People's Democratic Republic of Algeria
Ministry of Higher Education and Scientific Research
University of Tlemcen

Faculty of Letters and Languages
Department of English
Section of English

Investigating the impact of Bilingualism on Cognitive Abilities on Algerian students

Dissertation submitted to the department of English as a partial fulfilment of the requirements for Master's degree in Language Studies

Presented by

Mohammed El Amine BENSALAH

Chihab Eddine Mohamed MEDJAHED

Supervised by

Prof. Amine BELMEKKI

Board of Examiners

Prof. Naima BOUYAKOUB (President)

Prof. Amine BELMEKKI (Supervisor)

Prof. Omar AZZOUG (Examiner)

2021 - 2022

Dedication

We would like to dedicate this work to our respective families and friends whom we hold dear.

Acknowledgements

We would like to express our appreciation and gratitude to the people who have added to this thesis: namely our supervisor, Prof. Amine Belmekki, for his constant support, direction, and valuable guidance.

We are likewise obliged to our schoolmates for their assistance in collecting the necessary references.

At long last, our appreciation is conveyed to all the English department personnel, which added to our experience regarding teaching the spirit of leading scholarly exploration.

Abstract

Over the past few decades, several studies have found a link between bilingualism and improved performance in the task of measuring shifting, inhibition, updating and, core executive function. However, the results are inconsistent and the existence of this proposed bilingual advantage is controversial. This paper explores the hypothesis that bilingualism may be one of the factors contributing to improved executive function (EF). The main focus is on the study of bilingualism as a continuum that spans the two axes of use and proficiency, and further investigates whether the use of L2 is a better predictor of EF skills than the acquisition of L2. The data in this study are from 30 Algerian students of proximately similar age and socioeconomic status, but with different levels of bilingualism. Performance of two measurements of shifting (trail making task and plus or minus task) and inhibition (two stroop task and flanker task), and monitoring skill using linear regression model). The results of the analysis do not provide further evidence of the existence of bilingual benefits, probably due to the ceiling effect, and the particularity of Algerian dialects in general. Rather than taking in consideration the embedded diversity of languages in a particular dialect being, which is Tlemcenian. The results are presented in the light of the EF measurement issue. Whether a particular pattern of L2 use is more likely to affect cognitive performance than other patterns.

Key Words:

Bilingulism; Cognitive Abilities; Inhibition; Switching; Disengagement of Attention

Table of Contents

Appendix B – .Table A

List of Abbreviations

Abbreviations	**Explanation**
AoA	Age of Acquisition
EF	Executive functions
IC-model	Inhibitory control model
RPM	Raven's progressive matrices
RT	Reaction time
SAS	Supervisory attentional system
SES	Socio-economic status
TMT	Trail-making test

General Introduction

General Introduction

Bilingualism results in having advantageous side effects: aside from the obvious benefit in cross-border communication, the last 50 years or more have presented us with an increasing data of discoveries and researches (e.g. Peal & Lambert, 1962; Bialystok, 1988; Bialystok & Martin, 1988).2004; Kavé, Eyal, Shorek, & Cohen-Mansfield, 2008), which appears to imply not only advancements in communication and linguistics, but the presence of a so-called multilingual benefit for cognitive functioning Bilinguals have outperformed in various trials monolinguals on activities that require executive functioning, or what can be called the Executive control system of the brain On the other hand, some research (e.g, Duabeitia, Antón Hernández, Macizo, Estévez, Fuentes, and Carreiras 2014; Paap and Greenberg, 2013 Paap, Myuz, Anders, Bockelman, Mikulinsky, and Sawi (2017) looked for this cognitive superiority of bilingualism without finding it.

Several factors have been suggested as reasons or explanations for the contradictory findings in studies of the benefits of bilingualism. First, socio-economic status, intelligence, education level, various activities, and many other aspects can be as important as or more important than bilingualism in terms of its impact on executive function. Therefore, these factors act as confounding factors, influencing results and can make it difficult to identify what is caused by bilingualism and what is due to other factors.

It led the researchers to seek the answer to the following question:

Does bilingualism facilitate the development of cognitive abilities, and if so, how?

The question led to the formulation of the following hypotheses:

-It improves nonverbal and verbal intelligence.

-It has no effect on enhancing cognitive development.

-The proficiency in languages has a secondary effect on fluency.

To reach the stated objectives, we designed an exploratory case study research with students of the English department of the University of Abou Bakr

Belkaid Tlemcen. This research will collect quantitative and qualitative data relying on several research tools, mainly, Language and Social Background Questionnaire, Flanker Task, Stroop task, plus-minus task and Trail Making Task. The collected data will be analyzed using quantitative and qualitative methods.

The current work is purposefully divided into three reticulate chapters to carry out this case study. The primary one reviews the literature on bilingualism and provides the theoretical background for the problem under investigation. It seeks to draw a transparent description of bilingualism because it relates to people. The second chapter deals with the research style and methodology through a close description of the information collection procedures and the research instruments. The third and final one is concerned with the analysis and interpretation of data. Furthermore, the chapter seeks to answer the analysis queries by confirming or invalidating the research hypotheses. This restates the gathered result and seeks out a solution as to whether multilingualism affects psychological feature skills or not.

Chapter one: Literature Review

1.1Introduction

In a considerable part of the 20th century, bilingualism was seen as a general impairment, yet even an unfortunate result of the scholarly turn of events. This supposition was to a great extent founded on examinations utilizing knowledge tests, a significant number of which relied emphatically upon the member's capability in the authority language of the general public being referred to - implying that they could not dependably be utilized to contrast the exhibition of bilinguals with that of monolinguals in any case (Hakuta, 1986). This should be visible regarding what Grosjean (2008) alludes to as the "fractional view of bilingualism" (p. 10). Generally, bilingualism has been dissected in a monolingual setting, implying that bilinguals have been treated as two monolinguals in a single body and that every one of their dialects has been perceived as a different framework. Grosjean (2008) declared that bilinguals and monolinguals are both unique and the same: different as far as the phonetic capability they hold in their dialects, however indistinguishable in the degree of open skill they have accomplished to work in a perfect world in their day to day existence. As such, while a bilingual's etymological skill in every language will differ from one space to another, their full capability mirrors what they need to achieve their ordinary assignments effectively. Notwithstanding, because the conventional tests have been so arranged towards language structure instead of informative capacities, the outcomes have been misjudged as verification of the bad results of bilingualism (Grosjean, 2008).

A change in the bilingualism research accompanied the compelling 1962 concentrate by Peal and Lambert (see Bialystok, 2017, and references in that). Following the status development of French in Canada and the resulting expanded interest in bilingualism, Peal and Lambert evaluated the writing. They distinguished two fundamental issues with the examination hitherto: first and foremost, that distinctions in financial status had not been controlled for, and besides, that the bilingualism status of the members had not been as expected surveyed.

At first, the discoveries of Peal and Lambert prompted a few investigations zeroing in on metalinguistic mindfulness (see Bialystok, 2001 and Bialystok, 2017 for surveys). Notwithstanding, these investigations recommended that the bilingual benefit was not connected straightforwardly to metalinguistic information but rather to the area of mental capacities and the control bilinguals have over their dialects and language handling (Bialystok, 1988; see likewise Bialystok and Craik, 2010). It was theorized by, for example, Bialystok (1988) that this could be a more overall capacity: "If such processing is general to other cognitive domains and not restricted to linguistic processing, certain spatial problems may involve the same skill" (p. 566). Subsequently, the justification for investigating an intellectually broad bilingual benefit was laid out.

1.2 The bilingual advantage

A few examinations (e.g., Bak, Vega-Mendoza, and Sorace, 2014, Bialystok, Poarch, Luo, and Craik, 2014; Costa, Hernández, and Sebastián-Gallés, 2008; Poarch & Van Hell, 2012a) have found that solid bilinguals in all life stages beat monolinguals on an assortment of intellectually testing assignments. Proof for the bilingual benefit has been tracked down in kids (Bialystok& Martin, 2004; Poarch & Bialystok, 2015) and grown-ups (Bialystok, Craik, Klein, and Viswanathan, 2004) and solid, more established grown-ups (Kavé et al., 2008). Nonetheless, results will generally arise more in specific age gatherings: youngsters and more seasoned grown-ups. Bialystok et al. (2014) thought about the execution of gatherings of more youthful and more seasoned monolingual and bilingual grown-ups on undertakings estimating leader. They tracked down a more grounded bilingual benefit in the more established member bunch, proposing that the benefits might be simpler to recognize in more established speakers. Comparative outcomes have been found while contrasting youngsters with grown-ups (for example, Bialystok et al., 2005). Bialystok et al. (2014) expect to be that "because EF capacities are at their top in more youthful grown-ups, they show a "utilitarian roof" as in any further efficiencies related with bilingualism make little difference" (p. 703) maybe because of the way of life: youthful grown-ups, furthermore,

significantly school matured, will lead experiences that are to a more extensive degree loaded up with intellectually testing undertakings consistently, than those of more established individuals in more "flat" life circumstances (Valian 2015). The response time for grown-ups is so fast (500ms is typical for the overwhelming majority of the undertakings utilized) that many distinctions should be huge to yield factual importance (Grundy et al., 2017). Supporting this point, the impact has all the earmarks of being more articulated on undertakings of a complicated sort (Bialystok et al., 2014). The discoveries of these investigations in this manner demonstrate that being bilingual gives us some mental improvement. In the accompanying areas, pertinent speculations will be trying to make sense of the reason for this impact.

1.3 Parallel activation of two (or more) languages

The accepted reason for the bilingual benefit is the drawn-out utilization of cognitive control to precisely deal with a few dialects, both all the while (for example, a code-exchanging circumstance) and independently (when one language would not be required and subsequently should be restrained). Lately, a few investigations (for example, Costa, Caramazza, and Sebastian-Galles, 2000; van Heuwen, Schriefers, Dijkstra and Hagoort, 2008; Wu & Thierry, 2012) have found proof for the steady enactment of both (or all) dialects in a bilingual's collection. For occurrence, a 2012(b) concentrate by Poarch and Van Hell tried four gatherings of youngsters (bilinguals, trilinguals and L2 English students, and a monolingual benchmark group) and one gathering of a grown-up.German-English bilinguals, utilizing related status control. In five tests, unique member bunches were given drawings of typical articles and were told to name them in one or the other English or German. A big part of the objective words were German-English cognates. Also, the other half were noncognates. The lexical recovery was quicker for cognates than noncognates, even though the members effectively utilised one language during preliminaries. The creators presumed that this delineates the related assistance impact (Costa et al., 2000) and that it gives proof to resemble the initiation of the two dialects. Proof for the enactment of the two dialects working closely together

has additionally been found by utilizing noncognate words with comparable phonetic properties. A recent report by Marian, Spivey and Hirsch followed the eye developments of English-Russian bilinguals when given three items, two of which with phonologically comparable names in English and Russian (for example, marker and mark (=stamp)). In Russian, the members were told to get one of the things, and eye following uncovered that they would momentarily check out the thing with phonological likenesses (for example, the marker) prior to getting the mentioned thing (the stamp). This impact happened both when members were tried in both their dialects (bilingual mode) and when they were just tried in one language (monolingual mode), proposing that even in a monolingual setting, the two dialects are somewhat actuated. The equal initiation would imply that bilinguals keep both (or) their dialects as a whole reachable and that the dialects might uphold one another (for example, through related assistance). Nonetheless, they may likewise obstruct one another, inferring that bilinguals would need some extra control to pick the correct language structures for any specific open setting.

1.4 Bilingual control

An endeavour to make sense of the bilingual's command north of at least two dynamic dialects without a moment's delay is the inhibitory control (IC) model (Green, 1998), which is based on Norman and Shallice's (1986) model of an administrative attentional framework (SAS). The SAS was proposed as a clarification for instruments behind social attentional control, that is to say, the execution of and control over daily practice and non-routine way of behaving, and depended on the possibility that our activities are performed and balanced using prior compositions: "mental gadgets or networks that people might build or adjust on the spot to accomplish a particular task" (Green, 1998, p. 69). So, the model proposed that blueprints constrain standard way of behaving or automatized abilities, yet when, for reasons unknown, automatization is inadequate, the process is intervened by the SAS; however, alteration of the current compositions and checking of the presentation in the main job (Green, 1998; Miyake et al., 2000). Green's profoundly influential IC model took this further into bilingual processing.

