



# UNIVERSIDAD DE CUENCA

Facultad de Filosofía, Letras y Ciencias de la Educación

Carrera de Ciencias de la Educación en Lengua y Literatura Inglesa

Cognitive Skills Development: Comparison between bilingual and monolingual speakers

Trabajo de titulación previo a la obtención del título de Licenciada en Ciencias de la Educación en Lengua y Literatura Inglesa.

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**Cuenca, Ecuador**

11-noviembre-2021



## **Resumen:**

En este estudio se busca estudiar el desarrollo cognitivo del bilingüismo haciendo una comparación entre personas bilingües y monolingües. Asimismo, esta investigación se centra en dos aspectos; (1) una evaluación del rendimiento en cuanto al aprendizaje de los bilingües, y las ventajas y desventajas que presenta el mismo. Para ello, primero se revisaron veintidós estudios acerca del tema; posteriormente, se comparó y contrastó la información disponible para crear una discusión y así analizar los resultados que se encontraron en la revisión bibliográfica. Por consiguiente, los resultados revelaron que el bilingüismo mejora el funcionamiento cognitivo de las personas bilingües en su desempeño cotidiano mejorando sus niveles de atención y resolución de problemas. Además, retrasa el declive cognitivo que las personas de la tercera edad experimentan y mejora el uso de las regiones cerebrales para las destrezas cognitivas. De la misma forma, el bilingüismo aumenta la capacidad del control cognitivo de los individuos. Por último, este trabajo presenta ciertas recomendaciones y limitaciones a tomar en cuenta para investigaciones futuras.

**Palabras claves:** Evolución cognoscitiva. Funciones ejecutivas y el bilingüismo. El efecto del bilingüismo en la cognición. La ventaja del bilingüismo. Las ventajas y desventajas del control cognitivo en el bilingüismo.



**Abstract:**

This paper consists of five chapters. The first chapter presents a brief introduction to this research synthesis which consists of the background, statement of the problem, justification, and research questions. Then, the second chapter talks about the theoretical framework. This chapter provides the reader with some key theories and concepts related with the analyzed topic. The third chapter is the literature review. It is a very essential feature of this systematic research since it compares the available information about the subject matter. Chapter four includes the methodology used for the data collection process which details the inclusion and exclusion criteria. In the case of chapter five, it includes the analysis of the selected research studies. Finally, chapter six presents the conclusions derived from the analysis, and some recommendations for future research.

**Keywords:** Benefits of Bilingualism, Cognitive Skills, Cognitive Development, Bilingual Advantage, Linguistic and Non-Linguistic Tasks, and Executive Functions.



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Cuenca, 11 de noviembre de 2021

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## Acknowledgements

I wish to express my sincere appreciation to my parents and my brothers for their keenness, encouragement, and inspiration until the very end.

Yadira Quizhpi A.

I thank my parents from the bottom of my heart for being every single day with me. Even at my worst they were there, without them I would not know if I were here. Furthermore, my aunts and uncles supported me all the way through, and I held them in a special spot in my heart. Also, my deepest gratitude for my tutor who helped me to achieve this.

Linda Denis M.



## Dedication

Special thanks to my friends, that I made throughout this major, and Linda for her patience. Further, my tutor Catalina Jaramillo has always been there; thank you for all the time invested in me. Also, I wish to express my appreciation to all my teachers and fellow friends who indirectly or directly helped me throughout this career.

Yadira Quizhpi A.

To my beloved parents, brother and to the one and only Harry Potter who has guided me since childhood and taught me so much.

Linda Denis M



## Introduction

The term bilingualism engulfs many perceptions and perspectives. Firstly, it was believed that learning a second language may hinder the cognitive skills of individuals. This belief was held until the beginning of the twentieth first century. During this time period some studies (Bialystok, Craik, Klein, Viswanathan, 2004) emerged and enlightened the process of acquiring a second language, its advantages, and disadvantages. For instance, these studies showed the cognitive benefits that individuals gained by acquiring a second language. Furthermore, other studies established that bilingualism encompasses many assets such as a higher metacognitive awareness, that gives bilinguals insights about their own learning process, and a cognitive benefit, that provides tools to solve conflictive task faster than average unlike monolingual individuals (Grady, Luk, Craik, & Bialystok, 2015).

The bilingual advantage resides on the ability to manage two languages simultaneously without further complications as well as on the speed processing ability that bilingual individuals have to solve cognitively demanding tasks (Adesope, Lavin, Thompson, & Ungerleider, 2010). Moreover, bilingualism appears to provide people with superior attentional control abilities to manage and use them appropriately, when they need to



solve problems (Adi-Japha, Berberich-Artzi & Libnawi, 2010). However, the role of bilingualism on cognitive development and learning performance has not been thoroughly researched or has not been comprehended totally.

Thus, this bibliographical research attempts to shed some light and ease the debate whether bilingualism truly helps cognitive skills or hinders them. The compiled information shall help different teachers worldwide enabling them to know what the advantages and disadvantages of learning a second language are. Therefore, this research aims to understand the role of bilingualism on the cognitive development of individuals, the advantages and disadvantages it brings to bilingual individuals related to cognitive and linguistic skills.

This paper consists of five chapters. The first chapter presents a brief introduction to this research synthesis which consists of the background, statement of the problem, justification and research questions. Then, the second chapter talks about the theoretical framework. This chapter provides the reader with some key theories and concepts related with the analyzed topic. The third chapter is the literature review. It is a very essential feature of this systematic research since it compares and contrasts the available information about the subject matter. Chapter four includes the methodology used for the data collection process which details the inclusion and exclusion



criteria. In the case of chapter five, it includes the analysis of the selected research studies. Finally, chapter six presents the conclusions derived from the analysis, and some recommendations for future research.



## CHAPTER 1: Description of the Research

### 1.1 Background

Bilingualism is the capacity of a person to use two languages.

According to the situation, bilinguals can switch to the language needed at the moment (Bialystok, Poarch, Luo, Craik, F. I. M., 2014). Thus, this phenomenon is often linked with proficiency in cognitive skills compared with monolinguals. Over time bilingualism has evolved and it has distinguished two branches the psycholinguistic and the sociolinguistic; the first one recognizes this phenomenon as an advantage on the cognitive and linguistic development of children (Bermudez and Parra, 2012). It has been demonstrated that bilingualism promotes the growth of cognitive abilities which are superior to the cognitive abilities of monolinguals. The second one about sociolinguistic part is related to the study of the relationship between the linguistic part and the society “cultural aspect” and how it affects the learning process of a second language because bilinguals tend to switch words from one language to another language when they do not know one word, also known as transferring (Bermúdez Jiménez & Fandiño Parra, 2012). Therefore, according to Bermúdez Jiménez and Fandiño Parra





(2012), it is important to know that motivation is a substantial factor involved in the learning process of a second language because it triggers a person to get involved in such process and to learn a new language.

Research in cognitive aging has advanced enormously. Many studies were conducted on English speaking participants as well on speakers of different languages, but the results persisted because it does influence cognitive processing over the lifespan of a bilingual person (Bialystok et al., 2004). Bilinguals outperform monolinguals in several tests due to their enhanced cognitive skills. Also, results have reported an advantage over their monolingual peers in the realms of metalinguistic abilities and cognitive abilities related to executive function, involving selective attention, inhibition of attention, and switching attention in tasks with competing and misleading cues (Gathercole, Thomas, Kennedy, Prys, Young, Viñas Guasch, Roberts, Hughes, & Jones, 2014). Not only bilingualism has many advantages such as it delays some nervous system diseases, but also it allows bilinguals to do several things at the same time known as multitasking.

