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Natural language switching and the future of the bilingual advantage hypothesis

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Chapter 1

Introduction

1.1 The Question of Bilingualism

In the field of psycholinguistics, the topic of bilingualism has always been a source of great interest and debate, as it is not immediately obvious by which factors and mechanisms bilingual speakers are able to speak each language separately. Theoretical models agree on the assumption that during the lexical access of one of the languages, words corresponding to the language not in use become activated to some extent (Hermans, Bongaerts, De Bot, & Schreuder, 1998). Given that both languages are initially activated, bilingualism production poses the question of how speakers are able to select the appropriate words according to the linguistic context in which they are embedded in such a quick and error-free fashion and in particular, how they are able to prevent the expression of words belonging to the non-target language.

1.2 The Adaptive Control Hypothesis

One popular explanation of this question is the existence of a suppression mechanism, as proposed by Meuter and Allport (1999) and later developed further in the adaptive control hypothesis proposed by Green and Abutalebi (2013). According to this model of language selection, both languages initially receive equal activation, at which point the non-target language is identified as interference and is inhibited by a suppression mechanism. As for on which level of language production this suppression occurs, Green and Abutalebi (2013) leave this question open.

From the adaptive control hypothesis, three key predictions naturally follow: first, bilingual speech is inherently more effortful both cognitively and behaviourally than monolingual speech. This additional effort is due to the activation of the suppression mechanism required by bilinguals. Second, the extent to which each language is inhibited is a factor of the speaker's

competence in that language. Specifically, the stronger the bilingual speaker's competence in a given language, the greater the suppression required to prevent its expression. Third, according to the bilingual advantage hypothesis, the bilingual speaker's increased use of language control mechanisms, such as the suppression mechanism, improves the general cognitive control system. The bilingual advantage hypothesis derives from the observed neurological overlap between language control and general domain executive control (Hervais-Adelman, Moser-Mercer, Michel & Golestani, 2015; Garbin, Sanjuan, Forn, Bustamante, Rodriguez-Pujadas et al., 2010).

The adaptive control hypothesis has received extensive empirical support from experimental studies. With regards to the hypothesis' first prediction, studies have shown that switching between languages in laboratory experiments results in slower response times (Costa & Santesteban, 2004) and increased brain activation (Rodriguez-Fornells, Rotte, Heinze et al., 2002). With regards to the hypothesis' second prediction, these switch costs have been shown to be asymmetrical. Response times are significantly slower when the speaker switches from their second language (L2) to their dominant language (L1) than they are when the switch is from L1 to L2 (Costa & Santesteban, 2004). This asymmetry makes sense according to the adaptive control hypothesis, which explains it as the additional time it takes to deactivate the suppression mechanism, which was in its most activated state when it was previously inhibiting L1 in order to produce L2. With regards to the hypothesis' third prediction, some studies have found that bilinguals perform better than monolinguals in a number of non-linguistic tasks that require switching between tasks, conflict resolution and suppression of irrelevant information, as well as decreased activation in executive control regions of the brain (Kroll & Bialystok, 2013). However, the empirical evidence regarding the bilingual advantage hypothesis is mixed, with equally substantial bodies of literature both supporting (Bialystok, 2007) and opposing its claims (Paap, Johnson & Sawi, 2015).

1.3 Interactional Contexts of Bilingualism

In the discussion of bilingualism it is crucial to bear in mind that there are different types of interactional contexts in which bilinguals typically find themselves, as identified by Green & Abutalebi (2013). One type of interactional context is called the single language context, in which each language is used in distinct and separate contexts. A second type, the dual language context refers to the context in which both languages are used, but not interchangeably, meaning that language switches are frequently prompted by external circumstances. Within this context, the speaker typically communicates in different languages with different people. A third type is the dense code-switching context, in which known languages can be used interchangeably. In this context, the conversation's participants share two languages and the speaker is free to employ both languages and switch languages as they wish.

Green and Abutalebi (2013) proposed that each of these three contexts may engage 8 different processes of cognitive control. The single language context engages 3 processes: Goal maintenance, conflict monitoring and interference suppression. The dual language context is the most cognitively demanding, engaging 7 cognitive control processes: Goal maintenance, conflict monitoring, interference suppression, salient cue detection, selective response inhibition, task disengagement and task engagement. On the other hand, the dense code-switching context engages only the opportunistic planning process. Importantly, Green and Abutalebi (2013) predict language switch costs in all 3 contexts.