Following this model, we would expect that for a Norwegian-Spanish bilingual, the idea of canine would plan two lexical things: Hund and Perro, which would be related to Norwegian and Spanish individually. Considering the discoveries in the lexical enactment research referred to above, both lexical things would be activated1, and the speaker would need to repress the superfluous semantic structure (for example, Hund while communicating in Spanish). As indicated by the model, this Inhibition is performed by the SAS indicating the necessary language to the cycles controlling yield, which then chooses the right lexical thing and hinders the immaterial one. The components required to apply command over these parts of semantic handling have been associated with discoveries in neuropsychology, where studies have found that patients who had endured harm to the front-facing flaps this way were illustrating examples of weakness on errands requiring a type of leader control (see for example Jewel, 2013 & Miyake et al., 2000). This is steady with the possibility of a focal control framework situated in the front-facing projections, known as leader control or chief capacities.

1.5 Executive functions

Executive functions (EF) are a bunch of universally applicable mental cycles which are utilized to control and arrange lower-level mental cycles (Miyake et al., 2000; Diamond, 2013, Friedman and Miyake, 2017) while performing complex mental errands for which you "have to concentrate and pay attention, when going on automatic or relying on instinct or intuition would be ill-advised, insufficient or impossible" (Diamond, 2013, p.136). The leader control permits us to digress from automatized examples of activity, empowering us to, for example, drive on the opposite roadside or make sure to skirt that unexpectedly broken advance in the steps you have strolled consistently for the beyond 12 years. The idea of a leader control framework is emphatically connected with the Baddeley-Hitch model of working memory (1974) and its subsequent modifications (for example, Baddeley 1986; see Carroll, 2008) and to the previously mentioned Supervisory Attentional System (SAS, Norman and Shallice 1986). The Baddeley-Hitch model was decided to make sense of the components of working memory - how the brain briefly store

and control data used to perform mental undertakings - and proposes a framework where explicit mental cycles are managed and constrained by a focal control structure (the focal leader) (Baddeley, 1986; Carroll, 2008; Miyake et al., 2000). The Baddeley-Hitch model, along with the SAS and IC models, represents the two focal purposes of EF: controlling what, first and foremost, ought to be put away in transient memory and how this data ought to be utilized to perform mental cycles, and besides, forestalling the presentation of an automatized conduct when its execution would not be helpful.

Studies have demonstrated how EF execution can be worked on through rehashed practice on undertakings that draw on its parts. Training in a particular assignment moves to an overall EF capacity somewhat (see, for example, Jewel, 2013). Structures the theoretical foundation for the bilingual benefit: since bilinguals continually use EF to deal with their dialects, they ought to show an expanded exhibition in other mental errands drawing on EF (e.g., Bialystok et al., 2014; Poarch and Bialystok, 2015 this).

Since EF is viewed as utilized for a few parts of handling (for example, transient memory control and forestalling programmed conduct), researchers have recommended that the basic construction comprises a few modules (see, for example, Jewel, 2013 Miyake et al., 2000). Following Miyake et al.'s. Persuasive review (2000) on the structure of and connection between EF, the vast majority of the present examination thinks about three center EF parts: restraint, moving, and refreshing (Valian, 2015). These three parts will be introduced in the accompanying passages.

1.5.1 Inhibition

Inhibition is the component which empowers us to control our consideration and conduct, making it conceivable to oppose both inside and outside interruptions and spotlight on the job needing to be done (Diamond, 2013; Miyake et al., 2000). Because of restraint, we can keep away from doing automatized conduct and channel out pointless data. This inhibitory control is usually estimated through errands, for example, the Stroop task (Stroop, 1935), the Flanker task (Eriksen &

Eriksen, 1974), hostility to saccade assignments (Hallet, 1978) and the Simon task (Simon, 1967).

1.5.2 Updating

Updating and monitoring working memory representations (Miyake et al., 2000), or simply updating, is the capacity to continually refresh the data expected to play out an undertaking (for example, Valian, 2015). This capacity involves the "observing and coding [of] approaching data for pertinence to the job needing to be done and afterwards fittingly reconsidering the things held in working memory by supplanting old, as of now not applicable data with fresher, more important data" (Miyake et al., 2000, p. 57). Refreshing is firmly connected with working memory, to the degree that it is once in a while alluded to as working memory (see, for example, Jewel, 2013; Lehtonen et al., 2018). There are irregularities in the writing regarding the compatibility of these terms and how working memory fits under the EF umbrella. Refreshing capacities are usually evaluated through, for example, the n-back task (Kirchner, 1958), tone-reiteration identification (Galletly et al., 2007), and the keep-track task (Miyake et al., 2000; Morris & Jones, 1990).

1.5.3 Shifting

Inhibition is the component which empowers us to control our consideration and conduct, making it conceivable to oppose both inside and outside interruptions and spotlight on the job needing to be done (Diamond, 2013; Miyake et al., 2000). Because of restraint, we can keep away from doing automatized conduct and channel out pointless data. This inhibitory control is usually estimated through errands, for example, the Stroop task (Stroop, 1935), the Flanker task (Eriksen & Eriksen, 1974), hostility to saccade assignments (Hallet, 1978) and the Simon task (Simon, 1967).

1.5.4 The organization of Executive Functions

Executive Functions are believed to be both detachable and related, all depending on a typical variable. Miyake and Friedman (2012; see likewise Friedman and Miyake, 2004) investigated the connections between the EF parts

through inactive variable examinations and observed that they were ready to recognize two explicit EF factors, specifically moving and refreshing. They connected with these and tracked down a universally valuable component - the standard EF factor (Miyake and Friedman, 2012, Valian, 2015). No different Inhibition factor was discernable, yet it is, by and large, hypothesized that the average EF factor is additionally answerable for restraint as it is believed to be what controls "[…] one's capacity to effectively keep up with task objectives and objective related data and utilize this data to inclination lower-level data" (Miyake and Friedman, 2012; p. 11). Besides, it is speculated that the absence of remarkable change for Inhibition is because it connects totally with the normal EF factor. This prompted Miyake and Friedman to foster what is ordinarily known as the solidarity/variety system: a model wherein all EFs have a typical element (solidarity), which incorporates restraint and the two explicit parts for refreshing and moving (variety). It is significant, in any case, that there are still unclarities in regards to the arrangement and association of EF (Lehtonen et al., 2018), in the wake of examining different difficulties emerging with research on bilingualism and discernment.

1.6 Conflicting results, competing factors, and confusion

While the many outcomes were announcing execution contrasts because of bilingualism status point in the heading of a bilingual benefit, this is not the whole story. Over the new years, various investigations (for example, Ánton et al., 2014; Paap & Greenberg, 2013; Duñabeitia et al., 2014) have neglected to recognize prevalent EF capacities in bi-and multilingual. Hilchey and Klein (2011) and Hilchey, Saint-Aubin and Klein (2015) accumulated and dissected the discoveries of late examinations on the bilingual benefit in which non-verbal proportions of EF were utilized, and observed that the outcomes were conflicting and did not give a persuading degree regarding the proof.

“On the contrary, the patterns of results across the lifespan are simply too variable and vulnerable to non-replication to confidently ascribe a central role of bilingualism, in and of itself, to superior executive functioning and by extension

improved cognitive fitness. As such, only when a host of overlooked sociolinguistic factors are better accounted for will the association between greater executive function and bilingualism be satisfactorily determined" (Hilchey, Saint-Aubin, & Klein, 2015, p. 613).

The wandering outcomes have created a gap in the field of exploration. From one perspective, there are those accepting there is a bilingual benefit, yet that the trouble of precisely estimating EF, frustrating factors, and the many sorts and levels of bilingualism are clouding the results (see, for example, Valian, 2015; Bak, 2016a; Bak, 2016b). Then again, some are scrutinizing the presence of such a benefit, proposing that results are unreasonably conflicting to make any inferences. A few papers, most outstandingly by Paap and partners (for example, Paap, Johnson and Sawi 2014; Paap, Johnson and Sawi 2015; Paap, Johnson and Sawi 2016; Paap, Myuz, Anders, Bockelman, Mikulinsky and Sawi, 2017; however see Duñabeitia likewise et al., 2014; Duñabeitia and Carreiras, 2015) express this uncertainty. Moreover, they present strategic reactions coordinated at a significant part of the new exploration and address a portion of the primary issues that should be settled to progress further in research on the bilingual benefit. The most usually examined issues are distribution predisposition, task pollution, issues regarding the meaning of bilingualism, and what has been alluded to as a "woodland of perplexing factors" (Bak, 2016b). It is by and large settled upon by all that these tricky regions must be conquered to see as more steady proof that could direct us toward whether such a bilingual benefit exists and what it involves. In the accompanying subsections, I will depict these issues and their suggestions.

1.6.1 Publication bias

Whether a distribution predisposition could justify the separating results (de Bruin, Treccani, and Della Sala, 2015; Paap, Johnson and Sawi, 2015) has been puzzled over whether the image could be more complicated than the image that has arisen in writing. The record cabinet issue (Rosenthal, 1979) portrays the propensity that tremendous outcomes are more frequently distributed than invalid outcomes, leaving the last option "in a record cabinet" (Paap & al, 2015). This causes a one-

sided image of reality in which fascinating outcomes are noticeable, while the less distributed commendable outcomes seldom contact a group of people. While researching the distribution pace of gathering abstracts zeroing in on bilingualism and chief control, de Bruin, Treccani, and Della Sala (2015) viewed that 63% of the examinations which tracked down help for the bilingual benefit were distributed, contrasted with just 36% of those with invalid outcomes, and some (for example, Treccani, Argyri, Sorace, and Della Sala, 2009) have confessed to distributing just the consequences of those undertakings in which an impact was found (de Bruin, Treccani, and Della Sala 2015). The total degree of the distribution inclination is obscure, yet assuming it is the situation that such countless invalid outcomes are left unpublished, it implies that the image painted by the distributed results is seriously slanted.

1.6.2 Cause and effect: the problem of reverse causality

Might it be that those learning a language, or beside the people who wind up utilizing it effectively, are better intellectually prepared in any case? This question is alluded to as turnaround causality and talked about by Bak (2016a, 2016b). It is feasible to some extent to address it through longitudinal investigations or by acquiring data about youth mental execution (as in the Lothian accomplice based concentrate by Bak et al., 2014), or to a degree keep away from it by zeroing in instead on language students and contrasting their mental execution when some season of learning (Vega-Mendoza et al., 2015; Bak et al., 2016). Nonetheless, the large number of variables adding to the mental turn of events (see segment 2.3.4) makes it challenging to control the course of causality within all boundaries without a moment's delay. On the other hand, as Bak (2016a) expressed, the presence of one causal relationship does not invalidate another: on the off chance that individuals are here and there hereditarily inclined toward being bilingual, this does not mean bilingualism cannot likewise be intellectually valuable.

