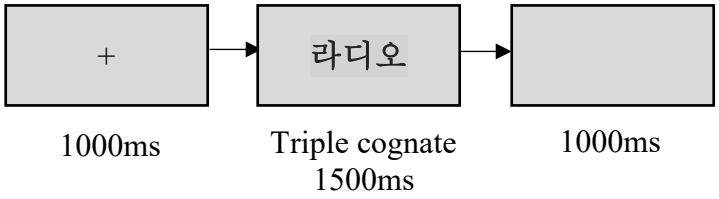
3.5.4.1 Experimental design

The word naming task was composed of two blocks of 80 stimuli each. Experimental conditions were double (English-Korean) and triple cognates (Brazilian Portuguese-English-Korean). Non-cognate words will be the control condition. Therefore, the experimental design of each block was the following: (1) a fixation stimulus (a cross) was presented on the center of the screen for 1000ms; (2) a double cognate, triple cognate or non-cognate word were presented for 1500ms; (3) a blank intertrial interval of 1000ms. Once the target word appeared on the screen, the microphone was activated and their production was recorded. Participants' RT were collected through an analysis of the time interval between the beginning of the recording and the onset of their production. The experimental design contemplated the aforementioned following conditions.

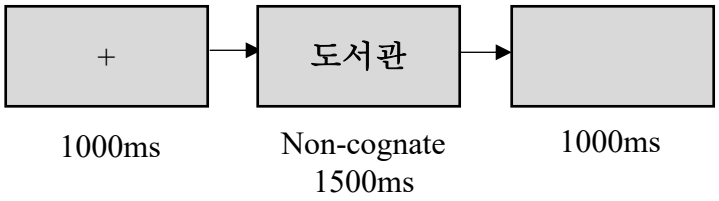
Figure 11 - Experimental condition 1: a double cognate trial



Experimental condition 2: a triple cognate trial



Control condition: a non-cognate trial



Source: own authorship

3.5.5 Meaning recognition task

Once participants finished the word naming task, they were redirected to the meaning recognition task, which had the purpose of investigating participants' knowledge on the meaning of the words presented in the word naming task. This previous knowledge, or lack of it, could reflect on their performance on the naming task.

In this task, the target words from the word naming task were organized in a list followed by four possible meanings in Portuguese. Participants could choose all meanings they found appropriate.

Table 6 - Design of the meaning recognition task.

TESTE DE RECONHECIMENTO (A)

ASSINALE OS SIGNIFICADOS QUE VOCÊ UTILIZA E/OU SABE PARA CADA PALAVRA DA PRIMEIRA COLUNA.				
버스	☐ ônibus	☐ braço	☐ garagem	☐ violão
라디오	☐ relógio	☐ lábio	☐ rádio	☐ caixa
도서관	☐ cinema	☐ biblioteca	☐ universidade	☐ livraria

Source: own authorship

The experiment was programmed in JavaScript, which allowed it to be ran on Google Chrome or Mozilla Firefox, in any computer available. The hosting and online programming of the experiment was made through LabLing's online domain. At the same time, the softwares Vim and Git were used in the programming. The former is a highly configurable text editor, and the latter, a version control system tool. Moreover, the jsPsych library (DE LEEUW, 2015) was used in order to simplify the development of the task and assure the quality of the reaction time (RT) measurements. Additionally, participants' oral response was automatically recorded, from the moment the target words appeared until the moment they left the screen. Their production was recorded using the html-audio-response plugin available in jsPsych.

3.6 PROCEDURES

With the purpose of reaching more participants, the experiment was conducted remotely. Since the experiment was hosted online, participants were able to conduct every task from their own homes on their own computers, which did not require them to come to the laboratory. Participants could accept the invitation to participate in the study following a link that led to the experiment's webpage. After agreeing to participate in the study, the webpage redirected to the word naming task.

The methodological choice of conducting the study remotely indeed has some limitations in measurement of reaction times, as Mathôt and March (2022) point out. One of the most relevant to the analysis of the results is related to temporal precision and accuracy. Considering each participant performed the task on their own computers, I do not have precise measurements of display duration in stimuli presentation. Moreover, it was impossible to be sure that participants were using optimal systems.

Subsequently to the MA qualifying exam, some adaptations were made concerning the order of the procedures. I decided to present the experimental task first in order to avoid any effects the questionnaires and proficiency tests might have on participants' performance, and consequently, the results. Thus, after completing the word naming task, participants were led to the meaning recognition task, which was followed by the biographical questionnaire and proficiency tests.

Figure 12 - Welcome message and instructions for participants.

Source: Own authorship

3.7 THE ETHICS REVIEW BOARD

In accordance with Brazilian law, the proposal went through the analysis of the *Conselho de Ética em Pesquisas com Seres Humanos (CEPSH-UFSC)* and received permission to be conducted[6]. Furthermore, the study received permission to be preregistered at the Open Science Framework (OSF), which has been done in July 2022(CARVALHO, 2022).

3.8 THE PRE-PILOT AND PILOT STUDY

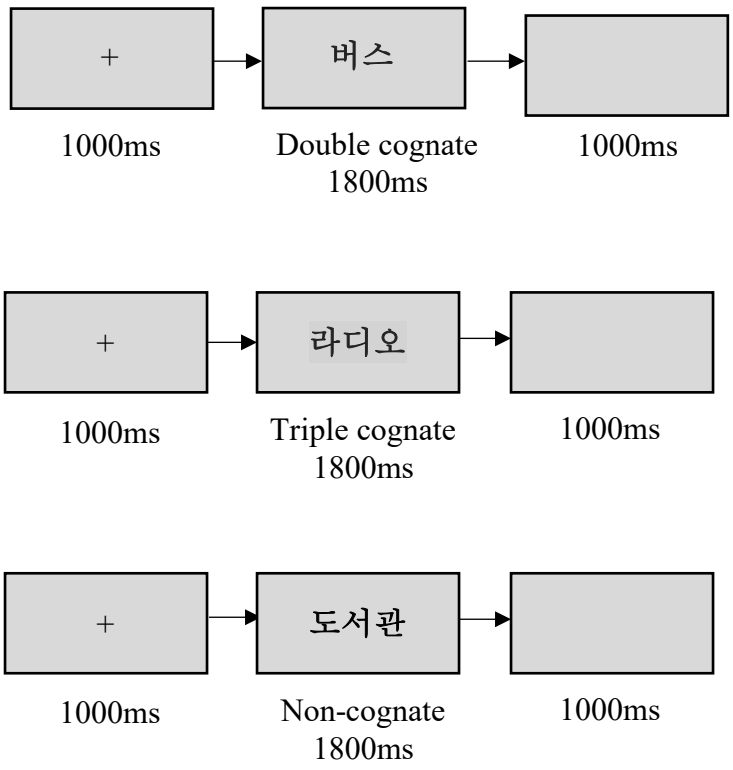
The pre-pilot study was conducted on August 23rd with 2 female participants aged 24 and 30 years old. The main objective of the pre-pilot study was to test the instruments, receive feedback from participants and gather some information about the design and procedures of the study (for instance, how long people took to carry out the entire task). Participants reported having spent from 40 minutes to an hour to complete the tasks, answer the language history questionnaire, and take the proficiency tests. The main difference between the pilot study and the pre-pilot study was

[6] CAAE: 58952722.0.0000.0121

that, by the pilot study, the experimental trial time had been adapted. The pre-pilot participants both have reported that the stimuli presentation time was too short.

The pilot study was conducted in September 2022 with 2 participants (1 male and 1 female, aged 34 and 33 years old respectively). The main difference between the pilot study and the pre-pilot study was that, by the pilot study, the duration of the stimuli had been changed. Based on the feedback received in the pre-pilot study, the presentation time was adapted from 1500ms to 1800ms. Examples of the new trials are given below:

Figure 13 – Experimental and control conditions after the pre-pilot adaptation



Source: own authorship

The choice of changing the stimuli exposure time from 1500ms to 1800ms also took into consideration that even the intermediate student of Korean who participated in the pre-pilot has found it difficult to name the words within the 1500ms. Thus, based on one of our previous experiments with students of Korean (CARVALHO; MOTA; RIGATTI, 2021), the stimuli presentation time was set to 1800ms.

4 RESULTS

The main goal of the present chapter is to present the results of the word naming task, as well as the language history questionnaire and the meaning recognition task, in order to investigate cognate facilitation effect in multilingual speakers of Brazilian Portuguese, English, and Korean. The cognate facilitation effect that I was interested in were from double and triple cognates. That is, I assessed the occurrence of facilitation effects by observing whether a participant named a cognate target word faster than a control non-cognate target word. Here, it is relevant to recall that the double cognates were English-Korean cognates, namely, L2-L3 cognates. Therefore, in the present study, double cognates assess the sharing of information across two non-native languages in participants' mental lexicon.

I also observed whether a participant named triple cognates faster than double cognates, considering previous studies have found the cognate facilitation effect to accumulate in speakers of more than one language. In this case, triple cognates were Brazilian Portuguese-English-Korean cognates. More than that, I was also interested in the role played by familiarity upon the cognate effects. At last, the issue of how proficiency in the target language interacted with the effects was also investigated.