At first, bilingualism was seen as a disadvantage in metacognitive processing, a detrimental disadvantage, but over time many research studies



were conducted, and the results were completely different to the suppositions that were made. Being bilingual not only fosters many skills, but it helps to solve conflicts faster than average, and the left lobe of the brain will have a greater connectivity (Bialystok, Craik & Luk, 2012). This study reviews different empirical studies where bilinguals' and monolinguals' cognitive skills were compared in order to identify the advantages of studying a second language.

## **1.2 Statement of the Problem**

Bilingualism is a process that throughout time has been investigated deeply. The term describes a person who is able to speak two languages (Barac and Bialystok, 2012). The abilities of a bilingual person are many, such as a higher metacognitive processing and a superior cognitive skill development. Some studies say that bilinguals may have greater metalinguistic awareness (Barac & Bialystok, 2012; Bialystok, Craik, Klein, & Viswanathan, 2004; Blom, Boerma, Bosma, Cornips, & Everaert, 2017), and enhanced metacognitive skills (Barac & Bialystok, 2011; Morales, Calvo, & Bialystok, 2013) because they give them insight into the abstract features of language and into their own learning processes; also, cognitive skills appear to give bilingual speakers an enhanced capacity to appropriately control and



distribute their attentional resources, to develop abstract and symbolic representations, and to solve problems (Adesope, Lavin, Thompson, & Ungerleider, 2010). Moreover, current research shows that bilinguals have an advantage in non-linguistic tasks that require cognitive flexibility, this advantage seems to appear at the age of 4 and it is maintained in adulthood (Adi-Japha, Berberich-Artzi & Libnawi, 2010).

The present research is designed to study the effects of bilingualism on cognitive skills between monolinguals and bilinguals. We want to conduct this research to investigate the benefits of being bilingual to motivate our future students to engage in the learning process of a second language.

### **1.3 Justification**

Bilingualism at first was believed to be doomed, that it delayed the cognitive development in children. Through the years, different trends focused on four different variables and aspects of it, which are Intelligence, Metalinguistic Awareness, School Achievement and Cognition (Barac & Bialystok, 2011). Different research studies showed different results until the year 2000 (Barac & Bialystok, 2011). It was found that bilingualism had a positive effect on certain cognitive abilities, specifically the set of executive function. These are the processes responsible for attention,



selection, inhibition, shifting and flexibility that are at the center of all higher thought (Barac & Bialystok, 2011).

The ability to speak in two languages yields several benefits; according to several studies (Bialystok, Craik, & Freedman, 2010; Branzi, Della Rosa, Canini, Costa, & Abutalebi, 2016) being bilingual should not be seen as detrimental or dangerous because after all it will help not only to foster metacognitive processing, but also cognitive development in the areas of attentional control, working memory, abstract and symbolic representation skills, and metalinguistic awareness (Barac & Bialystok, 2011). Bilingualism and cognitive development are closely related. The bilingual advantage resides on the capacity of processing two languages at the same time, also known as complex processing, which requires executive control; thus, that demonstrates according to Barac and Bialystok that the bilingual advantage does not reside only on inhibitory control, as it was believed decades ago, but it also extends to other aspects of executive function, such as monitoring, switching, and updating (2011).

Another asset of bilingualism is that the lifelong experience of managing two languages attenuates the age-related decline in the efficiency of inhibitory processing because it boosts inhibitory control, and it has a



positive effect on working memory leading to the presumption that bilingualism has a broader effect, it influences inhibitory and executive control as well (Bialystok, Craik and Viswanathan, 2004). Hence, this conjecture supports the thesis stated by Barac and Bialystok (2011), bilingualism is not only constrained to inhibitory control, but it also influences executive function.

All these skills are required in demanding cognitive tasks linked not only to learn a second language or linguistic tasks, but also to learn non-linguistic tasks that students perform on a daily basis in school. That is one of the reasons why we are interested in studying the cognitive benefits of being bilingual to motivate high school students and college students to learn a second language, because as we stated previously it will help them to achieve better performance in different areas of study; bilingualism is interdisciplinary. The following bibliographic investigation focuses on studying the cognitive benefits of bilingualism and whether they are important to study and how these skills are enhanced by studying a second language or being a bilingual.

#### **1.4 Research Questions**

\*In what sense cognitive skills related to learning performance are more developed in bilinguals?



\*What are the advantages and disadvantages of being bilingual regarding cognitive skills and linguistic skills in comparison to monolinguals?



## CHAPTER 2: Theoretical Framework

This research synthesis seeks to explain the cognitive development of bilingualism in terms of learning performance and the pros and cons of it. Thus, in the following part of the research synthesis an explanation of what bilingualism is and what it involves will be provided. Further, an introduction to the types of bilingualism and its subdivision will be also explained. Not only cognitive skills, which are vital in this research, will be covered and thoroughly explained; but also, the brain regions involved with it are going to be- briefly mentioned. In order to give the reader further insight, some of the most important neuropsychological tests and neuroimaging techniques will be described; since these are the data collection methods that some of the peer reviewed journals used to retrieve information from the participants. Moreover, a bunch of neurodegenerative diseases as well as learning performance will be reviewed since these are core topics to understand this systematic review.

### 2.1 Bilingualism

The term bilingualism, throughout history had some positive and negative connotations attached to it. Similarly, the definitions that have been



provided about this term are most of the times vague, biased, and somewhat contradictory. However, Weinreich (1968) one of the founding fathers of bilingualism studies tried to label it, as the action of using two alternatively languages and the individual that carries out such action as a bilingual person. Another renowned modern linguist such as Bloomfield (1933) described bilingualism as the native-like control of two languages. Both definitions aforementioned still lack some essential factors and characteristics of bilingualism. Therefore, Baumgart and Billick (2018) provided a more inclusive and better explanation of what bilingualism is and they converged in the idea that bilingualism is categorized by equal or non-equal proficiency in two languages that have been used throughout the lifespan of an individual.

### **2.1.1 *Types of Bilingualism***

According to Aksenevich (2015) the types of bilingualism are divided according to the cognitive organization, age of second language acquisition (AoA), linguistic prestige and kind of second language (L2). Therefore, in the following part a brief explanation of the different types and categories of bilingualism is provided.





### 2.1.1.1 Cognitive organization.

- Compound bilingualism “is that person who learns two languages in the same environment so that he acquires one notion, with two verbal expressions; in the brain there is a fused representation of two languages which are interdependent” (D’Acierno, 1990, p.12).
- Coordinate bilingualism “is a person who acquires the two languages in a different context, for instance one at home and the other at school, so that the words of the two languages belong to two separate systems which are independent” (D’Acierno, 1990, p.13)
- Sub-coordinate bilingualism “refers to when one language predominates over the other. In this case the person interprets words of his weaker language through the words of his stronger language; the dominant language acts as a filter for the other” (D’Acierno, 1990, p.13-14).

### 2.1.1.2 Age of second language acquisition (AoA)

- Early bilingualism: in this category there are two types of early bilingualism:



- o Simultaneous early bilingualism refers to a bilingual individual who has learned two languages since birth.
  - o Successive early bilingualism is when a bilingual individual has learned a second language (L2), after birth, specifically in preschool.
  - Late bilingualism occurs when an individual learns its L2 in adolescence or in adulthood.

### 2.1.1.3 Linguistic Prestige.

- Additive bilingualism is when the first language (L1) and L2 of an individual are socially recognized, thus the individual has a cognitive advantage.
- Subtractive bilingualism is when the L2 of an individual is not valued, therefore the individual has a cultural disadvantage.
- Passive bilingualism occurs when a bilingual individual is not capable of speaking in their L2, but the individual can understand it.
- Balanced bilingualism refers to when individuals have the same cognitive, semantic and lexical ability in L1 as well in L2 (Aksenevich, 2015; Fédération des parents francophones de



Colombie-Britannique, n.d.).