1.6.3 Defining bilingualism

A common issue in investigations of bilingualism is the definition and limits of semantic standards: where do you define the boundary between monolingualism and bilingualism? Or on the other hand, in this setting: which members ought to have a place with the monolingual gathering, and which for the bilingual gathering? Customarily, the ways have been spread out by the severe Bloomfieldian basis of complete familiarity with two dialects (Bloomfield, 1933) and the broad definition by Haugen (1953), which expresses that a bilingual can create "complete significant expressions in the other language". The field has moved more towards the broad definition, abandoning the division between adjusted bilingualism and pseudo-bilinguals, which was embraced by Peal and Lambert (1962, see segment 2). The idea of pseudo-bilingualism is presently considered tricky. As of today, the total view is that while bilinguals can be pretty much adjusted in the etymological capability they hold in their separate dialects, it is, for the most part, acknowledged that not adjusted familiarity or long-lasting bilingualism makes an individual bilingual. "Most bilinguals do not have equivalent familiarity with their dialects, many have a highlight in something like one of their dialects, and many procured their other language(s) when they were youths or grown-ups" (Grosjean, 2013, p. 7). Bialystok (2001) characterizes bilinguals as those "ready to talk (at least two) dialects to some degree of capability" (p. 5), however, this definition does not lay out a reasonable degree of 15 capability required to be characterized as a bilingual. In this way, it does not tackle the issue. In any case, members in examinations zeroing in on the bilingual benefit have generally been gathered by their self-evaluated capability level in their second language(s) (see, for example, Luk and Bialystok, 2013; de Bruin, Bak, and Della-Sala, 2015). Recently, nonetheless, the bearing has somewhat turned towards a utilization situated way to deal with bilingualism. This is in line with the more extensive meanings of the peculiarity utilized in the overall writing, for example, "the utilization of at least two dialects […] in day to day existence" (Grosjean, 2013, p. 7, my accentuation) and Luk and Bialystok (2013, among others) gave one more valid justification to incorporate use. As the bilingual benefit is viewed as brought about by a training impact, it is

consistent with accepting that how much utilization of a few dialects will impact the degree to which bilingualism influences EF. Because of this contention, de Bruin, Bak, and Della-Sala (2015) assembled members in their review given whether they were dynamic bilinguals, with the meaning of dynamic being that they detailed utilizing two dialects consistently. Their outcomes did not give proof on the side of the bilingual benefit. However, this might be expected for various reasons (see their paper for the entire conversation). The inquiry remains on where to define the boundary between dynamic and detached, or between "adequately bilingual" and "not bilingual enough" to have the option to identify any bunch of contrasts. Our insight today is excessively restricted to precisely surveying what degree of bilingual action is required to see an impact (de Bruin, Bak, and Della-Sala, 2015), yet a scarcely any examinations were done on language exchanging/code exchanging demonstrate that there is a relationship between frequently exchanging among dialects and better moving execution (for example Earlier and Gollan, 2011; Verreyt, Woumans, Vandellanotte, Szmalec, and Duyck, 2016). It can, nonetheless, be contended that we could avoid the limit out and out. Poarch and Bialystok (2015) guessed that assuming the bilingual benefit is a training impact, it ought to be reflected through the level of bilingualism or the number of dialects spoken. Assuming that this is the case, and bilingualism ought to be viewed as all the more a continuum, it could seem OK to investigate it in one more manner than through the customary polarity which has been most ordinarily utilized. In their review, Poarch and Bialystok looked at four gatherings: monolinguals, halfway bilinguals and trilingual, to explore contrasts between the gatherings because of the comprehension of bilingualism as a continuum. Their outcomes do not uphold their speculation (bilinguals and trilinguals outflanked monolinguals and "fractional" bilinguals, but there was no presentation distinction among monolinguals and halfway bilinguals on the one hand, and bilinguals and trilinguals then again. Nonetheless, this might mirror that the bunches were not adequately different. Their investigations showed that monolinguals and halfway bilinguals didn't vary essentially from one another in utilising non-English dialects at home (the halfway bilinguals were learning French at school yet not utilising it much beyond the homeroom). Also, bilinguals and

trilinguals didn't contrast in that frame of mind of the purpose of non-English. Subsequently, the gathering of members in this study was predominantly founded on capability. Had the gatherings been made based on varieties being used, this might an affected the outcomes because the training impact of bilingualism is bound to be related to using designs, as examined previously. Understanding this logic, it is possible that testing members and contrasting them on a utilisation based continuum instead of a capability-based downright gap could assist us with acquiring a more precise image of the level and examples of bilingualism expected to receive the rewards of mental performing various tasks. At long last, the focal point of bilingualism research has generally been concentrated around the experience of deep-rooted, concurrent bilingualism - all in all, those learning two dialects from birth. Notwithstanding ongoing exploration (for example, Bak, Vega-Mendoza, and Sorace, 2014) have offered help for the idea that a constructive outcome can likewise be found later. There is still vulnerability regarding whether these two different ways of learning a language will unexpectedly influence perception - all things considered, learning a language sometime down the road will require what can be alluded to as a "reconfiguration" of mental abilities (Duñabeitia & Carreiras, 2015). Consequently, consecutive bilingualism might be more valuable than concurrent bilingualism (Bak, 2016b). It has additionally been observed that the beginning of dynamic bilingualism is more touchy than the AoA (Luk & Bialystok, 2013), further fortifying the speculation that the dynamic utilisation of more than one language would be the most persuasive element of EF and mental capacities.

1.6.4 Demographic variation and lifestyle contributors to EF

Assuming bilingualism in all actuality does without a doubt add to the improvement of EF, it is not the main element that may influence this piece of insight. There are a few segment components that, in different ways decidedly or adversely influence discernment overall and EF precisely: notwithstanding age. (see, for example, Craik, 2017; Kavé et al., 2008; Valian, 2015), both financial status (SES) and level of schooling have been demonstrated to be indicators of an

individual's execution of EF assignments (Valian, 2015). Another variable, which is frequently applied in bilingualism research, is migrant status. In a significant part of the early examination, bilingualism was firmly associated with movement, as the bilinguals were generally of worker foundation (Bak, 2016a). Be that as it may, there are earmarks of being a propensity for transients to have better long-term well-being results, including mental well-being, than non-travellers - maybe because of self-selection.

This is known as the sound transient impact (Fuller-Thomson & Kuh, 2014) and is especially applicable for research on bilingualism and dementia. On the off chance that outsiders are prone to maintain better mental working in advanced age, it appears to be sensible to expect a distinction in more youthful individuals also. Subsequently, migration status might be a jumble for the situation of bilingualism research. Bak (2016a) proposed that "[a] great way forward […] is to study social orders in which bilingualism and migration can happen autonomously of one another" (p. 711). Moreover, a few exercises can be thought to be "intellectually improving" (Valian, 2015), including actual activity (see, for example, Precious stone and Lee, 2011), video gaming (Green, Sugarman, Medford, Klobusicky and Bavelier, 2012), and playing instruments (for example Bialystok and DePape, 2009) - and the rundown likewise incorporates a way of life factors like rest design (Astill et al., 2012), diet (Anastasiou and al., 2017), and self-preoccupation/extroversion (Campbell, Davalos, McCabe and Troup, 2011). Regardless of the considerable rundown of elements affecting EF, there is still a ton left to investigate concerning the scope of intellectually improving exercises furthermore the degree to which one requirement to participate in such exercises for them to give mental benefits. Furthermore, the detailed advantages are conflicting, just like with bilingualism (Valian, 2015).

Cautious planning of the segment and way of life factors which we suspect may impact mental capacities is required to limit the impact of perplexes. This should be possible through cautious enlistment and a point-by-point survey to gather data about different aspects of bilingualism.

1.6.5 The task impurity problem and related issues

The assortment of undertakings used to quantify EF is the hotspot for one more issue frequently alluded to as the undertaking pollutant issue (Burgess, 1997). So, this depicts the issue with testing explicit components of comprehension, as no undertaking tests just something single: "Execution in an errand reflects not just the course of interest (for example inhibitory control) yet in addition any remaining phases of handling from perceptual encoding through reaction determination and execution" (Paap et al., 2017, p. 90).

Consider, for example, the distinction between a Stroop card arranging task and a Flanker task. They are both accepted to gauge Inhibition, notwithstanding one requires noticing a PC screen and pressing buttons, and the other requires getting and accurately arranging cards. It is implied that notwithstanding being utilized to quantify similar EF, the undertakings are unique concerning one another in other regards. As a result, estimation in these errands will not just mirror the EF in question. Nevertheless, different capacities like perceptual or coordinated abilities (Valian, 2015) and, subsequently, execution contrasts cannot be credited to EF alone. While the distinctions on an individual level might be slight the ramifications in the bigger picture are more significant: in a few meta-examinations, no intercorrelation was found between various assignments estimating restraint (Duñabeitia et al., 2014; Paap & Greenberg, 2013; see likewise Valian, 2015). Assuming that errands intended to quantify something similar factor do not create results that cross over with one another, could they at any point honestly be thought to be proportions of a similar limit? An element connected with this is the variety where these errands are introduced, tastefully and content-wise. Mechanized errands might be more enthusiastically for those with less involvement in PCs, and designs in the undertaking programming (for example, fluctuating size of items or variety varieties) may likewise influence execution (Bak, 2016a; Valian, 2015). Little changes to the trouble in the standards utilized can impact bilingualism show up or then again vanish (Costa et al., 2009). Task space likewise seems to have an influence: there is proof proposing that verbal errands present a test to bilinguals

(for example, Bialystok et al., 2014). This is accepted because bilingualism likewise seems to adversely influence a few parts of language handling - for example, more slow lexical recovery and more modest open jargon (Bialystok, Craik and Luk, 2008; Bialystok & Luk, 2012). Assuming bilinguals are in some way dialled back because of verbal handling, the utilization of verbal EF assignments could cover execution contrasts between gatherings. Valian (2015) underlined that since members have just tried utilizing one of the assignments by and large. Hence, the outcomes might be impacted by the undertaking picked in the given review. We "really want fine-grained task examination to comprehend what cycles are being also enlisted, how they interface" (p. 7).

1.6.6 The elusiveness of cognitive functioning

There is still much vulnerability concerning the association and functions of mental parts. While neuroimaging studies can outwardly associate execution of different errands to brain activity in specific areas of the mind, furthermore may accordingly show us actual contrasts in the minds of bilinguals and monolinguals, they do not illuminate us straightforwardly what outcomes these distinctions might have, for example, mental execution, since there is "no immediate planning between mind structure and mental work" (Duñabeitia and Carreiras, 2015, p 372). This issue is undeniable in two ways. The first has all the earmarks of irregularities around the term working memory and where it fits in. This has brought about the term being utilized in a few settings: some utilization equivalently to refreshing, inferring that it is a different part of EF. Others notice working memory comparable to EF by and large, yet it is often hazy how it is connected to the following EF parts. Miyake and partners (2000) opened their conversation about EF by alluding to Baddeley's (1986) model of working memory, connecting every one of the parts of EF to the focal leader of this structure. Later on, they expressed that refreshing is "firmly connected to the idea of working memory" (p. 56), yet assuming EF shapes some portion of the functioning memory model, which would be valid for all parts, not simply refreshing. Subsequently, it is frequently challenging to grasp what is implied by working memory and how it ought to be contrasted or related with the