4.1 DATA ORGANIZATION

Any data frame that will be analyzed with R should be organized into multiple same size columns with one observation per row (GARCIA, 2021). Thus, the data organization stage focused on making sure that this procedure was followed. The experimental task was hosted on LabLing's website, as mentioned in the previous chapter, and the resulting data was in sent directly to a Google Sheet file, which made it easier to access the results immediately after participants concluded the tasks. The jsPsych library saved the audio files coded in base64, a commonly used encoding scheme that represents binary data in an ASCII[7] string format (LIU et al., 2011), as shown in Figure 14, in columns GS and GT. Simultaneously, participants' response to the questionnaires were also sent to the same file, as can be seen in columns GQ and GR, also in Figure 14.

[7] American Standard Code for Information Interchange

Figure 14 - Participants' responses were added to a Google Sheets file.

A1 | *fx* | ID

	GQ	GR	GS	GT
1	a_책상	a_하다	double_01	double_02
2	Escrivaninha	Fazer	GkXfo59ChoEB(	GkXfo59ChoEB(
3	Mesa	Fazer	GkXfo59ChoEB(	GkXfo59ChoEB(
4	Escrivaninha	Fazer	GkXfo59ChoEB(	GkXfo59ChoEB(

Source: Own authorship

After the data compilation in the file, the audio files were downloaded and converted to .wav files in the R environment using the av package (OOMS, 2020). After the conversion, the audios were uploaded to Chronset (ROUX; ARMSTRONG; CARREIRAS, 2017), a website that allows users to upload a set of .wav files and receive a list of onset latency estimates via e-mail. The files with missing data results or under 500ms were manually checked with the audio editor Ocenaudio[8].

The resulting raw data consisted of 4960 observations from 31 participants. Accuracy in word naming was interpreted as an indicator that participants were able to provide input for the activation of target words. Additionally, it was stipulated that for participants whose accuracy was below 70% would have their data discarded. Unfortunately, one participant had an error rate greater than 30% so their data was discarded.

4.2 THE LANGUAGE HISTORY QUESTIONNAIRE

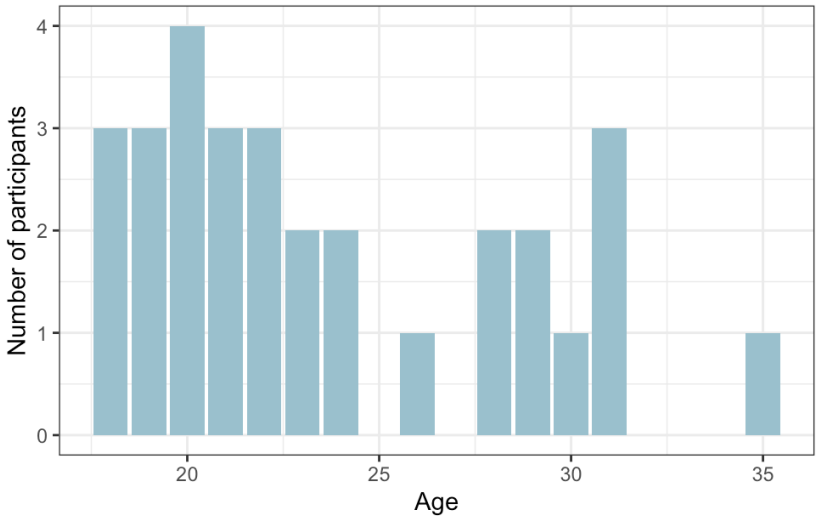
The language history questionnaire had the purpose of better understanding participants' background in language learning and demographic information that could help us interpret the results in the word naming and meaning recognition tasks.

The sample analyzed in the present study was composed of 31 people. However, one of the participants had to be discarded, considering more than 70% of their results in the word naming task were missing. After excluding this participant, the data of 30 people were analyzed (29 female,

[8] https://www.ocenaudio.com/

1 male), and their age ranged from 18 to 35 years old (M = 23.73, SD = 4.82). Figure 15 illustrates the number of participants per age.

Figure 15 - Number of participants per age



Source: Own authorship

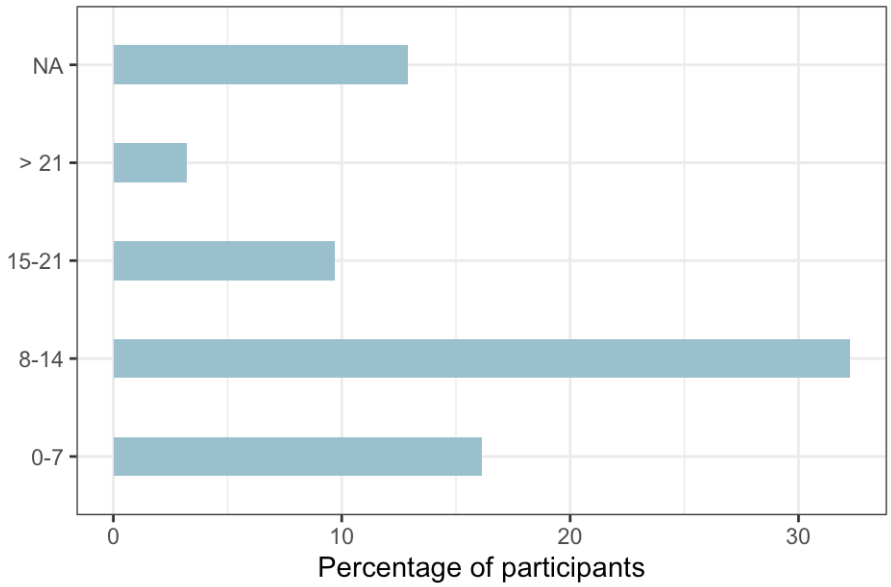
Besides Portuguese as their L1, 25 participants reported knowing English as an L2 and Korean as an L3. Additionally, three participants reported also having knowledge of Spanish, one reported knowing French and Italian and another one reported having basic knowledge of Japanese and German.

One aspect of particular interest for research on foreign language learning is age of onset, which is the age when the participant started having significant contact with the foreign language (BIRDSONG, 2006). Therefore, participants were asked the age which they started learning both English and Korean, and the number of years dedicated to the learning of each language. The answers for the English language are represented in Figure 16.

As it can be seen in Figure 16, NAs represent the participants who did not respond to this question (12.90%). Out of 30 participants, 32.26% of them began learning the English language in the age range of 8 to 14 years old. Furthermore, 16.13% of participants began learning English in the age range of 0 to 7 years old; 9.68% were between 15 and 21 years old when they began

learning English; and finally, 3.22% of participants were older than 21 years old by the time they began learning English (M = 11.29, SD = 4.82).

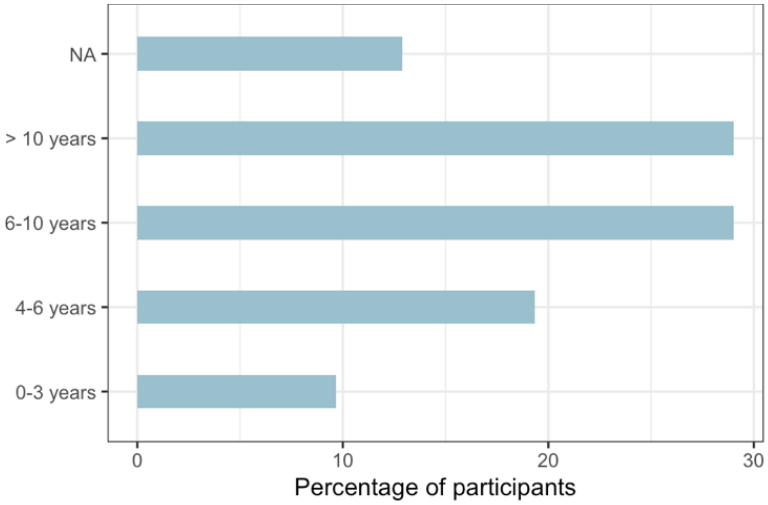
Figure 16 - Age at which participants started learning English



Source: Own authorship

Additionally to the age of onset, participants were also asked how many years they dedicated to the learning of the English language. Figure 10 depicts the percentage of participants per years of learning. Out of all 30 participants, 12.90% did not respond to this question (NAs). Apart from these participants, 19.35% reported to have spent from 4 to 6 years learning English; 29.03% of them have dedicated from 6 to 10 years to learning English, while 29.03% of participants have spent more than 10 years learning English (M = 9.62, SD = 6.11).

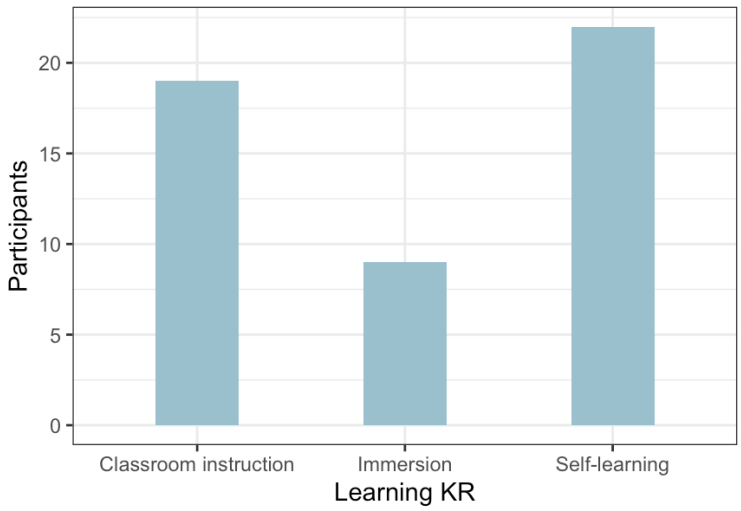
Figure 17 - Years dedicated to learning English.