#### 2.1.1.4 Kind of L2.

- Bimodal bilingualism adduces to those individuals who are fluent in a signed and in a spoken language (Poarch, 2016).
- Unimodal bilingualism is when an individual is fluent in two spoken languages (Poarch, 2016).

## 2.2 Monolingualism Definition

Monolingualism has been a popular term lately. According to Gramling (2016) this term has been used as an insult to those individuals who have not acquired a foreign language or that only know, their native language or mother tongue. In fact, Gramling (2016) says that monolingualism is only an invention. Another author, Derrida (1998) states that a person or a society could not only know one language; in his words, there is always an internal language and external language in an individual. Regardless, the popular opinions of these two authors, linguists, and other investigators all around the world such as Baumgart and Billick (2018) defined this term as to those individuals who are fluent and somewhat proficient in one language.



## 2.3 Cognitive Skills

This part aims to specify and explain what cognitive skills are and how they help individuals daily. According to Gottfredson “cognitive skills are a person’s ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience” (1997, p.13). In other words, cognitive skills help individuals to store, manage and retrieve information in the appropriate regions of the brain (Indeed, 2019). These abilities are divided into nine categories, but for the purpose of these studies only one of them will be reviewed: executive functions (EF).

### 2.3.1 *Executive Functions (EF)*

Executive control or function is an umbrella term that refers to “processes such as managing distracting information, overcoming a habitual response, or switching between tasks or rules” (Coderre and Van Heuven, 2014, p.1). Miyake and Friedman (2012) summarize it in a simpler version, namely that EF is a set of control processes that desire to regulate and control an individual’s thoughts and behaviors. According to Miyake, Friedman, Emerson, Witzki and Howerther (2000) EF consists of three components: ***inhibition, updating and shifting.***



- **Inhibition** is the process of deliberately overriding dominant or prepotent responses (Miyake et al., 2000).
- **Updating** refers to the mechanism of constant monitoring and rapid addition or deletion of working memory contents.
- **Shifting** involves switching flexibly between tasks or mental sets (Miyake et al., 2000).

#### 2.4 Brain Regions involved in EF

Coderre, Smith, Van Heuven and Horwitz (2016) state that a number of brain regions are involved with EF, mainly the prefrontal and parietal cortices. The following chart provides a summary of the brain regions and their connections and roles with EF.

Brain Regions	EFs and role
Anterior cingulate cortex (ACC) and dorsolateral prefrontal cortex (DLPFC)	<b>Inhibition:</b> conflict detection and resolution
Rostral cingulate zone (RCZ) located in the medial frontal cortex	<b>Updating:</b> performance monitoring and response conflict.
Left inferior frontal gyrus (LIFG)	<b>Shifting:</b> suppression of irrelevant semantic information

*Note.* Adapted from “the functional overlap of executive control and language processing in bilinguals”, by Coderre, E. L., Smith, J. F., Van Heuven, W. J., & Horwitz, B., 2016, *Bilingualism*, 19(3), p. 471.



## 2.5 Neurodegenerative Diseases

Berman and Bayati (2018) define neurodegenerative diseases as some of the toughest illnesses to treat. They affect the brain and cause certain neurons to die and regions to lose their function. One of the most common neurodegenerative disorders or illnesses is dementia. Dementia is the loss of cognitive functioning causing the death of neurons resulting in memory loss (Berman and Bayati, 2018). Dementia affects the daily life of an individual, resulting in the loss of the correct functioning of cognitive skills. This topic is crucial to the subject matter since a decline in bilingualism can be a symptom of dementia. There exist two types of dementia, but for the purpose of this research synthesis only one of them is going to be described in the following part.

### 2.5.1 *Alzheimer's Disease*

Alzheimer's disease is a type of dementia that causes memory loss. Eventually, patients are unable to carry out simple tasks or function as an independent human being (Berman and Bayati, 2017).

## 2.6 Neuropsychological tests

Neuropsychological assessments are “the normatively application of



performance-based assessments of various cognitive skills linked to a specific structure, region or pathway” (Harvey, 2012, p.91). This type of assessment is applied to evaluate the cognitive functioning of individuals and to see how they perform in a limited span of time and under pressure. Some of the most important and crucial kind of neuropsychological tests are going to be presented in order to understand how cognitive skills and EF are evaluated to later compare the performance of bilingual and monolingual individuals in such tests.

- **Attentional Network Task (ANT).** The ANT “is a combination of a Cue Reaction Time task and a Flanker task. In this task participants are asked to indicate whether a central arrow points to the right or left. This arrow is presented along with two flanker arrows pointing to the same (congruent trials) or different direction (incongruent trials) than the target arrow” (Costa, Hernández, & Sebastián-Gallés, 2008, p. 64).
- **Flanker Task.** According to Coderre et al. (2016) this task, originally known as the Eriksen Flanker task, presents directional arrows surrounded by other arrows that either point in the same direction (a congruent condition) or in the opposite direction (an incongruent condition) (2016, p.472). In essence, this task asks individuals to



respond to a central target flanked by distractors, usually arrows and letters (Stins, Polderman, Boomsma, de Geus, 2007).

- **Simon Task.** Proctor (2011) says that the Simon task “involves presentation of a stimulus in a left or right location to which a left or right keypress is to be made”(p.182). When the task uses visual stimuli, the relevant dimension is often color; when the task uses auditory stimuli, the dimension is often tone pitch.
- **Stroop Task.** The Stroop task, famously named after its creator John Ridley Stroop is a task that “requires participants to inhibit or override the tendency to produce a more dominant or automatic response when a conflict situation arises”(Miyake et al., 2000, p.57). This task asks “participants to read a list of words for colors, but the colors are printed in a different color to the word itself. Then, the participant must repeat the test with a new list of words, but this time the participants must name the colors that the words are printed in” (Farnsworth, 2019).
- **Mini-Mental State Examination.** The mini-mental state examination is a widely used test of cognitive function among the elderly. It includes tests of orientation, attention, memory, language, and visual-spatial skills (Measso, Cavarzeran, Zappala,





Lebowitz, Crook, Pirozzolo, Grigoletto, 1993).

- **Anti-saccade Task.** The anti-saccade<sup>1</sup> task requires participants to “use a mental process known as inhibition of triggering a reflexive saccade towards the stimulus” (Zee and Lasker, 2004, p. 1554). Moreover, this task probes individuals to have superior cerebral mechanisms that underlie response inhibition, attention, memory, and decision making. In this test “the subject has to cancel willfully a reflexive saccade to a suddenly appearing visual stimulus and then generate a voluntary saccade -the antisaccade- in the opposite direction to the mirror location of the original visual target” (Zee and Lasker, 2004, p.1554). Abnormalities found on this task have been helpful in diagnosing some mental illnesses and neurodegenerative diseases.

## 2.7 Neuroimaging techniques

Neuroimaging techniques are a series of methods that “allows humans’ brain structures or functions to be studied” (Brammer, 2009, p.389). These kinds of procedures are vast and widely used in the fields of medicine and neuropsychology to diagnose neurodegenerative illnesses or to map the distinctive regions of the brain and their functions. Some of the most relevant neuroimaging techniques used by different investigators in the area of



bilingualism are going to be described in the following part.