(other) EF parts. In the rest of this postulation, we will utilize the term working memory in a sense characterized by Baddeley (1986): "the brief stockpiling of data that is being handled in any scope of mental undertakings" (p. 34), except if other is determined. The second issue that shows the trouble of characterizing and understanding EF is the continuous conversation about the pertinence of Inhibition. Expanded interest in restraint was quite possibly the earliest speculation regarding why bilingualism could be gainful (Bialystok, 2017). Recently, the significance of restraint has been brought into question, as conflicting results and discoveries show that different viewpoints might be more pertinent. For model concentrates on testing bilingual newborn children on attentional adaptability (Kovács & Mehler, 2009; Singh et al., 2015) and memory speculation (Brito & Barr, 2012) showed that they outflanked their monolingual friends, showing an early impact of bilingualism on mind designs and advancement. This recommends that the mental change associated with bilingualism happens freely of language creation and, if this is the case, that there should be more going on than Inhibition. (Costa et al., 2009; Grundy, 2017; Bialystok 2017). All things being equal, it has been suggested that the bilingual benefit could have more to do with proficient checking than inhibition. Observing, or "the capacity to screen struggle in data handling and to assess the requirement for mental control" (Lehtonen et al., 2018), is likewise something that would be required in the compromise assignments that are many times used to gauge Inhibition. A better capacity in checking would likewise act as a clarification for why bilinguals seem, by all accounts, to be quicker at Inhibition undertakings, generally speaking, and not only for the incongruent preliminaries (Costa et al., 2009). One of the ongoing speculations is that bilinguals seem to bargain more effectively with changes in the degree of trouble and checking needs. Some read up tracking down help for this thought, including Costa and partners (2009). They tried monolinguals and bilinguals on two degrees of checking by utilizing a few forms of the Flanker task (for a more nitty-gritty portrayal of this undertaking. In the low monitoring conditions, a large portion of the preliminaries was either compatible or incongruent, diminishing the steady variation required to succeed. In the high-checking conditions, harmonious and incongruent preliminaries were conveyed

equally, expanding the interest in undertaking checking. Generally speaking, response times showed that bilinguals beat monolinguals on the popularity conditions just, showing that the bilingual benefit is more present in assignments requiring more significant observing levels. This is steady with different examinations that have been viewed as the bilingual benefit to arise all the more obvious in complex errands (for example, Bialystok et al., 2014). Also, in the investigation of Costa and associates, the contention impact of the popularity conditions connected with the number of consistent preliminaries, showing that the presentation of bilinguals on the Flanker task could not just be because of further developed restraint abilities, as restraint would just be required in incongruent preliminaries (see for example Bialystok, 2017). This is too reliable, with different finds showing that it is not the troublesome conditions that present the most concerning issue yet the transformation to more specific circumstances later troublesome ones (cf. Meuter and Allport, 1999; Poarch & Bialystok, 2015). The impact of specific circumstances being additional troublesome after a change from more requesting ones is made sense of by Diamond (2013) along these lines: "Basically, it is more straightforward to repress a prevailing reaction all of the time than just a portion of the time" (p.151). In other words, simple errands (for example, compatible flanker conditions) can perform using moderately automatized processes, yet when they get more muddled (for example, an interruption shows up, as in incongruent circumstances), we want to utilize more effortful control to keep up with the center. At the point when the undertaking becomes more straightforward once more, the extra control is, as of now, not proficient but instead pumps the brakes and subsequently should be "shut down" (Diamond, 2013; Green and Abutalebi, 2013). Bilinguals might have a superior framework for checking the controlling interest due to the constant need to screen what is happening and pick the correct language. This might be the reason for their clear benefit by and large RTs (Costa et al., 2009). Moreover, the distinction may likewise be a sign of bilinguals being better at task disengagement3 – the capacity to abandon the states of the past assignment and pull together on the new undertaking (Green & Abutalebi, 2013; Grundy, 2017). While further developed execution because of

checking and task withdrawal capacities can be reflected in worldwide RT, this is a broader speed of handling measure which does not inform us much concerning the genuine handling contrasts causing this improvement, as per Grundy and partners (2017). They instead proposed to dissect RT because of the impact of the past preliminary, to distinguish execution contrasts that show up because of further developed observing/task withdrawal. While contrasting the presentation of bilinguals furthermore monolinguals on two Flanker errands, they put together their examination concerning both customary Flanker measures and the consecutive congruency impact, or SCE: "the file of online responsive change in execution because of the congruency of the past preliminary" (p. 43), guessing that rehashed preliminary sort (for example two compatible preliminaries after each other) would diminish RT, while changed primary sort (for example incongruent-compatible) would result in an expanded RT - Besides, bilinguals would show a more modest impact because of a more effective capacity to withdraw from the past errand. Their discoveries upheld the speculation, and besides, the SCE investigation was more delicate to bunch contrasts as it distinguished contrasts that did not arise with standard RT measures.

Chapter Two:

Research Instruments and Data Collection Procedure

2.1 Participants

A random sample were selected to participate in this study. They are students who study at the department of English at the university of Tlemcen. precisely, they are students at the department of English. The selected number of students was 30 and their ages were between 20 and 25 years old.

2.2 Procedures

All members played out the previously mentioned undertakings separately in a classroom in the following request: Flanker task, Trail making task, Raven's progressive matrices task, plus-minus task, stroop task, and questionnaire. The examination took 50 to 70 min.

2.2.1 Questionnaire

All members finished an extensive poll and an updated form of the Language and Social Background Questionnaire (LSBQ; Luk & Bialystok, 2013). They detailed their age, orientation, schooling level, and contribution to other intellectually improving exercises and way of life factors, such as playing PC games or instruments and measuring actual activity. Gaming, instruments, and exercise were revealed hours out of each week.

In the poll, the members have posed a progression of inquiries about their language foundation, detailing their Age of Acquisition (AoA) for all dialects and tongues at any point scholarly, level of activity in each L2, going from "every day (five days per week or more)" to "not exactly one time per month," as well as the capability and use designs in the different L2s.

The capability was evaluated for every language on a scale from 1-to 10 in talking, composing, tuning in, and perusing. A composite score (of the multitude of modalities) for L2 capability was determined (L2 capability score). For use, they were approached to rate their relative use of every language in every methodology, amounting to a score of 100 in every one of the four modalities. Their rate scores were then used to work out composite scores for every methodology giving a total score for unknown dialect use (L2 use score) concerning creation and appreciation

separately. Due to high intercorrelation between the four modalities inside use and capability individually, just the absolute composite scores for L2 use and L2 capability were utilized for additional investigation.

2.2.2 Stroop tasks

Stroop tasks are routinely used to gauge Inhibition or the standard EF factor (Valian, 2015; Miyake & Friedman, 2012). To identify potential contrasts among verbal and nonverbal errands, both a verbal and a non-verbal Stroop task were utilized. The verbal Stroop task comprised three circumstances (harmonious, incongruent, and control). In each condition, the member was given a rundown of various words imprinted on a piece of paper. In the consistent condition, a variety of words matched the shade of the ink they were printed; in the incongruent condition, there was confusion (for instance, the word red was imprinted in green ink). All words were imprinted in dark ink in the control condition, and the member was approached to peruse the rundown as fast and precisely as expected. This was finished to control for contrasts in automatization as less automatized abilities to understand would benefit this errand (Bialystok et al., 2014). The member was given each condition independently and was expected to name the varieties as fast and precisely as conceivable, focusing on ink variety just and dismissing the accurate variety word. Their execution was coordinated (estimated in short order), and mix-ups (if they were made) were noted. The impedance cost (Stroop impact) was determined as the relative expansion in time taken to play out the incongruent condition contrasted with the compatible condition, utilizing the recipe (incongruent - compatible)/harmonious. We utilized the nonverbal Stroop task, the Nonverbal Stroop Card Sorting Test (NSCST). A plastic mat with four framed boxes, each joined by a shaded square shape, was set before the member, and the undertaking director put cards individually on the mat. The cards had two hued square shapes, one set apart with a white cross.

The member was told to sort cards into the correct box because of the shade of the square shape with the cross and to do as such as fast and precisely as could be expected. This assignment comprised of two circumstances, one harmonious and

one incongruent. In the harmonious condition, the square shapes on the cards were of similar variety. In the incongruent condition, they were two varieties, requiring the member to hinder the superfluous variety to put the card in the correct box. Worth focusing on. Even though this is a fundamental nonverbal task, a few members would mutter various names while arranging in the incongruent condition.

The two circumstances were planned, and botch counted. The Stroop impact was determined by tracking down the proportion for each condition (the time taken to finish the condition separated by several cards accurately arranged) and deducting the proportion of the harmonious condition from that of the incongruent.

2.2.3 Flanker task

The Flanker task was regulated utilizing E-Prime on a PC a reaction box. Five bolts were displayed on a screen, and the member was told to think about the center bolt (target bolt) and demonstrate the course wherein the bolt pointed by squeezing either a left or a right button. The errand comprised of four test preliminaries (consistent with bolts pointing right, compatible with bolts pointing left, incongruent with target pointing right, and incongruent with target pointing left) in randomized request, as well as 240 ordinary preliminaries (120 compatible, 120 incongruent), additionally in randomized request. Every preliminary started with a 1-second obsession point and finished just when the member answered by squeezing a button. In the consistent condition, all bolts pointed in a similar bearing, while in the incongruent condition, the flanker bolts pointed the other way from the objective bolt. The interruption brought about by the flanker bolts should be hindered. Consequently, the distinction in RT between the two circumstances creates a flanker outcome demonstrating the level of inhibitory control.

Missteps and individual reactions surpassing 3 SDs from the mean were eliminated for every member. Crude information from the Flanker task was utilized for three measures. First and foremost, the joined RTs on compatible and incongruent preliminaries were accumulated for every member to deliver a worldwide RT score. Also, the flanker impact (the Inhibition measure) was determined as the contrast between the mean RT of the incongruent condition and

the harmonious condition, separated by the mean of the compatible condition (I-C/C). Thirdly, the consecutive congruency impact was determined for every member, given the portrayals of Grundy et al. (2017). This was finished by parting the preliminary kinds into four classes, in light of the congruency of the previous preliminary: harmonious followed by harmonious (CC), compatible followed by incongruent (CI), incongruent followed by consistent (IC) and incongruent followed by incongruent (II). We then determined the c-flanker impact by taking the mean RT of IC preliminaries from the mean RT of CC preliminaries. Additionally, I-flanker impact was determined by taking away the mean RT of II preliminaries from the mean RT of CI preliminaries. At last, the SCE score per member was obtained by taking away the I-flanker impact from the c-flanker impact.

2.2.4 Trail-making task

The trail-making task (TMT) was directed utilizing pen and paper and comprised two conditions. In the principal round (TMT A), the members were given a piece of paper with circumnavigated numbers going from 1-to 25 and were told to define a boundary from number 1 to number 25 in persistent request without lifting the pen from the paper. For the subsequent round (TMT B), the piece of paper contained the letters A-L notwithstanding numbers 1-13.

Participants were approached to define a boundary between the circles as in the past condition, shifting back and forth among numbers and letters in the design of 1-A-2-B-3-C, etc. As with the non-verbal Stroop task, the moving condition (TMT B) made numerous members mutter the numbers and letters without holding back as they played out the errand. The two circumstances were coordinated, and a moving expense was determined for every member by deducting the time utilized in TMT A from TMT B and separating the outcome by TMT A.

2.2.5 Plus-minus task

In addition, less undertaking was directed with paper and pen and comprised of three circumstances: besides condition (c1), a short condition (c2), and a moving condition (c3). Each of the three circumstances were coordinated. For the primary

condition, the member was given a pen and a sheet with a rundown of thirty numbers and trained to add three to each number on the rundown as fast and precisely as conceivable and record the responses. For the following condition, guidelines were comparable. Then again, the member was told to deduct three from each number. In the last condition, the guidelines were to switch back and forth between adding and deducting three, starting with expansion. The numbers utilized in the undertaking were from 10-99, and no number showed up two times. The last condition requires moving, and here, numerous members were murmuring in addition to and short as they obliged the task to follow along. After the meeting, botches were noted, and the moving expense for every member was determined utilizing the equation (c3-(c1+c2)/2)/((c1+c2)/2).

Chapter Three:

Data Analysis, Suggestions and Recommendations

Chapter Three: Data Analysis, Suggestions and Recommendations

3.1 Results

In each of the subsections below we will summarize the findings from the statistical analyses. Section 3.1.1 focuses on the correlation results, starting with the correlations between EF measures and the linguistic variables. We will begin with the inhibition measures and the shifting measures, before moving on to monitoring measures and finally, WI will report the results from the correlations between EF measures and the non-linguistic variables.

3.1.1Correlations

Correlations results and p-values are introduced in table A. Note that for all the EF undertakings, a higher score shows more slow execution, implying that given the speculations, we would anticipate a negative connection with the language factors (for example, lower restraint cost = lower score, while more use = higher score: hence, if the measure of purpose prompts better Inhibition capacities, the relationship would be a negative one).