Source: Own authorship

Besides the age at which they began learning English and the number of years dedicated to the learning of the language, participants were also asked the way through which they acquired the English language. Here, there could be more than one answer, as participants could have used multiple ways of acquisition. Most participants reported to have learned English through self-learning, followed by classroom instruction, and immersion. Figure 18 shows participants' responses to this question.

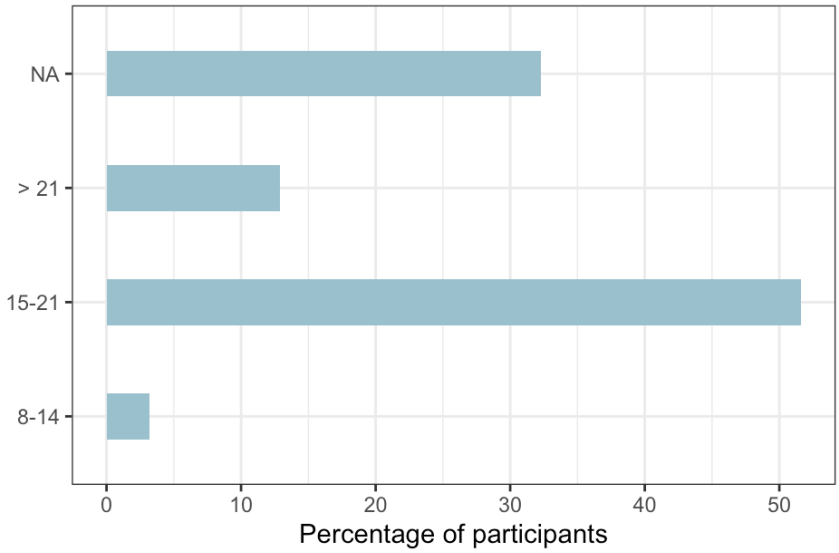
Figure 18 - Way of L2 English acquisition



Source: Own authorship

Participants were asked the same questions regarding their learning of Korean. However, it is important to highlight here that, differently from the questions regarding the learning of English language, only 21 participants responded the questions about the learning of Korean. First, they were asked the age at which they started to learn Korean. To this question, 32.25% of the participants did not respond, while 51.61% of participants reported to have begun their studies in the age range of 15 to 21 years old, as it is depicted in Figure 19. Additionally, 12.90% of participants reported to have begun their studies of Korean older than 21 years old, and 3.22% reported to have begun their studies at the age of 14 (M = 19.85, SD = 3.90).

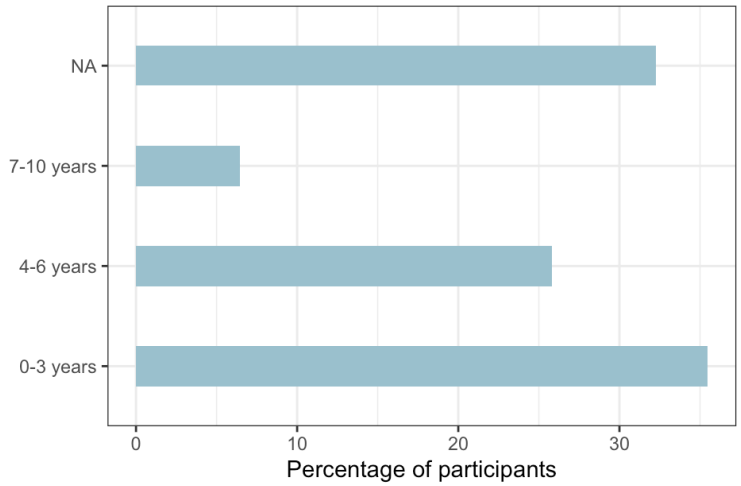
Figure 19 - Age at which participants began learning Korean



Source: Own authorship

Moreover, for the number of years dedicated to the learning of Korean, 35.48% of participants reported to have dedicated up to 3 years to the learning of the language, while 25.80% of participants reported to have dedicated from 4 to 6 years to the learning of Korean. Finally, 6.45% of participants have dedicated from 7 to 10 years to learning Korean. 32.25% did not respond to this question (M = 3.73, SD = 2.26). These results are shown in Figure 20 below.

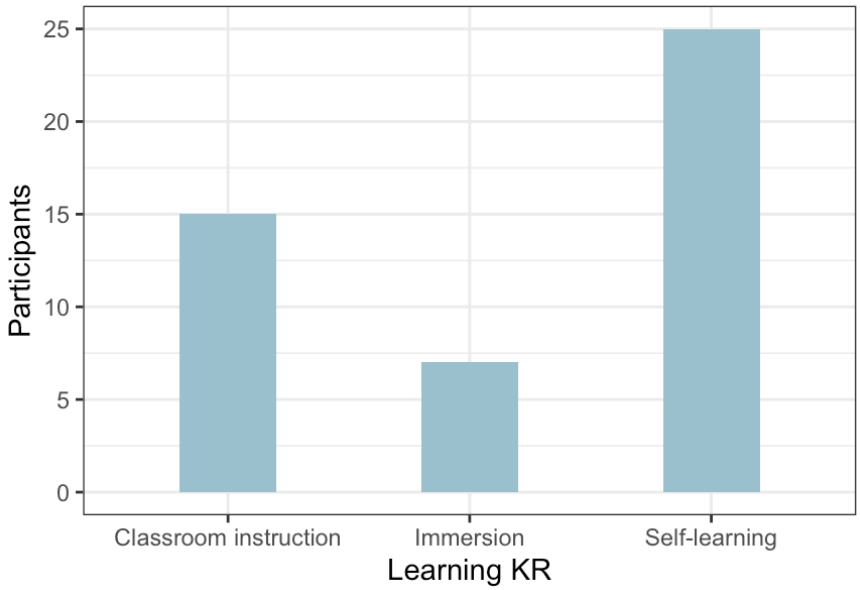
Figure 20 - Years dedicated to the learning of Korean



Source: Own authorship

In the same way as it was asked for the English language, participants were also asked the way through which they acquired the Korean language. Once again, there could be more than one answer, as participants could have used multiple ways of acquisition. Twenty-five participants reported to have learned Korean through self-learning, followed by 15 participants reporting to have learned through classroom instruction, and 7 reporting to have learned through immersion. Participants' responses are depicted in Figure 21.

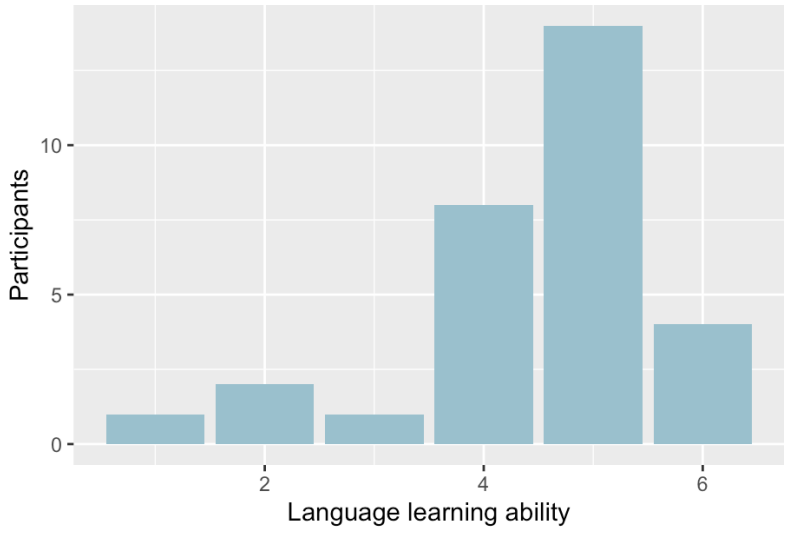
Figure 21 - Way of learning Korean



Source: Own authorship

Apart from my interest in the onset of learning and ways of learning, participants were also asked to self-rate their language learning ability and skills in each of the languages involved in the study. Overall, the vast majority of respondents have self-rated their general language learning ability as a 5 on a scale of 6. Their answers are depicted in Figure 22.