- **Computed Tomography.** Computed Tomography (CT) scanning uses a series of x-rays of the head taken from many different directions. It is usually used for a quick view for brain injuries and swelling from tissue damage (Mental Help, n.d.).
- **Magnetic Resonance Imaging.** Magnetic resonance imaging (MRI) provides structural information about the brain. This type of scanning uses magnetic fields and radio waves to produce two dimensional or three-dimensional images of the brain in order to scan for any trauma or brain related injuries (Mental Help, n.d.; Brammer, 2009, p.390).
- **Functional Magnetic Resonance Imaging.** Functional magnetic resonance imaging (fMRI) provides structural and functional data on the brain. This scanning relies on paramagnetic properties of oxygenated and deoxygenated hemoglobin to see images of changing blood flow in the brain associated with neural activity. This vital neuroimaging test shows images of the brain that allow the investigators to observe which and how brain regions are activated during the performance of different tasks (Mental Help, n.d.; Brammer, 2009, p.390).



- **Single-Photon Emission Computed Tomography.** Single photoemission computed tomography (SPECT) scanning is a medical imaging technique that is based on conventional nuclear medicine imaging and tomographic reconstruction methods (National Research Council, 2008). This test shows blood flows to tissues and organs by providing a three-dimensional picture. Further, this method helps with diagnosing seizure, strokes, stress fractures, infections, and tumors on the spine (Mayfield Clinic, 2019).
- **Voxel Based Morphometry (VBM).** Voxel Based Morphometry is an automated technique that has gained popularity during the last decade due to its ease of use. This method uses MRI and statistics to “identify differences in brain anatomy between groups of subjects, which in turn can be used to infer the presence of atrophy or, less commonly, tissue expansion in subjects with neurodegenerative diseases” (Whitwell, 2009, p.9661).
- **Surface-Based Morphometry.** Surface-based morphometry (SBM) is an automated technique very similar to the VBM. This method provides an estimation of shape of cortical surfaces. Further, it is a more sophisticated technique and thus provides more specific metrics on



cortical thickness, pial surface area, and cortical curvature (Škoch, 2017).

## 2.8 Learning performance

Learning performance means the ability to internalize a skill and using it in favor of the better, using it as a potential (Hoffman, 2014). Moreover, learning performance is a key term in behaviorism and refers to the difference between learning a behavior and putting it into practice (Learning-Performance Distinction, n.d.). It should also be noted that acquiring a skill or behavior usually does not require an individual to demonstrate it firsthand. Thus, learning performance and the acquisition of a certain skill takes time (Ertmer, & Newby, 1993; Serhat, 2020). Similarly, to obtain a better performance in certain skills, bilingualism has to be cultivated throughout the life of an individual. For example, bilingualism in older age delays cognitive decline. Moreover, bilingual individuals show different patterns of usage in the brain at different stages of their lives. Therefore, learning performance means the ability to internalize a skill and using it in favor of the better, using it as a potential (Hoffman, 2014).



## CHAPTER 3: Literature Review

This section aims to review the findings, contradictions, and similarities that authors have found regarding the cognitive development of bilingual individuals compared to monolingual individuals. Hence, the first part explains the superiority that bilinguals have when they manage cognitive skills in learning performance. The second part illustrates the advantages that bilinguals have with cognitive skills such as inhibiting and dealing with conflict more easily than monolingual individuals do. Further, some of the disadvantages that bilinguals have are presented as well.

### 3.1 Cognitive skills related to learning performance

#### 3.1.1 *Cognitive skills and brain regions involved in learning performance*

According to various authors (Bialystock, Craik and Freedman, 2007; Costa, Hernández, Costa-Faidella, & Sebastián-Gallés, 2009; Bialystok, Craik and Freedman, 2010) bilingual individuals have shown better learning performance due to the continuous use of cognitive skills. Thus, they are capable of solving or adapting to conflict faster than monolingual individuals. For instance, Costa et al., (2009) studied two hundred and forty-four undergraduates: a hundred and twenty-two monolinguals, and a hundred and



twenty-two bilinguals, from the University of Murcia and Barcelonato test whether bilinguals had better management of cognitive skills than monolinguals. The participants were tested with different cognitive tasks, such as a Flanker and Attentional Network Test (ANT) tasks. The authors found that bilinguals had faster response times (RT). Even though they had to manage two simultaneously activated languages in the brain, their cognitive flexibility allowed them to take several tests without losing concentration or letting any distraction get in their way. The authors found that the continuous use of two languages led the participants to better use of executive control processes. Additionally, the investigators determined that bilingualism had a positive effect on the attentional system across the lifespan of individuals. Finally, the correct use of those skills led to a 4.1-year delay of the onset of dementia symptoms.

A more comprehensive description of the effects of cognitive skills on the brain can be found in the study carried out by Coderre and Van Heuven (2014). These authors demonstrated that L2 could have both detrimental and facilitatory effects on L1 processing and vice versa, a process known as cross-linguistic effects. A total of seventy-six monolingual and bilingual people residing in England took part in the study. They were evaluated with Stroop and Simon tasks. After the analysis, the authors established that the bilinguals'



experience resulted in more effective cognitive control compared to monolinguals. Despite the cross linguistic activation from the two languages, bilinguals were able to override such conflict. Therefore, the authors concluded that the processing of two languages on a daily basis conferred more efficient cognitive processing abilities for bilinguals since they surpassed (RTs) monolinguals in every single task.

Similarly, lifelong bilingualism and the better management of cognitive skills appeared to provide bilingual individuals with a set of tools that would help to protect their brains against atrophy produced by mental diseases (Costumero, Marin-Marin, Calabria, Belloch, Escudero, Baquero, Hernandez, Ruiz de Miras, Costa, Parcet, Ávila, 2020). For instance, Bialystok, Craik and Freedman (2007) carried out a study with a sample of one hundred and eighty-four bilingual individuals who had been diagnosed with dementia in order to investigate the delay of cognitive decline they experienced. The researchers selected the participants based on a thorough evaluation of their socioeconomic status (SES) and age at onset of cognitive impairment. They were evaluated and examined with the Computed Tomography Scan (CT), Single-Photon Emission Computed Tomography (SPECT) scans, and their Blood Screenings. The researchers discovered that bilingualism delays dementia for 4.1 years. Additionally, they conducted a second study three



years later in which they again assessed the bilingual individuals based on their clinical history and the appearance of dementia (Bialystok, Craik and Freedman, 2010). They corroborated the findings of their prior study and evidenced that the age of symptoms onset and diagnosis of dementia in bilinguals was detected later.

According to Hernández, Martín, Bareló, and Costa (2013) switching, a cognitive mechanism involved in non-linguistic tasks, appeared to be positively affected by bilingualism. The authors found that bilingual individuals could keep their two languages apart with remarkable efficiency. They tested a total of two hundred and forty-four bilingual and monolingual participants who were undergraduates from the University of Murcia and the University of La Laguna. The authors used a Color Shape task to assess the participants' conflict resolution and determined: 1. bilinguals' language switching process benefited general task-switching performance, and 2. their executive control mechanisms were systematically more developed and functional than monolingual individuals. In conclusion, the researchers proved that bilingual individuals had slower switching costs at the moment of testing, and their performance was much better than that of their counterparts.

Alladi, Bak, Duggirala, Surampudi, Shailaja, Shukla, Chaudhuri, & Kaul (2013) found that the bilingualism effect was also observed within the





illiterate population affected by dementia. This demonstrated that bilingualism effects could not be reduced to differences in education or SES. Alladi et al. (2013) reviewed the case records of six hundred and forty-eight patients with dementia (three hundred and ninety-one were bilingual) and assessed them with the Mini-Mental State Examination (MMSE), Addenbrooke's Cognitive Examination (ACE-R) and the Clinical Dementia Rating.