3.1.1.1 Inhibition results

Results for the inhibition measures (Flanker, verbal Stroop, visual Stroop) and language factors are accounted for in table 1. No relationships between restraint measures and level of bilingualism arrived at importance at a=0.05. While relationships were feeble (scope of Rs(80) = ±0.022-0.116), they did, for the most part, show reliable examples in heading: Flanker and visual Stroop has been connected adversely with capability and use. Verbal Stroop related adversely with capability, yet decidedly with use. The most grounded connection in this set was the one between verbal Stroop and L2 use (Fig 2)

3.1.1.2 Shifting results

Results for the shifting measures (TMT and plus-minus) and the language variables are reported in table 2. No correlations yielded significant results at a=0.05. Correlations were weak (range of Rs(80) = ±0.029-0.108). While TMT correlated negatively with the language

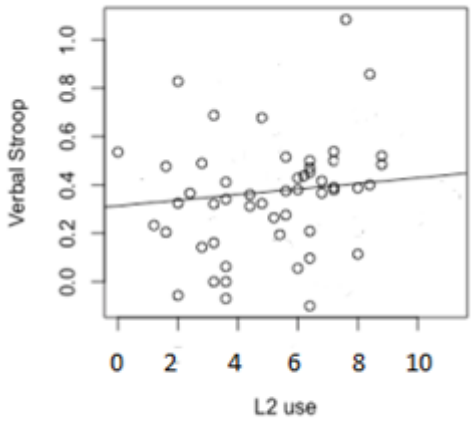

Fig 1 Scatterplot of L2 use and Verbal Stroop performance

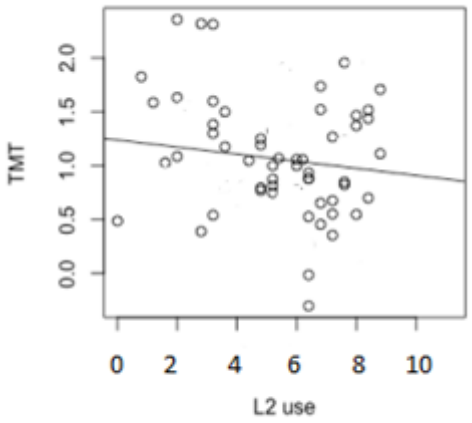

Fig 2 Scatterplot of L2 use and TMT performance

variables, the same relationships for plus-minus were positive. The strongest correlation was found between TMT and L2 use.

3.1.2 Regression

Numerous straight relapses were determined to foresee every one of the EF factors given level of bilingualism (use and capability), age, and RPM score. None of these indicators had a tremendous impact on any relapse models. The R2 for the different models went from 0.03 to 0.1, demonstrating that the models represented 10% of the fluctuation or less. The most grounded R2 was found in the TMT model (R2 = 0.1)

3.1.3 Summary of results

No tremendous relationships were found between EF measures, bilingualism level of bilingualism, or the other autonomous factors (age, actual work, diet, and RPM execution). The impact sizes were, in general little. However, the relationships headed down the usual path for the vast majority of the actions (Flanker, visual Stroop, TMT, what is more, worldwide Flanker RT). Straight relapse models recognized no significant impact of any of the autonomous factors on EF execution.

3.2 Discussion

The principal objective of this study was to research the connection between bilingualism and executive functions. In particular, the emphasis was on regarding

bilingualism as a continuum and examining how much there was a distinction between the impact of L2 use and L2 proficiency. The participants were tried utilizing undertakings taking advantage of inhibition, and shifting. They shifted in the level of bilingualism yet were generally moderately homogenous - with an end goal to control for conceivable puzzles. Be that as it may, Spearman correlations showed no vast connections between the EF errands and language measures. The accompanying part will discuss the outcomes considering hypothetical methodologies and related examinations. We will check on the speculations before examining the discoveries connected with the various measures, we will additionally talk about the job of L2 use according to EF practice.

We will likewise, in certain occurrences, remark on the bearing or strength of the connections, even though they are not critical. This may be finished in the situations where we track down designs that should have been visible as fascinating, in any event, while lacking factual importance. Given these perceptions, it is vital to note that we will not make any ends.

While the significance of the p-esteem has been bantered because of its discretion and the high reliance on example size (see, for example, Greenland et al., 2016; Wasserstein & Lazar, 2016), it is still seen as a significant validator for tangible outcomes. Besides, the impact sizes in this study are tiny (most are underneath 0.1), and along these lines putting much weight on them when they are likewise non-huge would be biased.

3.2.1 Main findings

This study's primary speculation was that a more significant level of bilingualism would correspond with the execution of the EF errands. No outcomes upheld this theory. Even though relationships for the Flanker impact, Flanker worldwide RTs, visual Stroop, and TMT measures went in the expected heading, impacts were little and not huge.

The subsequent speculation was that how much utilization of more than one language would be a more grounded indicator of EF capacities than L2 competence.

Since the EF is expected to be reinforced because of a training impact, it appears to be probable that the best measure for this practice would be used instead of capability. The outcomes show that for all EF assignments, except for verbal Stroop, the relationship coefficients for use are reliably inclining more towards the anticipated bearing than those for capability. This propensity should have been visible as a slight sign that utilization may be more unequivocally connected with preferable EF execution over capability. Given the general shortcoming and the absence of importance, the results offer no immediate help for this speculation. Besides, straight relapse models viewed neither use nor capability as huge indicators of EF execution. The third speculation expressed that a more grounded impact of bilingualism would arise on non-verbal EF errands than verbal ones because of the apparent additional test bilinguals experience while doing verbal assignments. There was a positive relationship between use and the verbal Stroop task (the principal verbal undertaking), demonstrating a positive connection between a more significant level of bilingualism on the utilization pivot and less timely execution on the verbal Stroop task. Be that as it may, a similar impact was not found for the capability pivot. While this might have been viewed as one more sign that utilization is more firmly associated with execution on EF assignments than capability and that this outcome could mirror the verbal inconvenience for bilinguals, the relationship was not tremendous. Consequently, this study does not offer help for the third speculation.

The fourth speculation expressed that the level of bilingualism would anticipate execution on proportions of checking more reliably than execution on Inhibition undertakings. This was conjectured due to the new conversation on the importance of Inhibition. The likelihood that bilinguals could be outflanking monolinguals on Inhibition undertakings because of a better capacity to screen the fluctuating trouble levels of the preliminaries instead of predominant Inhibition capacities. Checking skills were estimated with general response times on the Flanker impact and the SCE score. Results from this study give no proof to help this speculation. In the accompanying subsections, we will additionally talk about the discoveries connected with the actions for restraint.

3.2.2 Inhibition

This study utilized a few Inhibition instruments (a Flanker task, a verbal Stroop task, and a visual Stroop task). Assuming execution on the undertakings is affected by a few factors other than EF (for example, verbal handling needs, obstruction component, and show), the expectation was that this would be interceded somewhat by utilizing more than one measure. However, no association between any of the undertakings and the level of bilingualism was found. The absence of considerable outcomes in Inhibition is not extraordinary to this review, and it isn't clear which job restraint plays concerning both EF and the bilingual benefit.

The emphasis on Inhibition as a part of EF has been available in a large part of the writing on the bilingual benefit. Despite the solidarity variety model appearance, no different Inhibition factor, and disregarding the accompanying statement from the persuasive paper by Miyake et al. (2000) from which the solidarity/variety model comes:

"The conception of Inhibition used here is constrained to the deliberate, controlled suppression of prepotent responses. Thus, by inhibition, we do not mean inhibition that takes place in typical spreading activation models or connectionist networks. That type of inhibition usually refers to a decrease in activation levels due to negative activation […] and is not necessarily a deliberate controlled process" (p. 58)

Subsequently, on the off chance that one expects language handling as a spreading initiation organization (as many dos, see for example, Dell 1986; furthermore (Costa, 2005; La Heij, 2005), the sort of restraint examined in the solidarity/variety model seemed challenging to bind together with the inhibitory control model (Green's 1998) compelling idea of how bilinguals hinder the superfluous language, see segment 1.4) as a clarification for why restraint would be upgraded by bilingualism. Restraint undertakings like the Flanker, Stroop, and antsaccade assignments (the last option including intentional eye development away from an interruption) all utilize a degree of controlled restraint: you know of overlooking

flanker bolts or smothering the consequently perused variety of words. In bilingual language creation, nonetheless, it appears to be a possible supposition that many people do not know about stifling words in the unimportant language (to some degree, more often than not). It might just be that this concealment additionally requires some type of similar inhibitory instruments as intentional concealment or that there is some degree of movement between the two. Nonetheless, these two sorts of concealment can't be expected to cross over totally.

Clinicians have bantered the thought of different sorts of inhibitory control. In any case, has, as far as anyone is concerned, not been talked about corresponding to explore on bilingualism. There have been a couple of endeavors to order various sorts of a Inhibition (see, for example, Dempster, 1993; Harnishfeger, 1995; and Nigg, 2000), and these various scientific classifications were probably brought together by Friedman and Miyake (2004). They list three sorts of Inhibition: protection from distractor obstruction, protection from proactive impedance (or PI), and prepotent reaction Inhibition.

Prepotent reaction inhibition is likely the most widely recognized comprehension of inhibition (Diamond, 2013). It indicates the capacity to stifle programmed reactions on the yield level, as one does in, for example, the verbal Stroop task where automatized abilities to understand should be restrained to zero in on the assignment. Protection from distractor impedance, which happens at a perceptual phase of handling, is "the capacity to oppose or determine impedance from data in the outside climate that is immaterial to the main job" (Miyake and Friedman, 2004, p. 104). This can be exemplified with, for example, disregarding the distractor bolts of the flanker task or disregarding the plain tone in the visual Stroop task. Protection from proactive obstruction, otherwise called mental Inhibition (Diamond, 2013), is the capacity to oppose memory obstruction of beforehand important data while playing out an errand. This can be exemplified by complying with an adjustment of rules while playing out an errand and limiting obstruction from the disposed of rules. Mental Inhibition occurs on the halfway handling level, for example, in working memory.

An inert variable investigation of the three Inhibition types done by Friedman and Miyake (2004) uncovered a connection between prepotent reaction restraint and protection from distractor obstruction, though mental Inhibition was viewed as inconsequential to the next two. Their decision was that this demonstrates that what could be called Response-Distractor restraint is detachable from mental Inhibition. The last option could be connected with other parts of insight - probable working memory and mental adaptability. Considering that there are no less than two divisible parts of Inhibition, it is worth examining how much the various kinds are engaged with bilingual handling. Reaction Distractor impedance is the consolidated capacity to disregard unessential outside boosts and repress automatized reactions (Diamond, 2013; Friedman & Miyake, 2004), while mental Inhibition is characterized as the concealment of prepotent mental portrayals or restraint of considerations and recollections (Diamond, 2013). Consistent then to expect to be just any restraint occurring because equal actuation of at least two dialects would have more to do with mental restraint than with reaction distractor impedance. If so, the undertakings that are now used to gauge restraint (generally reaction distractor impedance errands) would not be guaranteed to identify contrasts relating to any gainful impact this inhibitory practice could have. Assuming it is the situation that the impact of bilingualism on reaction distractor Inhibition is restricted, it very well may be addressed why a few investigations have found an impact while utilizing undertakings taking advantage of this sort of inhibitory control. One clarification could be that task intricacy would likewise require more of the other EFs. Task intricacy has had all the earmarks of being significant in requests to track down a bilingual benefit. Maybe this expanded intricacy, as a rule, implies that fruitful presentation on an errand positively requires the work of other mental capacities, like observing or refreshing. I have, as of now, examined the significance of checking with regards to the Flanker task, and it would show up possible that this is likewise important in other reaction distractor undertakings.

While returning to the meaning of mental Inhibition and the meanings of refreshing and moving, there is a connection between mental restraint and the two different variables. Mental restraint is available in moving, as per Miyake et al.,

(2000), who depicts moving as comprising of the components task separation + task commitment + mental Inhibition (alluded to as protection from proactive impedance). Likewise, it would create the impression that mental Inhibition is required to be fruitful at the update, as one would need to forestall the interruption of already significant data into the refreshed content of working memory (Diamond, 2013). It is likewise discussed whether Inhibition is, as a matter of fact, detachable from refreshing or not (see Diamond, 2013 for a short outline). The firmly interwoven connections among Inhibition and the other EF factors show the intricacy of mental designs and underline the troubles related to unraveling the parts by estimating every one of them as a different substance.

The job of Inhibition is now bantered on a few grounds, and apparently, there is a rising measure of proof recommending that it isn't quite so significant as first suspected (see, for example, segment 1.6.6). If there is a probability of the essential pieces of restraint being intently connected with a refreshing and moving, it might seem OK to focus more on these capacities later on and continue investigating the job of observing.