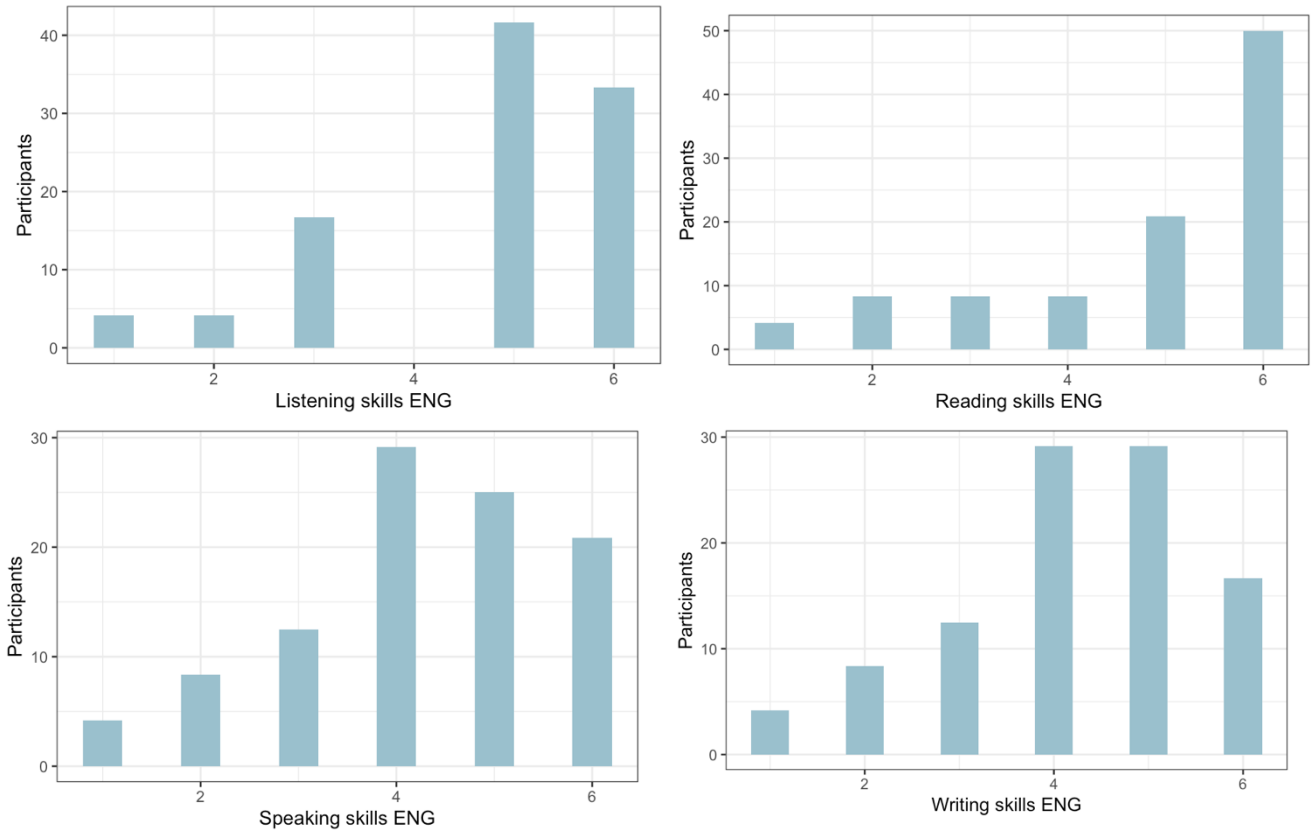
Figure 22 - Self-rated language learning ability



Source: Own authorship

Using this same scale, participants were asked to rate each of their communication skills in both English and Korean. For the English language, 20.8% of participants rated their reading skills as a 5, while 50% of participants rated their reading skills as a 6 on a scale of 0 to 6. Additionally, for listening comprehension, 41.6% of participants rated their skills as a 5 and 33.3% rated their skills as 6. On the other hand, for language production skills such as speaking and writing, the number of answers rated as 4 on a scale of 6 were higher. For speaking, 29.1% of participants rated their speaking skills as a 4, 25% as a 5, and 20.8% as a 6. At the same time, the same percentage of participants rated their writing skills as a 4 out of 6 (29.1%), another 29.1% rated their writing skills as a 5, while 16.6% rated this same skill as a 6. The compilation of participants' answer to this question is depicted in Figure 23.

Figure 23 - Self-rated listening, reading, speaking, and writing skills in English



Source: Own authorship

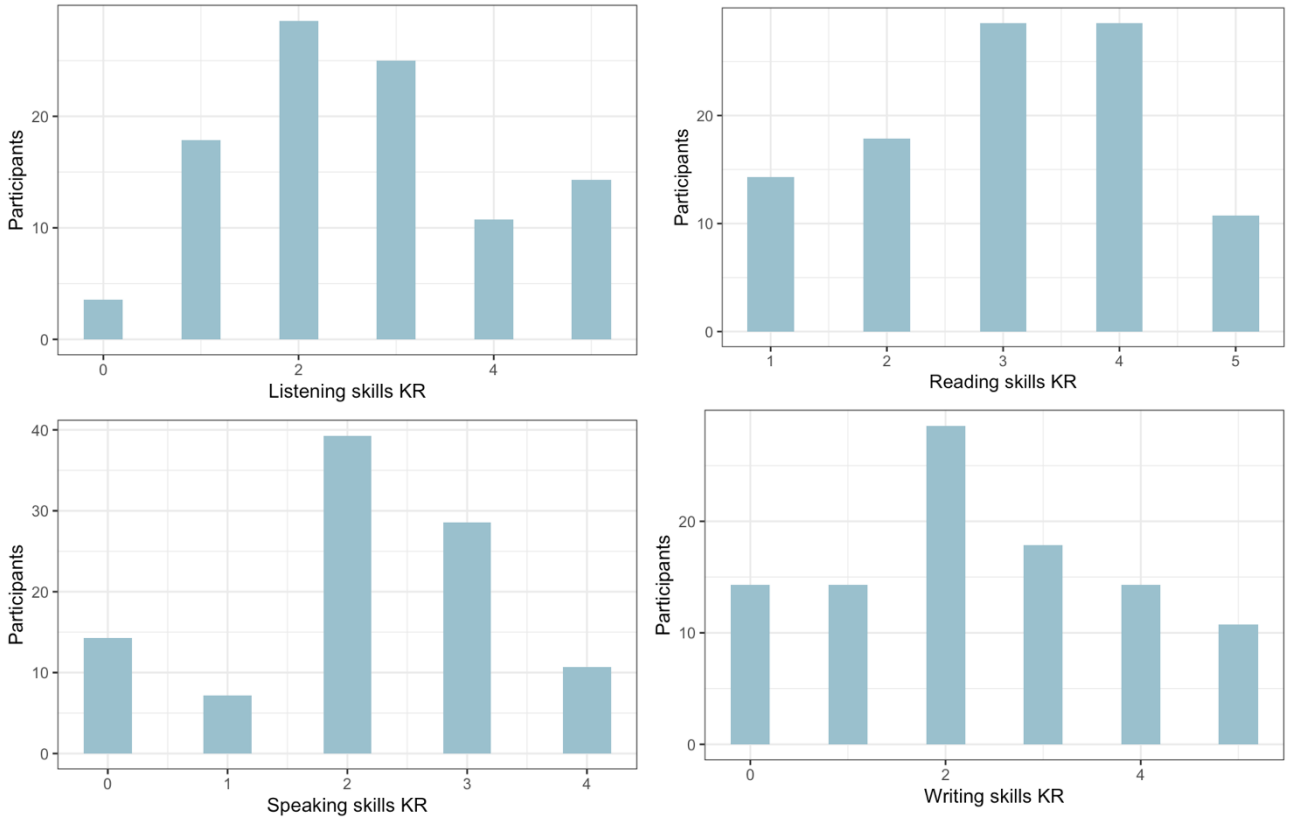
For the Korean language, self-reported results were quite different. On a scale of 0 to 6, the 50% of participants rated their Korean listening skills as 2 (28.6%) or lower (21.4%). At the same time, 25% of participants rated their listening skills as 3, 10.7% as 4, and 14.3% as 5.

For their reading skills, results were a bit higher, where 28.6% of participants rated their reading skills in Korean as 4 out of 6, and 28.6% as 3 out of 6. 14.3% rated their reading skills as a 1, 17.9% rated their skills as a 2, and 10.6% rated their reading skills as 5 out of 6. It is important to highlight that for the reading skills not a single participant rated their skill as 0.

When rating their writing skills in Korean, 14.3% of participants rated it as 0, 14.3% as 1 out of 6, 28.6% as 2 out of 6, 17.9% as 3 out of 6, 14.3% as 4 out of 6, and 10.6% as 5 out of 6. For their speaking skills, 14.3% rated it as 0, 7.1% as 1, 39.29% as 2, 28.58% as 3, 10.7% as 4. Not a single participant rated their speaking skills as 5 nor 6. Overall, no participants rated their

skills in Korean as a 6. The compilation of participants' answer to this question is depicted in Figure 24.