Overall, the results indicated that bilinguals' performance exceeded expectations. Despite the brain atrophy that the bilinguals suffered, they were able to surpass monolingual individuals on the tasks and their cognitive processing was not affected by dementia. To clarify, language switching played a key role; it led to the bilingual advantage in higher executive functioning which contributed to the delay of dementia symptoms by 4.5 years.

Likewise, Mendez, Chavez, and Akhlaghipour (2020) suggested that lifelong bilingualism had a positive impact on the learning performance of bilingual individuals. Two hundred and fifty-three elderly people from a clinical university program in the USA participated in the study. All of the participants were immigrants with moderate dementia, whose L2 was English. There were more males in the study, but none of the gender



differences reached significance. In order to analyze the data, the authors used three types of neuroimaging studies: Tomography, fMRI, and the Mini-Mental State Examination (MMSE). The test results showed that bilingualism appeared to delay Alzheimer's disease symptoms about 4 years later than monolingual individuals. In conclusion, bilingual individuals were able to adapt to several stressing conflict situations derived from neurodegenerative diseases and they were able to overcome such conflict situations, unlike the monolinguals.

The aforementioned studies also discussed if bilingualism acted as a neuroprotective factor against dementia (Alzheimer's disease). Costumero et al., (2020) corroborated the results of the previous studies with a recent longitudinal and cross-sectional study. The researchers used several neuropsychological evaluations such as: the Boston Naming Test, the Word List Acquisition, Semantic and Phonetic Test (Fluency Tasks), Remote Memory Test, Clock Drawing Test, Mini Mental State Examination (MMSE) and the Functional Activities Questionnaire (FAQ). All of the data collected was analyzed with neuroimaging studies like the MRI, Total Intracranial Volume (TIV) and Regional Based Morphometry (RMB). The authors found that bilingualism indeed had a key role in the delay of the dementia symptoms, since it contributed to cognitive reserve (CR) and neural



compensation. This study was the first to conclusively prove that bilingualism was protective against cognitive decline for mild cognitive impairment (MCI) patients. Notwithstanding, the data not only strengthened the idea of a bilingual advantage due to superior cognitive skills, but also that the acquisition of an L2 increased CR in MCI patients.

Authors such as Garbin, Sanjuan, Forn, Bustamante, Rodriguez-Pujadas, Belloch, Hernandez, Costa and Ávila (2010) suggested that bilingual individuals' experiences and cognitive skills management shaped the structure and usage of certain brain regions. Indeed, processing two languages on a daily basis conferred more efficient cognitive processing abilities; thus, certain parts of the brain would be more developed than others. Garbin et al. (2010) reported that every time that bilinguals engaged language control mechanisms, they were also recruiting cognitive control resources. The fMRI results showed a cluster of only one brain region involved in cognitive processing of bilingual individuals in contrast with monolingual individuals who used several brain regions. A cluster of activation with its peak in the left IFG insula was the region of interest for the bilinguals, specifically this was the region used for cognitive processing. Henceforth, the authors concluded that the bilingual experience had a long-lasting consequence for the establishment of a cognitive control network. Thus,



bilingual individuals had better management of the brain regions compared to monolinguals when solving or managing conflict situations.

Wei, Joshi, Zhang, Mei, Manis, He, Beattie, Xue, Shattuck, Leahy, Xue, Houston, Chen, C., Dong, & Lu (2015) found that regardless of the age of second language acquisition, the neural organization of the brain was influenced by experiences which could occur either early in childhood or in adulthood. The researchers carried out the study with thirty-six native English-speaking bilingual adults who were divided into groups according to their AoA: early bilinguals, intermediate bilinguals, and late bilinguals. The participants were tested with invasive procedures to observe the structural changes on their brain. These procedures were: Voxel Based Morphometry (VBM), Surface-Based Morphometry (SBM) and fMRI. The study results highlighted that learning an L2 was a challenging task which required to make full use of neural plasticity. Wei et al. (2015) concluded that bilingualism shaped the neural organization of the brain, using a cluster of brain regions, leading to superior executive skills and cognitive control compared to monolinguals.

Likewise, Coderre et al. (2016) had shown that bilingualism positively affected cognitive skills in the brain. According to these authors, bilinguals



used only one region of the brain when using cognitive skills, instead of using disparate areas of the brain like monolinguals do. The authors conducted a qualitative research study in which they compared fourteen native Spanish bilinguals and fifteen native English monolinguals' brain regions to observe if they were activated when cognitive skills were involved. The researchers used the Flanker task to assess the participants' executive functions and an fMRI scan to review the regions in their brain that were activated when they solved the tasks. After analyzing and revising the data, the authors concluded that clusters of overlap in the bilinguals' brain, specifically the LIFG, led to superior performance and faster response times when solving the Flanker task. Further, the authors reported that lifelong bilingualism restructured the organization of the brain networks which helped to protect the participants against cognitive decline in aging.

### **3.2 Advantages and disadvantages of being bilinguals regarding cognitive skills in comparison to monolinguals**

#### ***3.2.1 Advantages of bilingualism on cognitive skills***

Costa, Hernández and Galles (2008) claimed that bilingualism helped



the development of attentional control mechanisms involved in updating. Thus, bilingualism not only aided individuals to delay the deterioration associated with cognitive decline, but also allowed them to actively manipulate information in working memory. The authors recruited two hundred university students to take part in their study. Half of them were simultaneous bilinguals and the rest were monolinguals. Participants were evaluated by the ANT and Simon Task. After extensive research and data analysis, the authors found that the bilingual individuals were able to reach and maintain a state of alertness, allowing them to attain a high level of efficiency regarding attentional capabilities. Therefore, bilinguals could efficiently function when solving conflict and manipulate information to their convenience, which monolinguals could not do.

Salvatierra and Rosselli (2010) achieved similar results to the former studies. The participants were one hundred and twenty-five younger and older Spanish-English bilinguals, and one hundred and eight English monolinguals who were assessed with the Simon Task. The results showed that the older bilingual participants had faster RTs, meaning that they were more efficient at updating information in working memory than older monolinguals. Notwithstanding, the authors noted that the bilingual advantage was age dependent, meaning that the pros of bilingualism



appeared preferably on older participants. In conclusion, these authors stated that bilingualism increased skills that were associated with selective attention when working memory demands were low.

In the same way, several authors (Emmorey, Luk, Pyers, and Bialystok, 2008; Prior and Gollan, 2011, Marton, Goral, Campanelli, Yoon, and Obler, 2017) stated that different patterns of the bilingual advantage could be seen whether on the task complexity or, on the targeted executive function. For example, Emmorey et al. (2008) reported an advantage of bilingual individuals on inhibition and switching in a study they conducted with forty-five monolinguals and bilinguals. The researchers implemented a Flanker task to collect the data to prove that bilinguals had superior executive control and faster RTs when solving cognitive tasks. The results showed that the bilingual advantage improved several processes of cognitive skills, such as response selection and attentional control because of the constant practice in switching between two languages.

In line with the previous study, Prior and Gollan (2011) proved that the bilingual advantage resided on the ability of bilingual speakers to constantly switch between languages. The participants were forty-seven monolinguals, forty-one Spanish-English bilinguals and forty-three Mandarin-English



binomials' undergraduates from the University of California San Diego (UCSD). The primary tests to evaluate the participants were the Non-linguistic switching and language-switching tasks along with other tests such as a Verbal Fluency Trial, a Semantic Fluency Trial, an Intelligence Test, and the Matrices Subtest. The authors demonstrated that bilingualism could offset factors that lower executive functions, such as SES, but the bilingual advantage could vary across different bilingual populations. In summary, this investigation indicated that habitual language switching led bilingual individuals to more efficient control of executive functions.