3.2.3 Shifting

Two tasks were utilized to gauge shifting capacities, yet neither yielded tremendous results. Moreover, the connection between the addition to minor undertaking and the utilization and capability factors showed a positive relationship (demonstrative that a more significant level of bilingualism would be connected with more unfortunate execution on the assignment) instead of the usual negative relationship. There are no less than two potential clarifications for this unforeseen outcome. Right off the bat, the interest added to the assignment by number juggling activities brings about eccentric examples of execution, cf., the task Impurity. In addition to the fact that performance is in this task reliant upon moving, yet in addition on number juggling abilities. Fluctuating skills in basic mental computation could add to the multiple performing tasks requested of this undertaking to the degree that results no longer rely enough upon moving to see an impact of bilingualism. Also, while this undertaking is frequently depicted as non-

verbal, it tends to be addressed to which degree comprehension of numbers should be visible as discrete from language (see, for example, Spaepen et al., 2011). If the handling of numbers draws on similar frameworks as verbal handling, almost certainly, bilinguals will be adversely impacted by this.

The non-verbal angle could likewise be talked about for the TMT. It was not extraordinary for members to murmur under their breaths (for example, A-1, B-2, and so on) as they obliged the undertaking. Notwithstanding, this ought to most likely be deciphered as a conscious decision by the members to work with task execution, and reasonable that the beneficial impact of this would offset the potential adverse consequence of lexical handling. Once more, however, this represents the idea that the work of techniques beyond chief control probably implies that task execution is intelligent far beyond EF capacities.

More significant in this specific situation, be that as it may, are the potential justifications for why the outcomes neglect to show any impact of bilingualism on moving skills. It might have to do with the examples of purpose for the different dialects in the collection of the members: From our poll, we viewed that a large portion of the members involved their at least two dialects in discrete spaces, or in what Green and Abutalebi (2013) allude to as single-language settings. These are language designs in which every language is utilized in different circumstances - for example, English for work and Norwegian for home, and maybe some German on vacation. The semantic requests that add to a moving skill are not guaranteed to be entirely introduced in these circumstances. In their versatile control speculation, Green and Abutalebi recorded the conceivable contrasts in mental interest for three sorts of language settings (single language, dual language, and thick code-exchanging), speculating that the distinction prevalent causes mental control cycles to need to be adjusted. As such, speakers would require contrasting versatile examples, contingent upon which situation(s) they participate in. The most requesting circumstance regarding task separation and errand commitment (center elements of moving) would be a double language setting (for example, one in which the two dialects are utilized in a similar setting yet with various speakers).

Subsequently, it is possible that bilingual speakers, for the most part participating in single-language settings, do not get a similar measure of training in popular exchanging between dialects as those in dual language settings, maybe bringing about less improved moving abilities. Nonetheless, the adaptive control hypothesis must still be in a fundamental stage (Bialystok, 2017). Further examination is required to see if the speculation can track down help in exact proof.

3.2.4 The importance of use: practice makes perfect?

A significant thought in the plan of this study was the part of purpose versus capability. In zeroing in on the full range of L2 use instead of taking a dichotomous or unmitigated way to deal with bilingualism, the objective was to investigate the impact of a measure of purpose on EF capacities. The outcomes gave no tremendous impacts, even though there was a very feeble propensity of purpose being more unequivocally associated with further developed EF than what capability is.

It is legitimate to expect use as a more significant variable than capability (albeit the two are firmly connected) in light of the presumption that the bilingual benefit has to do with a training impact. This theory follows that more use would give more practice, which would prompt better EF. There are a few issues connected with training and automatization that ought likewise to be considered. What is more, we will frame these in the rest of this segment.

A concentrate by Bak, Long, Vega-Mendoza, and Sorace (2016) researched the effect of concentrated language learning on consideration. Utilizing a pre-test/post-test plan, the member gathering and control bunches were tried utilizing the TEA hear-able subtest set Elevator counting, which estimates attentional restraint (correspondingly to the Flanker task) and attentional moving.

They found that after just seven days of escalated language learning, members showed further developed execution on the moving undertaking, however, not on the Inhibition task.

These discoveries recommend that there is for sure something in the language educational experience that invigorates moving capacities and gives some training impact. Different investigations have found that EF can be deliberately prepared through different projects, for example, mechanized preparing, intuitive games, or explicitly planned additional items to school educational programs (see Diamond, 2013 for the broad rundown). In any case, these examinations likewise tracked down that there gives off an impression of being a few limits with the impacts of EF preparing: to see an impact, not just is there a requirement for rehashed practice, but a constant expansion in trouble. This need could be a consequence of the fake preparation circumstance. Playing a similar degree of trouble in a PC game would ultimately get exhausting, making a slip by of focus put a stop to the preparation impact. Notwithstanding, it appears to be sensible to expect that the requirement for steadily expanding trouble could be summed up as usually happening EF preparing: all things considered, it is through slowly dominating new degrees of trouble that we foster new abilities (Diamond,

2013).

Utilizing EF takes up assets, so recognizable activities become automatized to let loose working memory limits concerning other things (see Diamond, 2013; Green & Abutalebi, 2013). While gaining some new practical knowledge (for example, moving a vehicle into a tight carport), EF is utilized to empower us to remain in charge of the circumstance. Whenever we have stopped in this carport several times, the activities required become automatized, and we never again need EF altogether to effectively play out the assignment (in actuality; whenever you have automatized precisely how far to back up and the number of degrees to turn the guiding wheel, placing any thought into it whatsoever will probably entangle the cycle; see Diamond, 2013). Rehashed practice will make most recognizable activities be automatized and "second nature." In this way, for an accomplished bilingual, apparently possible that additional command over one's dialects this way will be automatized. When playing out the TMT, the test of productive moving is observable, and it seems clear to the individual playing out the task that additional

assets are utilized to monitor things. Then again, in most circumstances, the language we produce arises quickly - essentially given a certain level of capability. Just in unique circumstances, for instance, considering this, two inquiries give off an impression of being pertinent:

1. When a specific degree of capability is reached, and one has become used to the language exchanging circumstances pertinent to one's life, how much is EF utilized to control the utilization of a bilingual's dialects? What is more, connected with this: in the event that there is a limit, where could it be?

2. EF can be improved because of training, yet how long does this upgrade last? Does preparing to leave an enduring engraving on EF, or will rehearse, must be expected in request to keep EF execution up to a similar level? As far as anyone is concerned, these inquiries stay unanswered. From one perspective, we theorize bilingualism and other intellectually improving exercises might add to mental hold a kind of reinforcement asset that might help us on account of mental or brain disability or decline (for example, dementia, see Valian, 2015). Then again, we likewise make sense of the absence of brings about bunches comprising of more youthful individuals with a high measure of intellectually enhancing

exercises - inferring that at any rate, a portion of the beneficial impact dies down with time, assuming one does not continue to rehearse. It is possible that the distinctions between youthful and old have more to do with general mental deterioration (for example, a normally happening improvement of the cerebrum and its working). In any case, how the two contentions are utilized shows that there is still a ton to find out about how EF is impacted by training. It ought to be sure that there are somewhere around two sorts of circumstances in which language creation is muddled because of bilingualism: issues, first and foremost, connected with capability, either because of a lower L2 capability in general or because involving L2 in a new space or a new setting. Furthermore, a more mind-boggling language circumstance because of the utilization of a few dialects in a similar setting. Probable that the following situation would utilize EF to screen what is happening and effectively switch between dialects. This is additionally the hypothesis of Green

and Abutalebi's adaptive control hypothesis. They conjecture that such dual language circumstances present the most appeal to the control processes required to prevail in language creation.

Following this, it very well may be estimated that a bilingual benefit would be bound to show up in bilinguals who are not exceptionally capable in both (or all) dialects, or in bilinguals who regularly partake in double language circumstances, for instance, translators.

3.3 Limitations and future directions

In this section, we will discuss the limitations of the study and what could be done in the future in order to avoid issues which have or may have affected this study. We will begin by addressing limitations concerning data collection procedures and ending with analyses.

3.3.1 Procedures

A likely issue with investigations of this sort is their dependence on self-detailing. For this review, members evaluated their L2 capability in the modalities of talking, tuning in, perusing, and composing on scales from 1-to 10. This is, obviously, not an objective method for estimating capability, which was exhibited by the members' self-detailed scores in Algerians. They were requested to rate their capacities in all dialects they talked contrasted with the skill of a local speaker and keeping in mind that the majority of them revealed 10 (total score) on all modalities in Arabic, there was likewise a significant number which revealed less - some even as low as 7 – even. However, they were all local speakers. The irregularity in the announcing mirrors the subjectivity and reaction predisposition, making self-detailing a less solid wellspring of data. Almost certainly, the members' understanding of the scales concerning their L2 capability is more changed than Algerians capability. Subsequently, the L2 scores have a higher gamble of being impacted by reaction predisposition. Even though reaction inclination is a known issue, utilizing self-answering to get an intermediary of language capability is generally expected in investigations (see, for example, Luk & Bialystok, 2013).

This is because dispassionately testing the language abilities of every individual in each of their dialects in a moderately enormous example is not plausible because of both time limitations and the absence of assets. For instance, there are not an adequate number of state-sanctioned tests across dialects from which we can acquire reliable scores, and the tests that do exist are frequently deciphered. It is frequently compromised: interpreting tests are risky by implying their quality in various ways (see Peña, 2007). Be that as it may, a choice in this setting could have been to test the members in English (which we realize that every one of them would be generally capable of) utilizing a state-sanctioned test, and afterward correspond the consequences of the test with their self-revealed capability levels. This would have provided us with a sign of the unwavering quality of our announced scores (Luk & Bialystok, 2013).

The second point I need to specify in this setting is the selection of errands. We have addressed the verbal/non-verbal nature of the errands and how undertakings that are not explicitly verbal still use types of verbal handling. In actuality, the principal undertaking utilized in concentrating on some verbal way of behaving was not likely, was the Flanker task. Any remaining assignments had some chance of verbal substance. We have proactively examined this for the TMT and plus-minus task. The visual Stroop task chosen explicitly for its non-verbal design is a variety based - driving numerous members to mouth or mumble a variety of names softly for arranging. While the verbal substance of these errands is unique to that of the verbal Stroop task (where words make up the diverting component), it appears glaringly evident that there is some verbal handling going on, essentially for some members. For future investigations, it very well may be valuable to survey the chance of this sort of verbal impedance in undertakings, and to utilize errands where the gamble of this is negligible, for example, the Flanker task or the lift counting task from the Test of Everyday Attention. Tasks in which expressing works with execution ought to presumably be kept away from on the off chance that one is attempting to limit the impact of a verbal burden.

3.3.2 Analysis

The utilization of a correlational examination was finished to investigate the singular connections between factors reasonably and essentially. The enormous number of factors profoundly expands the gamble of a kind I blunder (bogus positive) without p-esteem change. On the other hand, P-esteem change is additionally inconvenient, as it decreases real power and expands the chance of type II blunders or bogus negatives (Field et al., 2012). This study utilized the Holm-Bonferroni technique, which is less moderate than the Bonferroni strategy. However, with an enormous number of relationships, the deficiency of measurable power is extraordinary in any case. Therefore, correlational examinations may not be ideal for dealing with such a piece of information. We might want to stress that just a single relationship was critical previously changing in this specific case, particularly that between worldwide Flanker RT and RPM execution. The relationship between these factors was not crucial for the examination questions, and subsequently, p-esteem change has not altogether adjusted the result of this review.

Direct relapses were additionally utilized to make more solid correlations. It ought to be noticed that while the aftereffects of this specific review did not yield importance, it might be those other measurable strategies. For example, blended impact models could yield various outcomes. Different types of examinations will be done on similar information later on to investigate this further.

3.4 Conclusion and further implications

The effects of this examine do now no longer offer proof for a bilingual advantage. The loss of vast effects approach that the information from this examine does now no longer lend aid to any of the preliminary hypotheses, despite the fact that there are a few susceptible inclinations that seem to suit the predicted pattern. The information suggests symptoms of a ceiling impact, that means that a excessive usual overall performance can also additionally have avoided the emergence of any variations bearing on bilingualism status. If that is the case, following up on those contributors at a later factor in time, e.g., after they have got old, would possibly

display different outcomes. This could additionally be precious as a way to similarly discover the function of bilingualism when it comes to cognitive decline, in addition to the consequences of aging on EF.