Figure 24 – Self-rated listening, reading, speaking, and writing skills in Korean



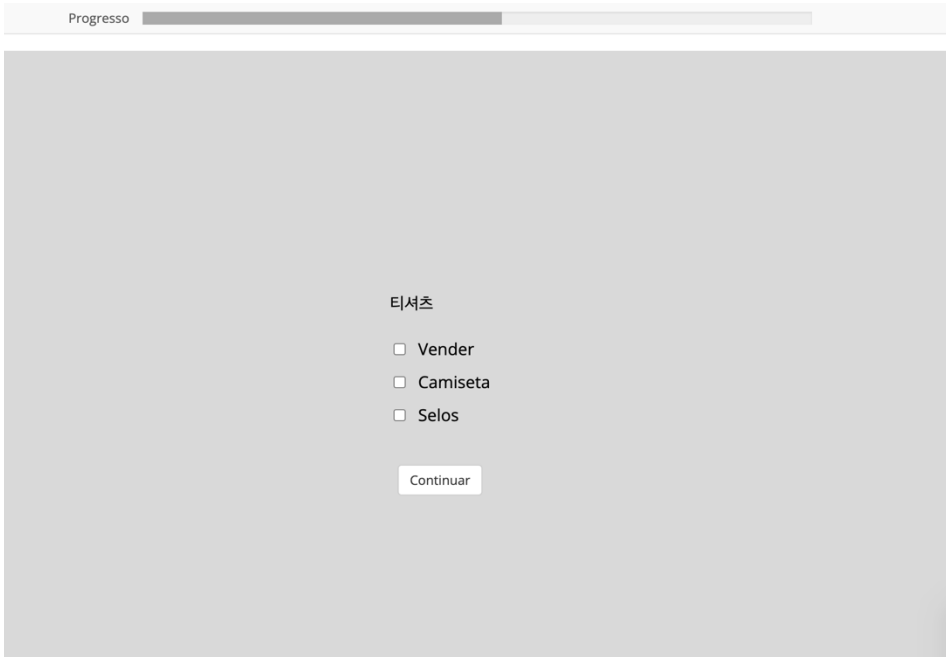
Source: Own authorship

Now that the answers to the Language History questionnaire have been reported, the next section will discuss the results for the meaning recognition task, followed by the results for the word naming task – the descriptive statistic and exploratory analyses.

4.3 THE MEANING RECOGNITION TASK

In the meaning recognition task, participants were asked to select the appropriate definitions for each of the words presented on the screen, for all the 160 target words from the word naming task. An example of a trial from the meaning recognition task can be seen in Figure 25.

Figure 25 - Example of a trial from the meaning recognition task.



Source: Own authorship

Overall, participants responses were rated from 0 to 1 considering whether or not they chose the correct response to each of the words presented. This scale had the purpose of rating their familiarity with the target words presented in the main task. Correct responses were rated as 1, while wrong responses as 0. Only one participant had most answers (55.62%) rated as 0.

Now that I have discussed the results for the familiarity task, in the following section I will describe the descriptive statistic for the naming latencies of the target words.

4.4 THE DESCRIPTIVE STATISTICS

For the purposes of the present study, naming latencies of the target words were analyzed in three different models. First, in order to answer the research questions, I analyzed RTs with condition and Korean level as fixed factors and participants as random factors. However, considering the data collected, I also decided to carry out two exploratory analyses. Thus, in the present section, I will describe first the descriptive statistics of the RTs based on condition and participants' level of Korean.

All data analyses were carried out in the R environment (version 4.1.2; R Core Team, 2019), with the R packages lme4 (BATES *et al.*, 2015), ggplot2 (WICKHAM, 2016), and tidyverse (WICKHAM *et al*., 2019). The results in Table 6 depict the RT descriptive statistics for condition,

in which participants average RT was 1017.96ms (*SD* = 233.72). At the same time, in Table 7, I present the RT descriptive statistics for Korean level of proficiency. In this case, participants' mean RTs were 1080.10ms (*SD* = 232.36) for low levels of Korean, and 1036.59 (*SD* = 237.42) for intermediate levels of Korean.

Table 6: RT descriptive statistics for condition

Condition	*Mean RT (ms)*	*SD*
control	1017.96	233.72
double	1100.12	243.21
triple	1123.32	243.85

Table 7: RT descriptive statistics for Korean Level

KR level	*Mean RT (ms)*	*SD*
low	1080.10	232.36
intermediate	1036.59	237.42

Source: Own authorship

Opposed to what it was expected, these results seem to indicate no facilitation effect in the naming of double and triple cognates. That is, this preliminary descriptive analysis seems to illustrate an interference of the L1 and L2 in the naming of cognate words in the L3. Additionally, proficiency does seem to play a role in these results, as intermediate learners of Korean presented naming latencies ($M = 1036.59$, $SD = 237.42$) shorter than for lower levels of Korean ($M = 1080.10$, $SD = 232.36$).

4.5 THE INFERENTIAL STATISTICS

Similar to the descriptive statistical analysis, the focus of the inferential analysis were the control and cognate words as well as participants' level of Korean. Mixed-effects modelling was used to assess if RTs significantly decreased depending on the target word condition. Condition and level of Korean were included as fixed factors, while participants were included as random factors. Considering I also wanted to assess whether or not proficiency in Korean would enhance facilitation effect in word naming, interaction terms for condition and proficiency were also included.

Thus, Table 8 illustrates the means and SDs for RTs by Korean Level. In this table it is necessary to highlight that participants' lowest RTs appeared in the interaction between the control

condition and intermediate proficiency of Korean. At the same time, among those with low levels of Korean, control target words were also the ones with the shortest RTs.

Table 8 - Means and SDs for RTs by Korean Level

Condition	*Korean Level*	*Mean RT (ms)*	*SD*
control	low	1039.04	220.55
double	low	1118.49	239.00
triple	low	1123.85	234.61
control	intermediate	984.04	223.59
double	intermediate	1070.68	235.42
triple	intermediate	1107.61	241.83

Source: Own authorship

These results indicate that even for more proficient participants, Korean words were named faster than cognate words. Based on these results, I find necessary to extrapolate the analysis in order to better understand why such event took place. Therefore, in the next main section, I will discuss an exploratory analysis of language proficiency, familiarity, and word length – all possible variables that could present effects in word naming latencies. However, for the moment, in the following subsection I present an inferential analysis of RTs per experimental condition and level of Korean.

4.5.1 Inferential analysis of RTs per condition and level of Korean

Table 9 illustrates the summary of the model for condition and Korean level.

Table 9 - Inferential analysis of RTs per condition and KR level

		RT	
Predictors	*Estimates*	*CI*	*p*
(Intercept)	1039.83	963.67 – 1115.98	**<0.001**
condition [double]	82.75	65.15 – 100.36	**<0.001**
condition [triple]	91.70	74.10 – 109.30	**<0.001**
kr lvl [intermediate]	-46.85	-158.33 – 64.64	0.410
condition [double] * kr lvl [intermediate]	-1.28	-27.05 – 24.49	0.922
condition [triple] * kr lvl [intermediate]	29.26	3.49 – 55.03	**0.026**
Random Effects			
σ^2	34403.20		
$\tau_{00\ participant}$	23715.68		
ICC	0.41		
$N_{\ participant}$	30		
Observations	4800		
Marginal R^2 / Conditional R^2	0.044 / 0.434		

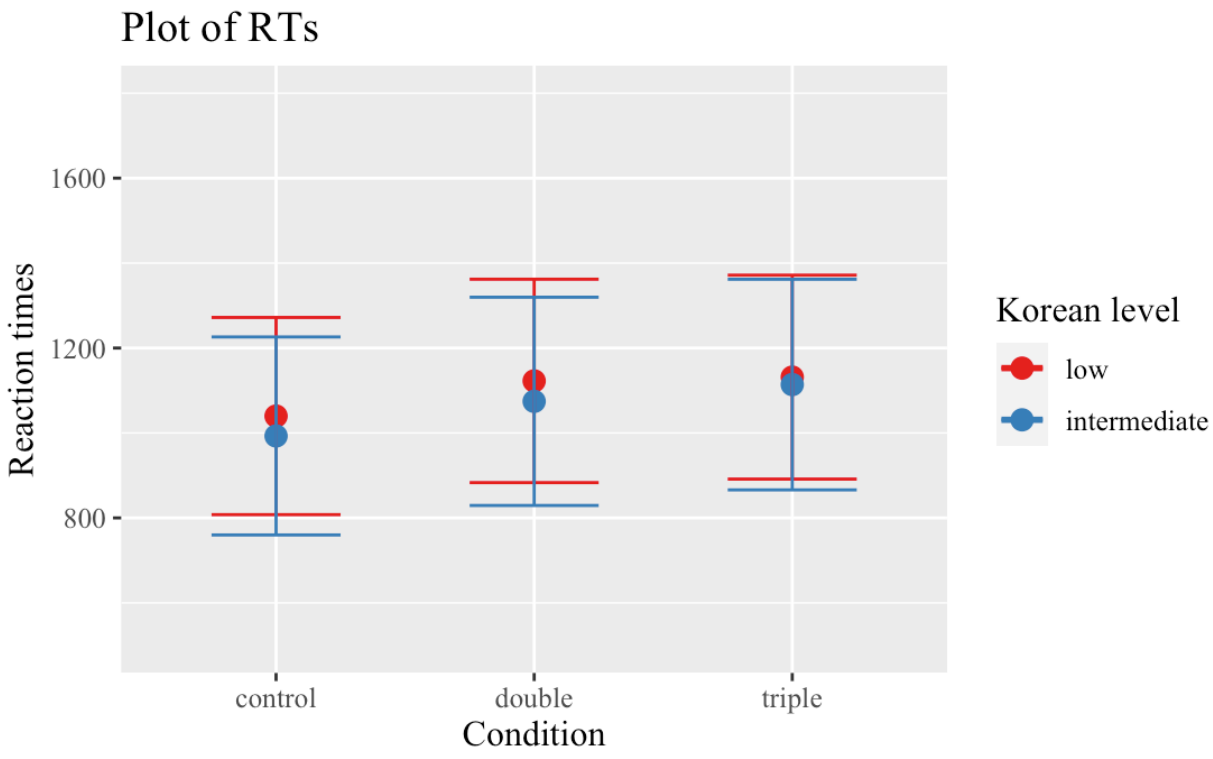
Source: Own authorship

The results showed a significant main effect of condition for control (β: 1039.83, $p < .01$), double (β: 82.75, $p < .01$), and triple conditions (β: 91.70, $p < .01$). Contrary to expectations, there was no significant main effect for Korean proficiency, even though a trend of facilitation effect was observed for intermediate levels of Korean (β: -46.85, $p = 0.4$). Moreover, there was no significant effect in the interaction between double cognates and intermediate levels of Korean, even though some facilitation was observed. Curiously, there was a significant inhibitory effect between the interaction of triple cognates and intermediate levels of Korean (β: 29.26, $p = .02$). It seems that it took longer for intermediate speakers to name triple cognate words in comparison to

those with lower levels of Korean. Finally, a comparison between marginal and conditional R^2 values indicates that the full model (i.e., the model with both fixed and random factors) explained better the variability than the model with only fixed factors.