A similar result was found by Marton et al. (2017), who tested seventy-seven young adults. The group of participants was divided into forty-one monolingual English speakers and thirty-six highly proficient bilinguals. In order to assess the participants' cognitive skills an Experimental task and a Switching task were used. The authors found that the bilingual participants showed more flexibility in adjusting to task goals and changing experimental conditions compared to the monolingual individuals. These results demonstrated that the bilingual participants had an overall superior performance compared to monolinguals. Even with the interference and conflict on the tasks, bilinguals had a speed processing advantage. The main conclusion that the authors drew from the data they collected was that when





switching between tasks, bilinguals had faster RTs in contrast to their monolingual's counterparts.

A series of recent studies (Bialystok and Viswanathan, 2009; Cox, Bak, Allerhand, Redmond, Starr, Deary, and MacPherson, 2016) have shown that bilingualism positively influences cognitive skills throughout the lives of individuals. Bialystok and Viswanathan (2009) tested ninety-eight children who were divided between monolingual English speakers from Canada, bilingual English speakers from Canada, and bilingual English speakers from India. All of the children were educated in English and used their L2 at home. The Anti-Saccade task was used to evaluate the participants. The authors reported that bilingual individuals were more skilled than monolinguals on inhibitory control and switching, but not on response suppression. In spite of the different bilingual population that took part in the research, no differences were found when performing the tasks. Thus, the authors deduced that bilingualism overrode cultural and linguistic differences. Finally, the analysis of the data led the researchers to the conclusion that bilingualism was a growing process and that the excellent peak performance was not acquired immediately. Therefore, the investigators established those bilingual adults had better management of their EFs and reached excellence during this stage of life due to the accumulation of their experiences. In other words, the



authors concluded that lifelong bilingualism protected against cognitive decline activity in older age.

Furthermore, Cox et al. (2016) proved through a longitudinal study that the managing of two languages had a positive impact on inhibition. These authors examined the case records of one thousand and ninety-one Scottish people who had participated in a study called the Lothian Birth Cohort that started in 1936 and ended in 2015; the study lasted almost eighty years. The participants had been divided into groups: monolingual individuals, bilingual individuals, and trilingual individuals. The data collection process was divided in several stages, but the most important stages of this study that had conclusive results were the trials conducted in 2004, 2010 and 2014. Cox et al. (2016) used the Simon Task, the Faux Paus Test, the Moray House Test, the Tower Test, the Self- Ordered Pointing Task, the Reversal Learning, and Moral Dilemmas task to evaluate the participants. The data showed that “the act of unconsciously activating two languages requires the selection of the appropriate language and suppression of the irrelevant linguistic information, which led bilinguals to have superior inhibition” (Cox et al., 2016, p.6).

### ***3.2.2 Disadvantages of bilingualism in cognitive and linguistic skills***

In contrast with the aforementioned advantages, Paap and Greenberg



(2013) stated that there was no coherent evidence for a bilingual advantage in executive processing in the study that they carried out. The authors did extensive research with two hundred and eighty-six undergraduate bilinguals and monolinguals students from the San Francisco State University (SFSU). A Flanker task, a Simon task, and an Attentional Network task (ANT) were used to evaluate the participants who were divided into three groups. Each group was tested with one of the tasks, respectively. The results revealed that there were not any advantages during the bilingual individuals' performance in the tasks. In fact, they did not find any evidence of superior executive function processing. Furthermore, they concluded that the advantages found in the empirical studies (Emmorey, Luk, Pyers, and Bialystok, 2008; Bialystok and Viswanathan, 2009; Prior and Gollan, 2011) might have been task-specific and that certain results obtained might have been biased. Therefore, Paap and Greenberg (2013) claimed that there was not support that bilingual individuals enjoyed an advantage in either inhibitory control or monitoring.

Similarly, Gathercole et al. (2014) found little evidence for bilingual individuals' advantages in a study that they carried out with six hundred and fifty Welsh people. They divided the participants into five age groups: primary schoolers, teenagers, young adults, adults, and older adults. The authors



used a Card Sorting Task, a Simon Task, and a Meta Linguistic Task. Gathercole et al. (2014) showed that bilinguals did not surpass their counterparts in any test; in fact, bilinguals had a similar performance to monolinguals in the tasks, meaning that their performance was not superior as demonstrated in other studies. Hence, the investigators concluded that bilingualism was not the main factor that improved cognitive skills and EF, but that many other underlying factors, such as reading, taking part in outdoor activities, and playing video games improved the bilinguals' EF.

On the other hand, according to Baumgart and Billick (2018) some disadvantages associated with bilingualism were generally linguistic in nature like lexical retrieval and smaller vocabulary size for each language. In line with the findings of the previous mentioned authors, Gollan, Montoya, Cera and Sandoval (2008) found that bilingual individuals were not able to retrieve vocabulary as quickly when they had to talk, a problem known as lexical retrieval. Fifty-seven monolinguals and seventy-three bilinguals took part in the study. The evaluation of the participants consisted of a series of observations of both groups when performing a linguistic task called Picture Naming. After gathering the data, the authors found that keeping more than one language in a single cognitive system showed some subtle but



significant processing costs. They reported that bilinguals tended not to practice both languages with the same level of consistency; as a result, these learners were likely to lose proficiency in the language that they used less. The vocabulary bank of bilinguals was affected; thus, it resulted in a lack of proficiency at the moment of speaking; they relied on the stronger language to communicate unknown words, and they tended to switch when talking in the non-dominant language.



## CHAPTER 4: Methodology

For this exploratory bibliographic research different studies were analyzed to study the effects of bilingualism on cognitive skills between monolinguals and bilinguals. The data collection process and analysis were based on the characteristics of a research synthesis. A research synthesis is the review of the literature of various studies with the aim of providing a synopsis of certain domain; in order to do so first a research question is set to gather information then, central issues for future research are identified (Norris and Ortega, 2006; Cooper, Hedges & Valentine, 2019).

The mandatory inclusion criteria for the studies to be included in this research synthesis were as follows. First, only studies that were published since 2004 were included in this research since bilingualism was only starting to be investigated.

Secondly, the studies included in this bibliographical research were studies that used a scientific or empirical method, and the aim of their research had to be related to the investigation of the cognitive bilingual advantage or disadvantage, or the cognitive development of bilingual individuals compared to monolingual individuals. Thirdly, the evaluation techniques used in the studies had to be neuropsychological tests or neuroimaging techniques. The studies were closely reviewed to determine



whether they fulfilled the inclusion criteria or not. If the studies did not match the criteria, they were not considered for the analysis.

The empirical research studies were collected from scholarly sources such as Google Scholar, Scielo, and the online databases Taylor & Francis Online, Springer Link, Science Direct, Scopus and ProQuest. The studies were found using the following keywords: *benefits of bilingualism, cognitive skills, cognitive development, bilingual advantage, linguistic and non-linguistic tasks, and executive functions*. A total of twenty-two studies were used in this research synthesis. The studies were coded and divided into categories such as date of publication and data collection techniques to answer the research questions in the analysis.



## CHAPTER 5: Analysis

To answer the proposed research questions, this analysis included twenty-two studies that were coded according to similar categories. First, the studies were divided according to the commonalities of their methodological characteristics such as the date of publication and the tests the researchers used to measure the participants cognitive functions. Then, the studies were grouped into two sets according to the research questions proposed for this research. The first set answered the first research question, namely in what sense cognitive skills related to learning performance are more developed in bilinguals. And the second set of studies responded to the second research question, namely whether there are advantages and disadvantages of being bilingual regarding cognitive skills and linguistic skills in comparison to monolinguals.