In the dialogue we even have additionally pointed to different troubles which make contributions to complicating the detection of a bilingual advantage. Firstly, the mission impurity problem, which on this context changed into maximum significantly contemplated withinside the verbal processing worried in responsibilities which might be in precept taken into consideration non-verbal. In aggregate with different elements which includes motor abilities and perceptual abilities, this interferes with the investigation overall performance and makes it tough to make sure that we're absolutely checking out what we intend on checking out. Secondly, we even have mentioned the function of inhibition. In mild of numerous theoretical factors of view, we argued that it is far probably that the significance of inhibition has been particularly exaggerated, and we cautioned rather improved attention on shifting, updating, and monitoring. Finally, we mentioned the relevance of exercise vs. automatization, and problematized the area of bilingualism as a contributor to EF. We argued that the locus of interest has to be at the language use styles of bilinguals, due to the fact regularly converting languages inside a context is much more likely to have an effect on EF than the use of separate languages for separate situations. For further research, it'd hence be critical to attention now to no longer only emphasis on linguistic abilities but also on quantity of L2 use, additionally to language switching styles of the sample. It may be questioned, however, how that is better performed in exercise: even as getting a participant`s estimate on their usual proportional language use can offer us with a reasonably dependable proxy, the use of self-reporting as a way to get an outline of language use forms can also additionally offer much less dependable information, because the improved degree of element could imply extra room for error.

A ceiling impact can also additionally provide an explanation for the shortage of findings and the small impact sizes, and hence, the outcome of this exploration does not negate the advantage of bilingualism. Furthermore, Bak (2016b) compared

bilingualism research to clinical research, wherein it is been discovered that small consequences detected in lab settings could have large consequences for patients withinside the actual world. Bak said that this could additionally be real for bilingualism, and that slightly measurable variations in cognitive exams might have extra implications in the contribution of bilingualism to e.g., cognitive reserve and useful consequences on cognition withinside the lengthy run, for instance in the context of slowing down cognitive deterioration.

It is more and more becoming clear that the variety of circumstances play a role in finding different results depending on the diversity of factors that can favor the argument of bilingual advantage. Especially, when the setting of study is about language, and in Algeria. Bak (2016a) describes the repetition problem of bilingualism studies using comparison to the boiling temperature of water. As the atmospheric pressure decreases, the boiling point of water decreases as the altitude increases. If we conducted experiments at the boiling point of water and only in London, Oslo, New York, Tokyo, etc., we came to the conclusion that water boils at 100 ° C, which is very surprising to Lapas or scientists. increase. Results for all other higher cities reported that water boils at 90 ° C. This different result is neither due to an error nor invalidating other results. This is the result of measurements made in different environments. According to this train of thought, problems related to the multiplication of bilingualism study do not necessarily deny the existence of an effect but may indicate that it does not show effect in all situations.

As a result, repeating the same experiment in the same environment and counting the number of such repetitions does not bring us closer to the truth. We need to compare the results in different environments (Bak, 2016a, p. 710). Therefore, by further investigating, optimizing the situation, and further clarifying the factors that influence the results, we can understand the true cognitive impact of bilingualism.

References

Anastasiou CA, Yannakoulia M, Kosmidis MH, Dardiotis E, Hadjigeorgiou GM, Sakka P, et

al. (2017). Mediterranean diet and cognitive health: Initial results from the Hellenic

Longitudinal Investigation of Ageing and Diet. PLoS ONE 12(8): e0182048.

Antón, E., Duñabeitia, J. A., Estévez, A., Hernández, J. A., Castillo, A., Fuentes, L. J., et al.

(2014). Is there a bilingual advantage in the ANT task? Evidence from children.

Frontiers in Psychology, 5, 398.

Army Individual Test Battery (1944). Manual of Directions and Scoring. Washington, DC:

War Department, Adjutant General's Office.

Astill, R. G., Van der Heijden, K. B., Van IJzendoorn, M. H., & Van Someren, E. J. W.

(2012). Sleep, cognition, and behavioral problems in school-age children: A century of

research meta-analyzed. Psychological Bulletin, 138(6), 1109-1138.

Baddeley, A. D. (1986). Working memory. Oxford University Press. New York.

Baddeley, A. D. & Hitch, G. (1974). Working memory. In G. H. Bower (Ed.) The psychology

of learning and motivation, 8, 47 – 89. Academic Press. New York.

Bak, T. H. (2016a). Cooking pasta in La Paz. Bilingualism, bias and the replication crisis.

Linguistic Approaches to Bilingualism, 6, 699-717.

Bak, T. H. (2016b). The impact of bilingualism on cognitive aging and dementia. Finding a path through a forest of confounding variables. Linguistic Approaches to Bilingualism, 6:1/2, 205-226.

Bak, T. H., Long, M. R., Vega-Mendoza, M., Sorace, A. (2016) Novelty, Challenge, and Practice: The Impact of Intensive Language Learning on Attentional Functions. PLoS ONE 11(4): e0153485.

Bak, T. H., Vega-Mendoza, M. & Sorace, A. (2014). Never too late? An advantage on tests of auditory attention extends to late bilinguals. Frontiers in Psychology, 5, 485

Bialystok, E. (1988). Levels of Bilingualism and Levels of Linguistic Awareness.

Developmental Psychology, 24(4). 560-567.

Bialystok, E. (2001). Bilingualism in Development. Language, Literacy, & Cognition. Cambridge University Press. Cambridge.

Bialystok, E. (2017). The Bilingual Adaptation: How Minds Accommodate Experience.

Psychological Bulletin, 143(3). 233-262

Bialystok, E. & Craik, F. I. (2010): Cognitive and linguistic processing in the bilingual mind. Current Directions in Psychological Science, 19(1). 19-23.

Bialystok, E., & Martin, M. M. (2004). Attention and inhibition in bilingual children: Evidence from the dimensional change card sort task. Developmental Science, 7, 325–339.

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

Bialystok, E., Craik, F., & Luk, G. (2008). Cognitive control and lexical access in younger

and older bilinguals. Journal of Experimental Psychology: Learning, Memory, and

Cognition, 34, 859–873.

Bialystok, E., & DePape, A. M. (2009). Musical expertise, bilingualism, and executive functioning. Journal of Experimental Psychology: Human Perception and Performance, 35(2), 565–574.

Bialystok, E., & Luk, G. (2012). Receptive vocabulary differences in monolingual and bilingual adults. Bilingualism: Language and Cognition, 15(2), 397–401.

Bialystok, E., Martin, M. M., & Viswanathan, M. (2005). Bilingualism across the lifespan: The rise and fall of inhibitory control. The International Journal of Bilingualism, 9, 103–119.

Bialystok, E., Poarch, G., Luo, L., & Craik, F. I. (2014). Effects of bilingualism and aging on executive function and working memory. Psychology and Aging, 29, 696–705.

Bloomfield, Leonard (1933): Language. Allen & Unwin LTD. London.

Brito, N., & Barr, R. (2012). Influence of bilingualism on memory generalization during infancy. Developmental Science, 15, 812–816.

Burgess, P. W. (1997). Theory and methodology in executive function research. In P. Rabbitt (Ed.), Methodology of frontal and executive function. Psychology Press. Hove.

Campbell, A. M., Davalos, D. B., McCabe, D. P, & Troup, L. J. (2011). Executive functions and extraversion. Personality and individual differences, 51. 720-725.

Carroll, D. W. (2008). Psychology of Language. 5th edition. Thomson Wadsworth. Belmont, CA.

Costa, A. (2005). Lexical Access in Bilingual Production. In Kroll & de Groot (ed.):

Handbook of Bilingualism. Psycholinguistic approaches. Oxford University Press. New

York.

Costa, A., Caramazza, A., & Sebastián-Gallés, N. (2000). The cognate facilitation effect:

Implications for models of lexical access. Journal of Experimental Psychology:

Learning, Memory, and Cognition, 26, 1283–1296.

Costa, A., Hernández, M., & Sebastián-Gallés, N. (2008). Bilingualism aids conflict

resolution: Evidence from the ANT task. Cognition, 106, 59-86.

Costa, A., Hernández, M., Costa-Faidella, J., & Sebastián- Gallés, N. (2009). On the bilingual

advantage in conflict processing: Now you see it, now you do not. Cognition, 113 (2), 135–149.

Craik, F. I. M. (2017). Cognitive problems in older adults: Can bilingualism help? In:

Bialystok, E. & Sullivan, M. D. (ed.): Growing Old with Two Languages. Effects of

Bilingualism on Cognitive Aging. John Benjamins Publishing Company.

Amsterdam/Philadelphia.

de Bruin A., Bak, T. H., & Della Sala, S. (2015). Examining the effects of active versus inactive bilingualism on executive control in a carefully matched non-immigrant sample. Journal of Memory and Language, 85, 15-26.

de Bruin, A., Treccani, B., & Della Sala, S. (2015). Cognitive advantage in bilingualism: an example of publication bias? Psychological Science, 26, 99-107.

Dell, G. S. (1986). A spreading-activation theory of retrieval in sentence production. Psychological Review, 93(3), 283-321.

Dempster, F. N. (1993). Resistance to interference: Developmental changes in a basic processing dimension. In M. L. Howe & R. Pasnak (Eds.), Emerging themes in cognitive development. Vol. 1: Foundations (pp. 3–27). Springer–Verlag. New York.

Diamond, A. (2013). Executive functions. Annual Review of Psychology, 64, 135-168.

Diamond A. & Lee K. (2011). Interventions and programs demonstrated to aid executive function development in children 4–12 years of age. Science 333, 959–64

Duñabeitia, J. A. & Carreiras, M. (2015). The bilingual advantage: Acta est fabula. Cortex, 73, 371-372.

Duñabeitia, J. A., Hernández, J. A., Antón, E., Macizo, P., Estévez, A., Fuentes, L. J., Carreiras, M. (2014). The inhibitory advantage in bilingual children revisited, myth or reality? Experimental Psychology, 61, 234-251.

Eriksen, B. A. & Eriksen, C. W. (1974). Effects of noise letters upon identification of a target letter in a non-search task. Perception and Psychophysics, 16, 143-149.

Field, A., Miles, J. & Field, Z. (2012). Discovering statistics using R. Sage.

Friedman, N. P & Miyake, A. (2004). The Relations Among Inhibition and Interference Control Functions: A Latent-Variable Analysis. Journal of Experimental Psychology: General, 133-1. 101-135.

Friedman, N. P. & Miyake, A. (2017). Unity and diversity of executive functions: Individual differences as a window on cognitive structure. Cortex, 86, 186-204.

Fuller-Thomson, E., & Kuh, D. (2014). The healthy migrant effect may confound the link between bilingualism and delayed onset of Alzheimer's disease. Cortex, 52, 128–130.

Galletly, C. A., MacFarlane, A. S., & Clark, C. R. (2007). Impaired updating of working memory in schizophrenia. International Journal of Psychophysiology, 63, 265–274.

Gogolin, I. (1997). The “monolingual habitus” as the common feature in teaching in the language of the majority in different countries. Per Linguam, 13(2), 38–49.

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

Green, D. W., & Abutalebi, J. (2013). Language control in bilinguals: The adaptive control hypothesis. Journal of Cognitive Psychology, 25, 515– 530.

Green, S. C., Sugarman, M. A., Medford, K., Klobusicky, E. & Bavelier, D. (2012). The effect of action video game experience on task-switching. Computers in Human Behavior, 28(3), 984–994.

Greenland, S., Senn, S.J., Rothman, K.J., Carlin, J. B., Poole, C., Goodman, S. N., & Altman, D. G. (2016). Statistical tests, P values, confidence intervals, and power: a guide to misinterpretations. European Journal of Epidemiology, 31(4), 337-350.

Grosjean, F. (2008). Studying Bilinguals. Oxford University Press. Oxford.