In order to illustrate the data presented above, a plot of RTs is depicted in Figure 26 below. It shows the RTs for control, double, and triple conditions, divided by participants' level of Korean. Interestingly enough, intermediate speakers of KR had slower RTs in naming triple cognate words, resembling those from lower levels of KR. Simultaneously, for low level speakers of KR, the average RTs for both double and triple cognates did not present any differences between themselves. In other words, participants with lower levels of Korean did not name triple cognates faster nor slower. Their RTs for triple cognates was similar to the ones for double cognates.

Figure 26 - Plot of RTs



Source: Own authorship

In the next section, I will present the exploratory analyses I conducted in order to better understand if there were any effects of L2 proficiency, familiarity, and word length.

4.6 THE EXPLORATORY ANALYSES

After carrying out the main analysis that aimed at answering the research questions of the present study, I decided to conduct three exploratory analyses to investigate whether or not proficiency in the L2 (English), familiarity, and word length played a role in the naming of the target words – in this specific order.

4.6.1 Exploratory analysis with English proficiency as a fixed factor

Table 10 illustrates the summary of the model for condition and English proficiency as fixed factors.

Table 10 - English proficiency as fixed factors

		RT	
Predictors	*Estimates*	*CI*	*p*
(Intercept)	987.62	880.29 – 1094.94	**<0.001**
condition [double]	63.16	38.26 – 88.06	**<0.001**
condition [triple]	89.60	64.70 – 114.50	**<0.001**
eng proficiency [high]	41.38	-83.95 – 166.71	0.517
condition [double] * eng proficiency [high]	25.90	-3.18 – 54.98	0.081
condition [triple] * eng proficiency [high]	21.48	-7.59 – 50.56	0.148
Random Effects			
σ^2	34416.58		
$\tau_{00\ participant}$	23545.56		
ICC	0.41		
$N_{\ participant}$	30		
Observations	4800		
Marginal R^2 / Conditional R^2	0.047 / 0.434		

Source: Own authorship

In this model, similarly to the previous one, cognate trials did not present a facilitation effect compared to control trials. There was a significant main effect of condition for control (β: 987.62, $p < .01$), double (β: 63.16, $p < .01$), and triple conditions (β: 89.60, $p < .01$). Once again, there was no significant main effect for low English proficiency, even though a trend of facilitation effect has been observed (β: -41.38, $p = 0.5$), as well as a trend of facilitatory effects in the interaction between double cognates and low English proficiency (β: -25.90, $p = 0.08$) and triple cognates with low English proficiency (β: -21.48, $p = 0.148$). However, considering there was no significant effect, it would be interesting to further analyze these effects in a future study. Overall, L2 proficiency does not seem to play a role in L3 naming.

4.6.2 Exploratory analysis with familiarity as a fixed factor

Table 11 illustrates the summary of the model for condition and familiarity.

Table 11 – Familiarity as a fixed factor

		RT	
Predictors	*Estimates*	*CI*	*p*
(Intercept)	1057.36	998.88 – 1115.85	**<0.001**
condition [double]	71.93	28.78 – 115.09	**0.001**
condition [triple]	-12.68	-68.43 – 43.07	0.656
familiarity [1]	-44.75	-68.50 – -21.00	**<0.001**
condition [double] * familiarity [1]	13.04	-32.24 – 58.31	0.572
condition [triple] * familiarity [1]	126.88	69.54 – 184.22	**<0.001**
Random Effects			
σ^2	34267.01		
$\tau_{00\ participant}$	22858.21		
ICC	0.40		
$N_{\ participant}$	30		
Observations	4800		
Marginal R^2 / Conditional R^2	0.041 / 0.425		

Source: Own authorship

Unexpectedly, in this model, double cognate trials did not present a significant facilitation effect when compared to control trials. However, there was a trend of facilitation in triple cognate trials (β: -12.68, p = 0.656). This would mean that triple cognate trials with which participants were not familiar with, were named faster than non-cognate trials. Additionally, familiarity seems to have played a facilitation effect in word naming (β: -44.75, p < .01), therefore, there was a significant facilitation effect in trials participants were familiar with the target word. Moreover, there was no effect in the interaction between fixed factors (namely, condition and familiarity)

with the exception of the interaction between triple cognates and familiarity (β: 126.88, p < .01). These results could indicate an interference of participants' L1 and L2 in the naming of cognate words they were familiar with.

Another factor that could influence RTs is word length. Considering it was not possible to control for word length, there is a possibility of word length effect in the present results. In order to assess this, I conducted an exploratory analysis of word length which I will discuss below.

4.6.3 Exploratory analysis of word length as a fixed factor

The exploratory analysis of word length effect in RTs revealed some interesting results. First, it has shown that there was a significant effect of word length in participants RTs. Two-syllable words significantly increased (β: 93.21, p <.01) participants RTs in comparison with one-syllable control words (β:916.66, p < .01). In the same way, three-syllable (β: 155.35, p <.01), four-syllable (β: 216.55, p <.01), and five-syllable (β: 193.64, p <.01) words all had a significant effect in RTs. Thus, longer words indeed increased participants' reaction times.

Table 12 - Word length as fixed factor

		RT	
Predictors	*Estimates*	*CI*	*p*
(Intercept)	916.66	857.41 – 975.90	**<0.001**
condition [double]	62.75	49.83 – 75.67	**<0.001**
condition [triple]	52.07	37.58 – 66.57	**<0.001**
length [2]	93.21	69.24 – 117.18	**<0.001**
length [3]	155.35	129.34 – 181.36	**<0.001**
length [4]	216.55	187.02 – 246.08	**<0.001**
length [5]	193.64	148.83 – 238.44	**<0.001**
Random Effects			
σ^2	32519.40		
$\tau_{00\ participant}$	23311.20		
ICC	0.42		
$N_{\ participant}$	30		
Observations	4800		
Marginal R^2 / Conditional R^2	0.070 / 0.458		

Source: Own authorship

Now that I presented all the exploratory analyses conducted, I will further discuss the results in the following chapter.

5 DISCUSSION

This study's general objective was to investigate cognate facilitation effect in L3 Korean in BP-ENG-KR unbalanced multilinguals during an L3 word naming task. In this study, the Korean language was chosen due to its increasing popularity among young people in Brazil. Moreover, another reason for choosing Korean as the L3 in this study was due to its distinctive written representation in comparison to the other two languages involved in this study. Despite the difference in their scripts, Korean has a long history of lexical borrowing from the English language, thus, it is not uncommon to encounter words across the two languages with shared phonological representations. Additionally, considering the global status of English as a lingua franca, some of these words are also present in the BP lexicon. The study's broader goal was divided into specific objectives.

The first one was to examine if double cognate words would be named faster than non-cognate words. Considering previous studies conducted in bilingual and multilingual individuals, that investigated not only cognate effect from the L1 to the L2 (CHOI; NAM; LEE, 2010; DIJKSTRA; GRAINGER; VAN HEUVEN, 1999; HOSHINO; KROLL, 2008; LIM; CUI; AHN, 2020; ROGERS; WEBB; NAKATA, 2015), but also from the L1 and L2 to the L3 (DIJKSTRA et al., 2010; LEMHÖFER; DIJKSTRA, 2004; TOASSI; MOTA, 2018), it was expected that double cognates would be more efficiently named than non-cognate words. This is hypothesis 1.

The second objective was to examine if triple cognate words would be named faster than non-cognate words. Here, previous studies such as Lemhöfer and Dijkstra (2004), and Toassi and Mota (2018) were also taken into consideration when elaborating this hypothesis. Thus, it was also expected that the triple cognates would be named faster than non-cognate words, considering cognate effects were observed to accumulate over languages. This is hypothesis 2.

The third and final objective was to compare the naming of triple and double cognates and verify if triple cognates would be named faster than double cognates. It was expected that triple cognates would be named faster than double cognate words, considering the target words belong to all the languages present in participants' minds. Moreover, I expected the effect to accumulate over languages, similarly to what Lemhöfer, Dijkstra, and Michel (2004) observed. This is hypothesis 3.