1.4 Contributions of Blanco-Elorrieta and colleagues

In more recent years, the work of Blanco-Elorrieta and Pylkkänen (2017) has provided both empirical support and criticism of the adaptive control hypothesis. Specifically, Blanco-Elorrieta and Pylkkänen (2017) have identified that *"language control processes adapt to the demands of the interactional context"* (pp. 9034) in the case of the dual language context, as predicted by Green and Abutalebi (2013). However, in contrast with the prediction of Green and

Abutalebi (2013) that dense code-switching contexts are inherently costly, Blanco-Elorrieta and Pylkkänen (2017) found that language switch costs were entirely absent in both a naturalistic production task at a single-word level and in a comprehension task at a conversational level.

In addition to their contributions regarding the adaptive control hypothesis of Green and Abutalebi (2013), Blanco-Elorrieta and Pylkkänen (2017) propose a more naturalistic paradigm to study language switching. Traditionally, language switches are studied with *"artificial switching paradigms, in which bilingual individuals are asked to name a picture or a number in one or another language as prompted by an external cue displayed on the screen"* (pp.1117, Blanco-Elorrieta and Pylkkänen, 2018) and the relationship between the cue and the target language is arbitrary. On the other hand, Blanco-Elorrieta and Pylkkänen (2017) propose more realistic and intuitive cues, leading to the finding that switch costs in a dual language context are particularly sensitive to different salient cues.

1.5 Scope of the dissertation

Considering the latest developments of research on language switching, this thesis dissertation aims to review the innovative proposals of Blanco-Elorrieta and their colleagues regarding the effects of interactional contexts on switch costs and their significance in understanding the bilingual advantage hypothesis by illustrating their proposals with two of their articles on the subject:

First, the empirical study *"Bilingual Language Switching in the Laboratory versus in the Wild: The Spatiotemporal Dynamics of Adaptive Language Control"* by Blanco-Elorrieta E. and Pylkkänen L. (2017). This study identifies a reduction of switch costs in realistic conditions in comparison with those observed in the traditional switching paradigm, as well as the absence of switch costs in a dense code-switching context.

Second, the theoretical article *"On the need for theoretically guided approaches to possible bilingual advantages: An evaluation of the potential loci in the language and executive control systems"* by Blanco-Elorrieta E. and Caramazza

A. (2021). This article evaluates potential sources for a bilingual advantage and evaluates its compatibility with a variety of proposed language selection models.

The ultimate aim of this dissertation is to propose a review of the articles and contextualize them within the existing literature in order to identify their contributions, their limits and potentially fruitful pathways of future research.

Chapter 2

Bilingual Language Switching in the Laboratory versus in the Wild

2.1 Experimental objectives and methods

A great deal of previous research has identified the prefrontal cortex and the anterior cingulate cortex (ACC) as primary centres of language control networks (Rodriguez-Fornells et al., 2002). In addition, these same areas have been identified as key components of general cognitive control (Macdonald, Cohen, Stenger & Carter, 2000), leading to the proposal that language switching may be performed in a qualitatively similar way as non-linguistic task switching. Specifically, the proposal that language switching can improve task switching performance relies on the premise that both forms of switching are neurologically effortful. Non-linguistic task switching has indeed been found to be inherently costly (Wylie & Allport, 2000), whereas the finding that language switching is inherently costly remains debatable, as discussed previously. One reason why the finding that language switching is effortful remains controversial is that it contrasts with bilinguals' intuitive observation that switching is convenient and natural when with other bilingual conversation partners (Kleinman & Gollan, 2016). It is therefore striking that laboratory results conflict with bilinguals' personal experience. For this reason, the authors call into question the external validity of the typical laboratory paradigms used to investigate language switching.

In this experiment, 19 right-handed native Arabic speakers (8 male, 11 female) of an adult age with a high knowledge of English participated. In each experimental context, participants looked at a screen which presented a cue, indicating the target language of their response. The experiment consisted of 3 scenarios which varied based on the type of cue presented (Fig. 1):

1. The bilingual interlocutor context, in which the participants were presented with a picture of a bilingual interlocutor. The image of the interlocutor was presented on an iPhone call screen to make the

scenario more realistic. In this context, participants could perform the trial in the language of their choice and with the freedom to switch.

2. The monolingual interlocutor context, in which the participants were presented with a picture of a monolingual interlocutor. When the participant was cued with a picture of a monolingual interlocutor, they could perform the trial only in the language understood by the monolingual presented.

3. The colour cued context, in which the participants were presented with a green or red square. The colour of the square arbitrarily indicated the target language. When the square presented was green, the target language was English, whereas when the square was red, participants could perform the trial only in Arabic.

Fig. 1: The three kinds of cue displayed to participants during the experiment, each corresponding to an experimental context: The monolingual interlocutor context, the bilingual interlocutor context and the colour cued context. Figure adapted from Blanco-Elorrieta & Pylkkänen (2017).