### 5.1 Analysis of the methodological characteristics of the studies

The following table shows the first category related to the year of publication of the studies.



**Table 1. Studies per Publication Date**

<b>Publication Date</b>	<b>Number of Studies</b>	<b>Percentage (%)</b>
<b>2004-2009</b>	6	27.27
<b>2010-2015</b>	10	45.45
<b>2016-2020</b>	6	27.27

Note. N=22

Table 1 illustrates the number of studies per publication date. The selected studies for the analysis have been published since 2004. Bialystok and Viswanathan (2009) are the pioneers of the perspective that bilingualism has nowadays. The authors are the main researchers that shaped the concept of bilingual advantage. Moreover, authors such as Bialystok, Craik and Freedman (2007) and Costa, Hernández, and Sebastián-Gallés (2008) that fall into the period of 2004 until 2009 are the first researchers that started viewing the effects of bilingualism as an advantage rather than a disadvantage. Additionally, a vast number of studies were published from 2010 to 2015, since the advances in and availability neuroimaging techniques in the field of bilingualism (Wei et al., 2015). In fact, technology helped authors to understand better how the bilingual brain functions and to



compare the bilingual mind and the monolingual mind (Garbin et al., 2010; Hernández, Martin, Bareló, and Costa, 2013; Wei et al., 2015).

**Table 2.** *Neuropsychological evaluations per peer reviewed journal*

Type of Neuropsychological Evaluation	Number of Studies	Percentage (%)
Neuropsychological Tests	13	65
Neuroimaging Techniques	7	35

Note. N=20

Table 2 represents the most common tests used by some authors (Coderre et al., 2016, Costumero et al., 2020) to collect information regarding the cognitive development in bilingual and monolingual individuals. Most of the studies (65% of them) used neuropsychological tests when studying the cognitive functioning of participants; a further 35% of them used neuroimaging techniques to visualize how the brain worked during certain tasks. The results from these assessments led the researchers Costa, Hernández, Costa-Faidella, & Sebastián-Gallés (2009) to find that bilingualism helped individuals under conflict situations leading them to have faster conflict processing which resulted in faster RTs in each trial of the tests. Therefore, bilingualism might help individuals to have a faster cognitive and conflict processing. Moreover, using this kind of



evaluation has become a trend lately, since they are the ones that directly target the cognitive skills performance of each individual (Coderre and Van Heuven, 2014). All the studies reviewed (100% of them) demonstrated that studies lately use only neuropsychological evaluations.

Likewise, in table 3, the neuropsychological tests found in the 22 studies are presented. It is important to mention that the studies presented in this table used one of the neuropsychological tests revised previously, while other researchers opted for more unknown data collection techniques. Further, some of the studies opted to use more than one neuropsychological test to collect data.

**Table 3.** *Most Common Neuropsychological Tests*

<b>Neuropsychological Tests</b>	<b>Number of Studies</b>		<b>Percentages (%)</b>
<b>Flanker Task</b>	4	15	26.66
<b>ANT</b>	3		20
<b>Stroop Task</b>	1		6.67
<b>Simon Task</b>	5		33.33



<b>MMSE</b>	1		6.67
<b>Anti-Saccade Task</b>	1		6.67

Note. N=22

Therefore, table 3 demonstrates that the Simon task is one of the most widely renowned tests used in the field of neuropsychology with the topic bilingualism (Costa, Hernández, and Sebastián-Gallés, 2008). Authors such as Lee Salvatierra and Rosselli (2010) used this type of task because it evaluates the interference and conflict resolution of individuals, allowing researchers to study the behavior of their participants on a deeper level, and determine if they are able to prevail and succeed despite the conflict, or fail. In this research synthesis, 33.33 % of the studies applied this method, specifically those studies that were carried out in the period of 2004 to 2015, while the rest of the studies used the Flanker and ANT. The former assessments are starting to rise in popularity due to the wide range of cognitive skills they can target. Alerting, orienting and EF are one the skills the ANT and Flanker task target, in sum these two tests were used by 46.66% of the studies demonstrating their popularity among the investigations about bilingualism (Paap and Greenberg, 2013; Coderre et al., 2016). All the tasks illustrated that the advantages for bilingual individuals are



vast and that there are more that have yet to be discovered.

### 5.1 Analysis based on the research questions

#### 5.1.1 Cognitive skills related to learning performance in bilinguals and monolinguals

To provide an answer to the first research question some studies were grouped due to their similar results. Table 4 shows these categories.

**Table 4.** *Learning Performance in Bilingual and Monolingual Individuals*

Categories	Bilingual Individuals	Monolingual Individuals	Percentage (%)
<b>Better Management of Cognitive Skills</b>	3	0	27.27
<b>Structure and Brain Usage of Cognitive Skills</b>	5	0	45.45
<b>Cognitive Skills Protection Against Cognitive Decline</b>	3	0	27.27

Note. N=11

Table 4 demonstrates that bilingualism had a strong effect on the brain



regions of bilingual individuals; 45.45% of the studies found this characteristic. Additionally, the studies that found this positive impact of bilingualism on the brain were those that applied neuroimaging techniques. This finding indicates that bilingualism leads individuals to have a cluster of overlap when they use EF. Thus, it provides bilinguals an advantage compared to monolinguals since they use different regions of the brain when an executive function is activated which results in poor testing (Garbin et al., 2010). The first thing to remember from table 4 is that 72.72% of the peer reviewed journals concurred in the fact that protection against cognitive decline and the better management of cognitive skills are present day studies that proved that bilingualism fosters learning performance. Another important fact to bear in mind is the fact that the studies concurred in the use of neuroimaging techniques leading to more effective collection processes and indicating the new path that the investigations in the future will follow.

Furthermore, the results of table 4 demonstrated that bilingualism had a positive impact on the learning performance of bilingual individuals. The participants in 27.27% of the studies had better management of cognitive skills as evidenced by their faster response times (RTs) than monolinguals during the performance of neuropsychological tests (Bialystock, Craik and Freedman, 2007). Despite the difficulty of managing two languages



simultaneously, bilingual participants were able to override such conflict and surpass monolinguals on every task (Hernández, Martin, Bareló, and Costa, 2013). This conflict suppression advantage that bilinguals had delayed cognitive decline in old age. Bilingual individuals were able to delay some symptoms of dementia for 4.1 years (Alladi et al., 2013). Despite the brain atrophy they suffered, bilinguals were able to overcome it and perform normally in demanding tests, unlike monolinguals (Mendez, Chavez, and Akhlaghipour, 2020). Likewise, 27.27% of the peer reviewed journals that found that bilingualism postpones the deteriorating effects of aging on cognitive functioning and dementia were carried in 2010 and used neuroimaging techniques; this fact is relevant to mention because it supports the previous idea that most of the studies currently analyzed are very recent.

### **5.2.2 Advantages and Disadvantages of Bilingual and Monolingual Individuals on Cognitive Skills**

This section of the analysis indicates the advantages and disadvantages that bilingualism has on cognitive skills. Table 5 details the number of studies in this research synthesis that had pros and cons.