In order to assess these hypotheses, a word naming task was constructed with Korean words which were double cognates, triple cognates with English and Brazilian Portuguese or non-cognate

words. Double cognates had their phonological information and meaning shared between Korean and English, while triple cognates had their phonological information and meaning shared between Korean, English, and Brazilian Portuguese. There were also non-cognate words, which were present only in the Korean lexicon. For this study, word naming was chosen considering phonology is overtly involved in the process of lexical access and production (word naming), differently from other tasks, such as the lexical decision task (JIANG, 2013, p. 91). Considering the cognate words in the word naming task only shared phonological form, I judged a naming task to be more appropriate for the purposes of the present study. The results for these three objectives will be discussed in the next sections of this chapter.

5.1 WORD NAMING TASK ANALYSES

Word frequency was controlled when stimuli were selected for the word naming task. Even though I also considered controlling for word length and word onset, as it is suggested by Jiang (2013), after going through the corpus for the creation of stimuli, it was evident that this choice would limit the number of cognate words that could be selected. As it was previously mentioned in Chapter 2, loanwords go through adaptations when inserted into the Korean lexicon. Thus, the incorporation of English loanwords must follow the orthographic and phonological rules of the Korean language. Considering there are no consonant clusters in either syllable-initial or syllable-final positions in Korean, the transcription of English loanwords containing consonant clusters to the Korean language requires an epenthetic vowel (close back unrounded vowel /ɯ/) to break up the consonant cluster (e.g., allergy - /aleɾɯki/) (SHIM, 1994). Additionally, consonants in the word-final position are also not allowed in loanword adaptation, thus, it is necessary to add epenthesis in order to preserve releases of word-final obstruents in the source language, English (KIM; KOCHETOV, 2011). Thus, all non-syllabic consonants, except the post-alveolar [tɕ] and [tɕh], trigger insertion of [ɯ] to form an independent syllable.

For a practical example, let us take the English word ‘desk’. It has three consonants, but only one vowel [ɛ]. Therefore, neither [s] nor [k] are followed by a vowel. These stranded consonants cannot be pronounced in Korean. Thus, the [ɯ] vowel is inserted to create a syllable on its own. The English word ‘desk’ becomes [tɛsɯkhɯ] with two additional vowels [ɯ] inserted at surface level in Korean, and consequently, the word will then consist of three syllables instead of one (LEE; MADIGAN; PARK, 2016). Considering these adaptations increase word length and are

present in the vast majority of cognate words, it was not possible to control for word length. This effect was reflected in the stimuli, as the majority of the triple cognates selected (24 out of 40) were three-syllable words. At the same time, matching word length in control words to double and triple cognates' would not be feasible. Even though I could try to select the majority of target words containing three syllables instead of two, this could affect familiarity, especially considering that the most frequent Korean words in the corpus were two-syllable words. By aiming at controlling for both frequency and length, there would not be enough triple cognate stimuli to move on with the task.

In Table 13, I present the word length and quantity for the target words selected to compose the word naming task stimuli.

Table 13 - Length of the target words by number of syllables

Target type	*# of syllables*	*# of words*
control	1	7
control	2	57
control	3	11
control	4	5
double cognate	1	1
double cognate	2	23
double cognate	3	12
double cognate	4	2
double cognate	5	2
triple cognate	2	8
triple cognate	3	24
triple cognate	4	7
triple cognate	5	1

Source: Own authorship

Having made this issue clear, I will move on to the discussion of the results.

5.1.1 Double cognates and non-cognate words' reaction times

In general, a significant difference between control and double cognate words was seen. However, this difference was the opposite of what was expected in my hypothesis. Control target words were named faster than double cognate words. This could be related to the fact that none of the languages involved in this analysis were participants' L1. Additionally, these results could reflect an interference from the writing scripts, or from the orthographic adaptation required by English loanwords in the visual recognition, and consequently, lexical production. The epenthesis required to adapt English loanwords is made through the insertion of a phoneme that is not present in neither BP nor English. Therefore, since participants are not used to this phoneme, being either more challenging to access or to articulate, delaying speech onset.

Another possible explanation related to phonology is that the L2 could have activated its phonological representation, however, the adaptations made from English to the Korean language add an extra processing cost, which are necessary in order to inhibit the L2 phonological representation and name the word in Korean L3. Toassi (2016) presented some results that followed the same line, in this case, from the L3 to the L2. When the prime word was presented in German, participants' L3, in contrast to the target language L2 English, an extra processing cost was observed in order to inhibit the L3 phonological representation and name the word in the L2.

Additionally, the results seem to show a trend of facilitation effect depending on proficiency. Low proficiency participants tended to take longer to name double cognates and control words, in comparison to intermediate speakers of Korean. These results, however, were non-significant.

Similar results were observed in triple cognate words, which is the discussion topic of the next subsection.

5.1.2 Triple cognates and non-cognate words

Similar to the results from double cognates, a significant difference between control and triple cognate words was seen. However, this difference was, once again, not the one expected by my hypothesis. Target words which were not cognates across languages were named faster than triple cognates. Following the same line as the previous results, one possible explanation could be

that extra processing cost was necessary in order to inhibit not only the L1, but also the L2 phonological representations and name the word in L3 Korean. Another hypothesis is that it took longer for participants to identify triple cognates considering the mapping between graphemes and phonemes occurred in a recently acquired writing script, which could be exposed to direct interference from the L1 and L2 phonologies.

Additionally, the results show a facilitation effect depending on proficiency in this case. Intermediate participants of Korean took more time to name the target words in comparison to low-level speakers of Korean. This could indicate that for low-level speakers of Korean, the activation of their L1 facilitated the recognition and naming in the L3, while for more proficient speakers inhibiting the L1 could have caused an interference as it adds an extra processing cost. Nonetheless, this specific interaction had a smaller significancy than the other results I reported. Thus, it would be interesting to test these results in a bigger sample, in order to make sure this interaction stands true.

Considering my last research question aimed at understanding if there would be a facilitation effect across double and triple cognates, the next subsection will discuss the results focused on the accumulation of the cognate facilitation effect.

5.1.3 Double and triple cognates

The third and final research question aimed at understanding if a cognate facilitation effect would accumulate over languages, at it has been previously observed by Lemhöfer, Dijkstra, and Michel (2004). However, our results illustrate the opposite of what I predicted. Double cognate words were named faster than triple cognate words, and naming latencies for both experimental conditions were longer than for the control condition.

Overall, the results seem to indicate that the more languages involved in the naming of target words, the longer it took for participants to name them. Based on this evidence, it is possible to infer that naming triple cognates implied in more processing cost for participants, since they had to inhibit phonological representations not only in the L1, but also in the L2.

Additionally, comparing the results seem to show a trend of facilitation effect depending on proficiency. Low-level speakers of Korean tended to take longer to name double cognates and control words, in comparison to intermediate speakers of Korean. However, these results were non-significant.

The absence of the cognate facilitation effect in L3 word naming by BP-ENG-KR multilinguals is the main finding of the present study. Participants did not present faster naming latencies for trials with neither double nor triple cognate words. On the contrary, control words presented faster naming latencies than cognate words, for both low and intermediate levels of Korean. Additionally, triple cognate words did not facilitate word naming in comparison to double cognates. These results do not align with my hypotheses, as I expected to identify cognate facilitation effect despite no sharing of orthographic information. In the following subsection, I will further discuss the results comparing them to findings from other studies.

5.1.4 Summing up: cross-language effects on visual word recognition

In sum, the results from the three analyses have shown cognate inhibition, opposed to the expected facilitation effect. Under specific conditions, the facilitative effect of cognates can decrease, vanish or even turn into inhibition. The latter is obtained when competition outweighs facilitation, and factors such as word, task, and participant levels can play a role in cognate recognition and processing (LIJEWSKA, 2020).

As it is discussed in Lijewska (2020), at the word level, cross-language similarity, word frequency, and concreteness and word class, can influence RTs during cognate processing. I will not explore concreteness and word class in the present discussion, due to the fact that these only influence cognate recognition at sentence processing levels – which was not the case in the present study (BULTENA; DIJKSTRA; VAN HELL, 2014). As for cross-language similarity, it corresponds to the degree of similarity between identical and nonidentical cognates – the first being the ones whose orthographic form is the same across languages, while the second is not exactly the same in orthography, but identical in meaning. Decreasing the degree of cross-linguistic similarity results in smaller effects in processing, as cognate facilitation significantly drops when nonidentical cognates are processed (BULTENA; DIJKSTRA; VAN HELL, 2013). In this context, identical cognates are thought to share a single representation across languages, while nonidentical cognates would have one representation in each language (COMESAÑA et al., 2015; DIJKSTRA et al., 2010). In the case of the present study, it is possible that the distinct representations across languages, combined with other particular factors – such as task type and context, level of L2 and L3 proficiency, stimuli word length, participants' cognitive control or L3 frequency of use, could have influenced cognate processing, increasing RTs for cognate trials.

Additionally, it is delicate to compare our results to the ones previously reported in the literature, especially considering that the vast majority of studies investigating cognate processing in multilinguals have been mainly based on European participants (ZHU; MOK, 2020). Another important issue to mention here is that even though there are studies that have assessed script differences in cognate facilitation effect (DIMITROPOULOU; DUÑABEITIA; CARREIRAS, 2011; HOSHINO; KROLL, 2008; LIM; CUI; AHN, 2020; NAKAYAMA et al., 2012; ROGERS; WEBB; NAKATA, 2015), to the best of my knowledge, only a few studies have assessed this effect in an L2 or L3 with a different writing script rather than the Latin alphabet (DEGANI; PRIOR; HAJAJRA, 2018). In other words, studies that have investigated cross-script cognate facilitation effect, mostly assessed this issue in participants whose L1 was represented by a non-Latin alphabet, instead of their most recently acquired language.