Grosjean, F. (2013). Bilingualism: A Short Introduction. In Grosjean, F. & Li, P.: The Psycholinguistics of Bilingualism. Wiley-Blackwell. West Sussex.

Grundy, J. G., Chung-Fat-Yim, A., Friesen, D. C., Mak, L., & Bialystok, E. (2017). Sequential congruency effects reveal differences in disengagement of attention for monolingual and bilingual young adults. Cognition, 163. 42–55.

Hakuta, K. (1986). Mirror of Language. The Debate on Bilingualism. Basic Books, Inc. New York.

Hallett, P. E. (1978). Primary and secondary saccades to goals defined by instructions. Vision Research, 18, 1279 –1296.

Harnishfeger, K. K. (1995). The development of cognitive inhibition: Theories, definitions, and research evidence. In F. N. Dempster & C. J. Brainerd (Eds.), Interference and inhibition in cognition (pp. 175–204). Academic Press. San Diego, CA.

Haugen, E. (1953). The Norwegian language in America: A study of bilingual behavior. University of Pennsylvanina Press. Philadelphia.

Hilchey, M., & Klein, R. (2011). Are there bilingual advantages on nonlinguistic interference tasks? Implications for the plasticity of executive control processes. Psychonomics Bulletin & Review, 18, 625–658.

Hilchey, M. D., Saint-Aubin, J., & Klein, R. M. (2015). Does bilingual exercise enhance cognitive fitness in non-linguistic executive processing tasks. In J. W. Schwieter (Ed.), Cambridge handbook of bilingual processing (pp. 586–613). Cambridge: Cambridge University Press.

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

Kavé, G., Eyal, N., Shorek, A., & Cohen-Mansfield, J. (2008). Multilingualism and cognitive state in the oldest old. Psychology and Aging, 23, 70–78.

Kirchner, W. K. (1958). Age differences in short term retention of rapidly changing information. Journal of Experimental Psychology, 55, 352– 358.

Koch, C. & Roid, G. (2012). A Nonverbal Stroop Task Assessment of Inhibition Among Children with Autism. Presented at National Academy of Neuropsychology.

Kovács, A. M., & Mehler, J. (2009). Cognitive gains in 7-month-old bilingual infants. Proceedings of the National Academy of Sciences of the United States of America, 106, 6556 – 6560.

La Heij, W. (2005). Selection processes in Monolingual and Bilingual Lexical Access. In

Kroll & de Groot (ed.): Handbook of Bilingualism. Psycholinguistic approaches.

Oxford University Press. New York.

Lehtonen, M., Soveri, A., Laine, A., Järvenpää, J., de Bruin, A., & Antfolk, J. (2018). Is bilingualism associated with enhanced executive functioning in adults? A meta-analytic review. Psychological Bulletin, 144(4), 394-425.

Luk, G. & Bialystok, E. (2013). Bilingualism is not a categorical variable: Interaction

between language proficiency and usage. Journal of Cognitive Psychology, 25:5, 605- 621.

Luk, G., De Sa, E., & Bialystok, E. (2011). Is there a relation between onset age of bilingualism and enhancement of cognitive control? Bilingualism: Language and Cognition, 14, 588–595.

Marian, V., Spivey, M., & Hirsch, J. (2003). Shared and separate systems in bilingual language processing: Converging evidence from eyetracking and brain imaging. Brain and Language, 86, 70-82.

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

Miyake, A., & Friedman, N. P. (2012). The nature and organization of individual differences in executive functions: four general conclusions. Current Directions in Psychological Science, 21, 8-14.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex ‘‘frontal lobe’’ tasks: A latent variable analysis. Cognitive Psychology, 41, 49– 100.

Morris, N., & Jones, D. M. (1990). Memory updating in working memory: The role of the central executive. British Journal of Psychology, 81, 111–121.

Nigg, J. T. (2000). On inhibition/disinhibition in developmental psycho- pathology: Views from cognitive and personality psychology and a working inhibition taxonomy. Psychological Bulletin, 126, 220–246.

Norman, D. A. & Shallice, T. (1986). Attention to action: Willed and automatic control of behaviour. In R. J. Davidson, G. E. Schwartz & D. Shapiro (eds.), Consciousness & self-regulation, 4, 1–18. Plenum Press. New York.

Paap, K. R., & Greenberg, Z. I. (2013). There is no coherent evidence for a bilingual advantage in executive processing. Cognitive Psychology, 66, 232-258.

Paap, K. R., Johnson, H. A., & Sawi, O. (2014). Are bilingual advantages dependent upon specific tasks or specific bilingual experiences? Journal of Cognitive Psychology, 26(6), 615–639.

Paap, K. R., Johnson, H. A., & Sawi, O. (2015). Bilingual advantages in executive functioning either do not exist or are restricted to very specific and undetermined

circumstances. Cortex, 69, 265–278.

Paap, K. R., Johnson, H. A., & Sawi, O. (2016). Should the search for bilingual advantages in executive functioning continue? Cortex, 74(4), 305–314.

The test of everyday attention (TEA). Bury St. Edmonds, United Kingdom: Thames

Valley Test Company.

Rosenthal, R. (1979). The file drawer problem and tolerance for null results. Psychological Bulletin, 86, 638-641

Simon, J. R., & Rudell, A. P. (1967). Auditory S-R compatibility: The effect of an irrelevant cue on information processing. Journal of Applied Psychology, 51, 300–304.

Singh, L., Fu, C., Rahman, A., Hameed, W., Sanmugam, S., Agarwal, P., Jiang, B., Chong,

Y., Meaney, M. J., & Rifkin-Graboi, A. (2015). Back to basics: A bilingual advantage in infant visual habituation. Child Development, 86, 294–302.

Spaepen, E., Coppola, M., Spelke, E., Carey, S. & Goldin-Meadow, S. (2011). Number without a language model. Proceedings of the National Academy of Science of the United States of America, 108(8), 3163-3168.

Spector, A., & Biederman, I. (1976). Mental set and mental shift revisited. American Journal of Psychology, 89, 669–679.

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

Treccani, B., Argyri, E., Sorace, A., Della Sala, S. (2009). Spatial negative priming in bilingualism. Psychonomic Bulletin & Review, 16, 320–327.

Valian, V. (2015). Bilingualism and cognition. Bilingualism: Language and Cognition, 18, 3-24.

van Heuven, W. J. B., Schriefers, H., Dijkstra, T., & Hagoort, P. (2008). Language conflict in the bilingual brain. Cerebral Cortex, 8, 2706–2716.

Vega-Mendoza, M., West, H., Sorace, A., & Bak, T. H. (2015). The impact of late, nonbalanced bilingualism on cognitive performance. Cognition, 137, 40–46.

Verreyt, N., Woumans, E., Vandelanotte, D., Szmalec, A., & Duyck, W. (2016). The influence of language-switching experience on the bilingual executive control advantage. Bilingualism: Language and Cognition, 19, 181–190.

Wasserstein, R. L. & Lazar, N. A. (2016). The ASA's Statement on p-Values: Context, Process, and Purpose. The American Statistician, 70(2), 129-133

Weber, J. & Horner, K. (2012). Introducing Multilingualism: A social approach. Routledge. Oxon/New York.

Wu, Y. J., & Thierry, G. (2012). Unconscious translation during incidental foreign language processing. Neuroimage, 59, 3468–3473.

Language and Social Background Questionnaire

Today's Date:. 1-Sex: Male oFemale o

2-Student Status (current year of study):

3- Handedness: Left oRight o

4. Date of Birth:

5- Do you play first-person shooting (FPS)/action video games? Yes o No o

If yes, on average how many hours do you play per week? ……

6- Do you have hearing problems? Yes o No o

If yes, do you wear a hearing aid? Yes o No o

7- Do you have vision problems? Yes o No o

If yes, do you wear glasses or contacts? Yes o No o

Is your vision corrected to normal with glasses or contacts? Yes o No o

8- Are you colour blind? Yes o No o

If yes, what type? ……

9- Have you ever had a head injury Yes o No o

If yes, please explain:……

10- Do you have any known neurological impairments? (e.g., epilepsy etc)

Yes o No o

If yes, please indicate:

11- Are you currently taking any psychoactive medications? Yes o No o

If yes, please indicate:

12- Please indicate the highest level of education and occupation for each parent:

Mother	Father
1. No high school diploma 2. High school diploma 3. Some post-secondary education 4. Post-secondary degree or Diploma	1. No high school diploma 2. High school diploma 3. Some post-secondary education 4. Post-secondary degree or Diploma

5. Graduate or professional degree Occupation: First Language: Second Language Other Language:	5. Graduate or professional degree Occupation: First Language: Second Language Other Language:

13- Were you born in Algeria? Yes o No o

If no, where were you born?

When did you move to Algeria

Year

14- Have you ever lived in a place where Arabic is not the dominant communicating language? Yes o No o

If **yes**, where and for how long?

15. List all the language and dialects you can speak and understand including English, in order of

fluency:

Language	Where did you learn it?	At what age did you learn it? (If learned from birth, write age "0")	Were there any periods in your life when you did not use this language? Indicate duration in months/years.
1-	**O Home** **O School** **O Community** **oOther:**		
2-	**O Home** **O School**		

	O Community **oOther:**		
3-	**O Home** **O School** **O Community** **oOther:**		
4-	**O Home** **O School** **O Community** **oOther:**		

Relative to a highly proficient speaker's performance, rate your proficiency level on a scale of 0-

10 for the following activities conducted in English and your other language(s).

16- Arabic No Proficiency 0 High 5 Proficiency 10

English No Proficiency 0 High 5 Proficiency 10

French No Proficiency 0 High 5 Proficiency 10

Other Language No Proficiency 0 High 5 Proficiency 10

Community Language Use Behavior

17- Please indicate which language(s) you most frequently heard or used in the following life stages, both inside and outside home.

	All Arabic	Mostly Arabic	Half Arabic half other language	Mostly the other language	Only the other language
Infancy					
Preschool age					

Primary School age					
High school age					

18- Please indicate which language(s) you generally use when speaking to the following people.

	All Arabic	Mostly Arabic	Half Arabic half other language	Mostly the other language	Only the other language
Parents					
Siblings					
Grandparents					
Other Relatives					
Neighbors					
Friends					

19- Please indicate which language(s) you generally use in the following situations.

	All Arabic	Mostly Arabic	Half Arabic half other language	Mostly the other language	Only the other language
Home	Home	Home	Home	Home	Home
School					
Work					
Social activities (e.g., hanging out with friends)					

Shopping/ Restaurants/ Other commercial services					
Health care services/ Government/ Public offices/ Banks					

20-Please indicate which language(s) you generally use for the following activities.

	All Arabic	Mostly Arabic	Half Arabic half other language	Mostly the other language	Only the other language
Reading					
Emailing					
Texting					
Social media (e.g. Facebook, Twitter etc.)					
Writing shopping lists, notes, etc.					
Watching TV/ listening to radio					
Watching movies					
Browsing on the Internet					

21- Some people switch between the languages they know within a single conversation (i.e. while

speaking in one language they may use sentences or words from the other language). This is known as “language-switching”. Please indicate how often you engage in language-switching. If you do not know any language(s) other than English, fill in all the questions with 0, as appropriate.

	Never	Rarely	Sometimes	Frequently	Always
With parents and family					
With friends					
On social media (e.g., Facebook, Twitter)					

Thank you for participating!

Appendix B –

. **Table A** : Participants’ characteristics

	Mean (SD)	**Min**	**Max**
Male/female ratio	**11/19**		
age	**21.1**	**18**	**23**
Years of formal education	**15**	**13**	**17**
Starting age L2 aquisition	**7.5**	**7**	**9**
Raven’s matrices score	**7.89**	**6**	**9**
Flanker	**-0.052**		
Flanker Global RT	**-0.017**		
Verbal Stroop	**-0.022**		

Visual Stroop	**-0.046**		
TMT	**-0.066**		
Plus-minus	**0.101**		
Sport(h/w)	**2.3**	**1.5**	**3**
Computer games	**3.4**	**0.5**	**7**

SD = standard deviation. a Measured by the mean level of education of both parents. Level of education was indicated on a 5-point scale. b Number of correct items out of 9.