**Table 5.** *Advantages and Disadvantages of Bilingualism per Peer Reviewed Journal*

<b>Categories</b>	<b>Bilingual Individuals</b>	<b>Monolingual Individuals</b>	<b>Percentage (%)</b>
<b>Advantage in EF</b>	6	0	75
<b>Disadvantage inEF</b>	0	2	25

Note. N=8

This table shows that bilinguals have an enormous advantage on cognitive skills compared to monolinguals. Bilingualism influences equally all the cognitive skills, specifically, EF. The bilingual participants in each of the journals were able to inhibit irrelevant information, retrieve it and use only the relevant data provided to them (Emmorey, Luk, Pyers, and Bialystok, 2008; Prior and Gollan, 2011). On the other hand, the monolingual counterparts were not accustomed to managing, switching and inhibiting irrelevant information. Specifically, the foregoing investigations disrupted the disadvantages, demonstrating that bilingualism enhances EF and helps individuals to reach task goals and to use efficiently EF (Cox et al., 2016). Finally, the table indicates that most of the recent studies with recent data collection techniques were able to prove that bilingualism has many





advantages, some of which are not readily apparent. In table 6, a distinction of the EF and the advantages related to them is explained.

**Table 6.** *Influence of Bilingualism on EF*

<b>Categories</b>	<b>Bilingual Advantage</b>	<b>Monolingual Advantage</b>	<b>Percentage (%)</b>
<b>Inhibition</b>	2	2	40
<b>Switching</b>	2	0	20
<b>Updating</b>	2	0	20
<b>Linguistic Skill</b>	0	2	20

Note. N=10

Table 6 explains specifically on which EFs a bilingual advantage was found. First, it is important to realize that 60% of the studies found a bilingual advantage on all the EFs and that only 4 of the studies found a disadvantage on an EF; namely, inhibition. Further, it is worth mentioning that 2 studies found a linguistic skill disadvantage (Gollan et al., 2008; Baumgart and Billick, 2018). This is common for bilingual individuals since their vocabulary size is smaller compared to monolinguals and bilingual participants in most of the cases also suffer from a problem known as lexical retrieval (Gollan et al., 2008). Additionally, table 6 indicates that bilingualism and EFs have an intertwined relationship, meaning that EFs are a key advantage in



bilingualism. A bilingual individual can surpass any conflict, retrieve vital information in the working memory when needed, and their attentional control is precise and impeccable (Bialystok and Viswanathan, 2009). Bilingual individuals can focus on the task at hand and suppress any distractor that may arise (Marton et al., 2017). Even though 2 studies (Paap and Greenberg, 2013; Gathercole et al., 2014) found a disadvantage in inhibition, the researchers in both studies demonstrated a bias against bilingualism. The tests they used were outdated and the sample size of participants was very small, indicating that some errors may have been made. Moreover, the selection process of those participants was inadequate. While a disadvantage on the linguistic area may exist, it does not diminish or at all affect the superior cognitive functioning and performance that bilinguals experience. This disadvantage can be easily overcome with practice and time.



## CHAPTER 6: Conclusions and Recommendations

### 6.1 Conclusions

This research synthesis has shown the continuous debate whether bilingualism influences cognitive skills development positively or not. Moreover, this investigation pointed out the advantages and disadvantages that bilingualism has, and further it showed how bilingualism improved the cognitive functioning of individuals.

Many authors (Hernández, Martin, Bareló, and Costa, 2013; Alladi et al., 2013) pointed out that bilingualism has many tools to deal with conflict. Thus, one of the conclusions withdrawn from this investigation is that elderly bilingual individuals can stop the deterioration of the brain functions due to the better management of cognitive skills; namely, cognitive decline. Likewise, bilinguals tend to handle cognitively demanding tasks better than monolinguals. Moreover, the brain of a bilingual individual has a better cognitive organization and brain regions are used effectively. Instead of using a bunch of disparate brain regions to deal with cognitively demanding tasks and wasting valuable time, bilingual individuals prioritize the use of brain regions and use a cluster of overlap; meaning that only one of them is used.



So, they can save precious time.

Thereupon, the selected studies have provided enough information to assume that bilingualism is a lifelong experience that continuously provides advantages. Inhibition, updating and shifting, known as EF are the basis for bilingual individuals to have a better management of cognitive skills compared to monolingual individuals. Further, bilingualism helps individuals to retrieve an important fact from the working memory, so they can manipulate and use it in their favor. Besides, bilingual individuals are able to switch from task to task when they need since their attentional control is on point leading them to solve demanding activities and to maintain the focus on them with no difficulties. All these advantages are not only used academically, but also help bilingual individuals daily.

Despite the difficulties that bilingual individuals have with linguistic skills, they do not hinder the learning performance of bilingual individuals. In fact, these conflictive situations can be perceived as a challenge, because they lead bilinguals to use other resources, or to use all the skills they possess to make up for poor management of linguistic skills. Without further ado, bilingualism does not affect or retard the learning process of an individual; instead, it develops tools to help the individual to succeed.



Bilingualism enhances the skills that the person already possesses, and it upgrades the cognitive system to a more functional, proficient, and competent one.

## **6.2 Recommendations, Limitations and Areas for Future Research**

Even though the number of studies revised in this research synthesis is considerably broad, the majority of studies were carried out only in North America, Europe and Asia. None of the investigations reviewed were applied in Latin America. Thus, this might be considered as a limitation because bilingualism might have a different connotation in this continent (Bermúdez Jiménez, & Fandiño Parra, 2012). Further, other underlying factors such as the SES of South America might affect bilingualism per se (Hernández et al., 2013). Therefore, carrying out empirical research in the Ecuadorian context might help researchers find other valuable variables to understand better the extent of the bilingual advantage.

Additionally, most of the participants of the studies were young adults, adults, or elderly people, hence it limited the results of the studies. Since not many studies were applied to children, further research needs to be carried out to find if bilingualism influences positively all age groups equally; or future



investigations should merely focus on children to find out how bilingualism affects them during their school years. In fact, this is a pivotal point since it is an age where cognition starts to appear and influence the decision-making process of individuals.

Finally, future research should target the consequences of bilingualism as a result of an immigration process on children. Since children's reactions have not been researched, it is important to learn how bilingual children manage their minority language in comparison to their majority language, and it is also imperative to investigate whether the majority language hinders or helps them in their education process. In this way, the new research to come would tackle new conceptions of bilingualism from a new point of view. In addition, it would offer a clear and actual perspective of how the process of acquiring a second language in the twentieth first century might provoke either advantages or disadvantages on the cognition of children.



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## Appendix 1

### List of Primary Studies for Analysis

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## Annexes

Annex 1: Table 1. The publication date of the peer-reviewed journals.

Publication date	Authors	Number of studies	Percentage (%)
2004-2009	<ul style="list-style-type: none"><li>- Bialystock, Craik and Freedman, 2007;</li><li>- Costa, Hernández and Galles, 2008;</li><li>- Emmorey et al., 2008;</li><li>- Gollan et al., 2008</li><li>- Bialystok and Viswanathan, 2009;</li><li>- Costa-Faidella and Galless, 2009;</li></ul>	6	27.27
2010-2015	<ul style="list-style-type: none"><li>- Bialystok, Craik and Freedman, 2010;</li><li>- Garbin et al., 2010;</li><li>- Lee Salvatierra and Rosselli, 2010;</li><li>- Prior and Gollan, 2011;</li><li>- Hernández, Martín, Bareló, and Costa, 2013;</li><li>- Alladi et al, 2013;</li><li>- Paap and Greenberg, 2013;</li><li>- Coderre and Van Heuven, 2014;</li><li>- Gathercole et al., 2014;</li><li>- Wei et al., 2015;</li></ul>	10	45.45



2015-2020	<ul style="list-style-type: none"><li>- Coderre et al., 2016;</li><li>- Cox et al., 2016;</li><li>- Baumgart and Billick, 2018;</li><li>- Marton et al., 2017;</li><li>- Costumero et al., 2020;</li><li>- Mendez, Chavez, and Akhlaghipour, 2020.</li></ul>	6	27.27
<b>TOTAL</b>		22	100