Poarch and van Hell (2014, Experiment 3), indeed have investigated L2 and L3 picture naming in Russian-German-English multilinguals. However, in this case, participants L2 and L3 shared the same script – which means that the new script recognition skill had begun to be acquired when they first learned their L2 German. In the same line, Hoshino and Kroll (2008) tested Japanese-English and Spanish-English bilinguals and found picture naming to be faster for cognates than for noncognates. Once again, participants' L2 was English, represented by the Latin alphabet. Moreover, in the recent study by Lim, Cui, and Ahn (2020), cognate effect was found in Korean-English bilinguals. Here, it is also the case in which the L2 is the same as in the previously mentioned studies. Additionally, cognate effect was also modulated by L2 proficiency, one of the participant-level differences that can influence the cognate processing (LIJEWSKA, 2020).

One thing that the present study has in common with Lim, Cui, and Ahn (2020), Hoshino and Kroll (2008), and other cited studies with both bilinguals and multilinguals, is that the English language holds the status of L2. Nonetheless, differently from Poarch and van Hell (2014), Lemhöfer, Dijkstra, and Michel (2004), and even more recent studies, such as Zhu and Mok (2020), the participants' L1 and L2 shared the same script, while their L3 – the most recently learned language – was the odd one out. Thus, there is a possibility of extensive L1-L2 interactions due to typological similarities, which could have led to inhibition in cognate processing instead of a facilitation effect.

Another feature to be taken into consideration is the distance between Korean and the other two languages involved, which could also justify the inhibition observed. Distant language pairs

impose an extra effort on L2 naming, even when lexical items share both phonological and semantic features. Cognitive control demands are high, as it has been observed in Ghazi-Saidi and Ansaldo (2017) in which they observed the behavioral and neural correlates of cross-linguistic transfer (CLT) effects at the word level, in a pair of linguistically distant languages (Persian-French). Overall, they observed that in distant language pairs, naming in L2 is effortful and demanding, less automatic, and it must recruit more neural resources for lexical retrieval, and articulatory processing. Additionally, they highlight that it also requires more attention and cognitive control, even in cases where there is phonological overlap. The activation with different word types reflected the interaction of language and other cognitive systems including executive control and working memory circuits, even with phonologically similar and highly consolidated words (GHAZI-SAIDI; ANSALDO, 2017).

This extra effort required in the processing of distant language pairs can also reflect an accommodation of the new language into the brain, as the new writing system imposes constraints on processing that the brain must accommodate (LIU et al., 2007; PERFETTI et al., 2007). Language distance in terms of the similarity on orthographic transparency between L1 and L2 is also thought to influence the balance between assimilation and accommodation (Kim et al., 2016). In a more recent investigation with fMRI, Kim and Cao (2022) have shown that the brain network for Korean is not simply depicted as the one typically observed with alphabetic scripts (e.g., English) but rather highly similar to that of Chinese, a morpho-syllabic script, possibly because the Korean writing system leads to syllable-level phonological representation and processing – which resembles the Chinese language.

Another important factor influencing visual lexical recognition at word level refers to word length. According to Szubko-Sitarek (2015, p. 109), word length can be based on orthographic measures (number of letters) or phonological measures (number of phonemes and syllables). In the case of Korean, word length is measured by the number of syllables. As mentioned in the beginning of the present chapter, 24 out of 40 triple cognates were three-syllable words. Simultaneously, 23 out of 40 double cognates and 57 out of 80 control words consisted of two syllables. Prioritizing frequency and phonological proximity of the loanwords to their original counterparts instead of word length had to be done in order to have enough stimuli for the elaboration of the task. Controlling for word length would restrict the options of frequent, phonologically similar triple cognates. This issue could be another influencing factor to our results.

New et al. (2006, p. 45) report in their review article on the word length effect in written lexical access, these different measures are generally highly interconnected, and they also correlate with other variables that influence word recognition. Although it seems plausible that visual word recognition should slow down depending on the word length, a variety of tasks used to examine the effects of word length on visual word recognition have shown inconsistent results ranging from inhibitory (i.e. longer words are more difficult) to null effects (SZUBKO-SITAREK, 2015). For instance, Frederiksen and Kroll (1976) obtained inhibitory length effects in naming but not in lexical decision, while Hudson and Bergman (1985b) found length effects in both types of tasks. In the same line, the present study has shown an inhibitory effect of word length, which is a possible explanation of why I did not see any cognate facilitation effects – in opposition to what I first expected.

All things considered, even though the results did not corroborate my hypothesis, important implications can be made regarding lexical access and production research with multilinguals – especially those investigating languages represented by different writing systems. In the following chapter, I present the conclusions drawn from the results, as well as limitations and suggestions for further research.

6 CONCLUSION

This study was elaborated with the purpose of investigating cognate facilitation effect in Brazilian Portuguese-English-Korean multilinguals. This population was carefully selected after observing a crescent interest of Brazilians in learning the Korean language. Additionally, English was also involved in this study not only because it is the most commonly spoken L2 in the world, but also because of its history with the Korean language and lexical borrowing.

Hypotheses were drawn for each of the three research questions, which concerned respectively, double cognates facilitation effect in comparison to non-cognate words; triple cognates facilitation effect in comparison to non-cognate words; and triple cognate facilitation in relation to double cognate words. The main experiment was composed of a word naming task, followed by a meaning recognition task, a language history questionnaire, and one proficiency test for each of the additional languages involved. Significant results were found, but opposed to what I expected in my hypothesis. I have observed a significant effect of cognate inhibition in Korean L3 word naming. In general, proficiency did not seem to predict word naming, as there was a trend of facilitation in double cognates, but it was not significant. At the same time, for triple cognates, higher proficiency in the L3 has shown to significantly delay word naming – showing contradictory effects.

All in all, the findings of the present study might still corroborate with the non-selective view of lexical access and word production and could be explained by the Multilink model. In this case, L3 lexical links still rely on the previously acquired languages considering their level of L3 proficiency, as there could be differences in the resting level activation of more recently acquired words. Since no facilitation effect was observed, it is also possible to speculate that this interference was caused by task type, word length – as cognate words had more syllables than non-cognate words – or by other more specific factors such as, language distance, extensive L1-L2 interactions, or frequency of L3 use.

Moving forward, I will discuss the limitations and suggestions for future studies.

6.1 LIMITATIONS AND SUGGESTIONS FOR FUTURE STUDIES

Even though the results of the present study did not of corroborate with my hypothesis, they present themselves as a fundamental piece of research in the area of multilingualism, assessing non-European populations and dealing with languages represented by diverse writing scripts. All

things considered, the fact that the results were the opposite of what was expected, some limitations need to be pointed out.

The first limitation to be mentioned is the sample size. Even though cognate facilitation effect has been widely observed, it still depends on a variety of factors, such as task type, language distance, and individual differences across participants. As mentioned in the previous chapter, under certain conditions, the facilitative effect of cognates can decrease, vanish or even turn into inhibition (LIJEWSKA, 2020). Even though there is no ideal number of participants for a RT study (JIANG, 2013), considering I was not able to control for certain conditions, such as word length, having a larger sample would allow us to confirm some of the results that here were non-significant. For instance, there was no significant facilitation effect in the interaction between intermediate proficiency in Korean and double cognate recognition, even though I observed a trend of facilitation.

One limitation in my methodological choice is related to the choice for an online data collection instead of an in-person data collection. I opted for the online data collection considering the specificity of the sample. Despite the rising interest in learning Korean, finding participants with the required profile in Florianópolis (the Laboratory's location) would be challenging. As a consequence of my methodological choice for an online data collection, participants used different computers to access the experiment. Therefore, it is possible that delayed stimuli presentation could occur due to display refreshing times being different in each machine, an issue raised by Mathôt and March (2022) which I could not control for at the time of the data collection. Future studies should bear this in mind when opting for an online data collection, especially when dealing with reaction times.

Another limitation to be cited is the restricted source of materials for stimuli elaboration in the Korean language. Although I had access to the list of vocabulary words for learning Korean, finding the appropriate stimuli was a troublesome task. The list dates back to 2003, and despite my effortful attempts, it was not possible to gain access to more recent Korean language corpora. Thus, due to time constraints and lack of easily accessible materials in Korean for the creation of the stimuli list, there is room for a more detailed and critical stimuli selection in future studies. Participants' L3 proficiency should also be considered in future studies. The main goal of this study was to assess visual word recognition in beginner learners, but it is possible that their Korean

level of proficiency has affected the cognate effect. Bearing this in mind, a suggestion for future studies is that they investigate a similar sample, but with higher levels of Korean proficiency.

Additionally, considering task type is a factor that has shown to produce different effects in cognate recognition, this population could still be investigated under different tasks, in order to check if the interference was an occurrence restricted to word naming, or if it still appears in other word recognition tasks. Lexical decision or self-paced reading tasks could be implemented to further explore whether the results presented here were task-specific or if they can be generalized to this type of sample.

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