Each participant performed both production and comprehension tasks featuring these 3 separate scenarios, meaning that the experiment consisted of 6 experimental conditions in total. Each trial consisted of the presentation of one of the three types of cues followed by the presentation of one of 96 stimuli. In the 3 production tasks participants had to verbally identify the visual stimulus in the target language, whereas in the 3 comprehension tasks participants had to press one of two buttons to indicate whether the auditory stimulus matched with the visual stimulus shown on screen. Before beginning the experiment,

participants read a short personal story about each of the interlocutors to be presented in the monolingual interlocutor and bilingual interlocutor contexts. The purpose of this exercise was to allow the participants to familiarize themselves with the interlocutors and with their linguistic background, thus making the cues more realistic and relatable on a personal level.

In addition to the 6 experimental conditions presented above, participants also performed a natural conversation task, in which participants listened to snippets from a real recorded conversation between two bilinguals and had to answer a comprehension question at the end. These snippets were selected specifically by the researchers to include many language switches. These 3 kinds of tasks are displayed in Figure 2.

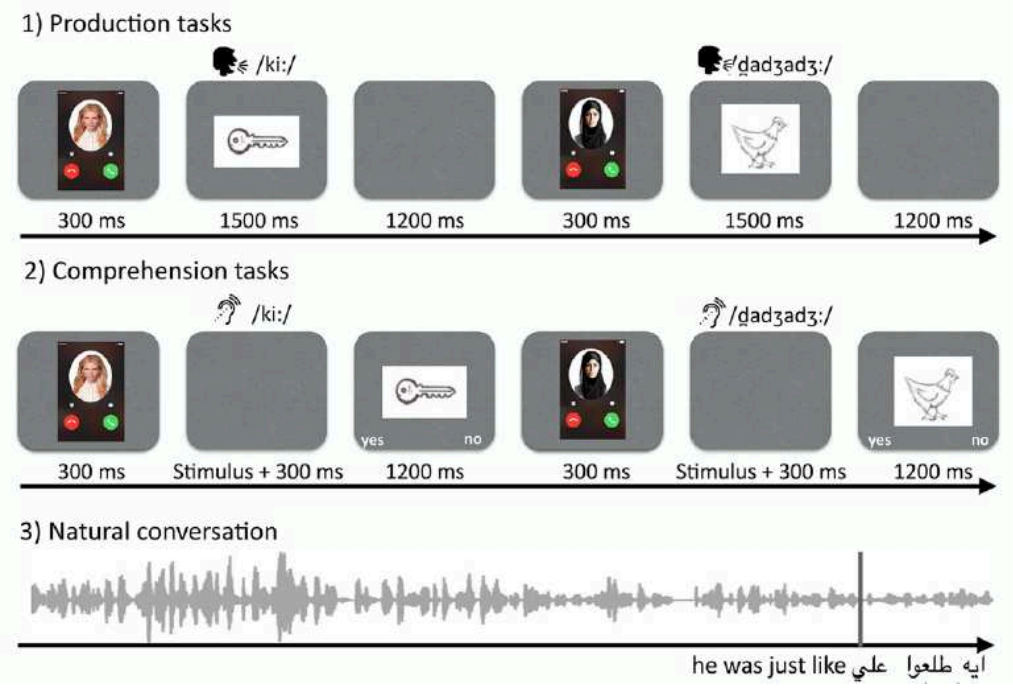

Fig. 2: the 3 kinds of tasks employed in the study. In the production tasks, participants were presented with the cue, followed by a visual stimulus which they identified in the target language. In the comprehension tasks, participants were presented with the cue followed first by an auditory stimulus and second by a visual stimulus, which they identified as a match with a button press. In the natural conversation task, participants listened to an auditory snippet of a conversation featuring language switches. Figure adapted from Blanco-Elorrieta & Pylkkänen (2017).

The 96 stimuli employed in the experiment were presented once in each experimental condition, meaning that the experiment consisted of 576 trials in total. The stimuli were presented with equal frequency in one of 3 types of trials:

1. Switch trials, in which the target language of the presented stimulus differed from that of the previous stimulus.
2. Switch+1 trials, in which the target language of the stimulus was the same as that of the previous stimulus but also followed a switch trial.
3. Non-switch trials, in which the target language of the stimulus was the same as the previous two trials.

The different types of trials were presented an equal number of times in each experimental condition.

In the analysis of behavioural data, behavioural switch costs were calculated as the difference between reaction times in switch trials and reaction times in non-switch trials belonging to each task. Errors and excessively delayed responses were excluded from analysis. In the analysis of neurological data, the regions of interest to be analysed were the dorsolateral prefrontal cortex (dlPFC), the ACC and Broca's area. In addition, the auditory cortex data gathered during the comprehension tasks and the natural conversation task were also analysed on the basis that the auditory cortex may be involved in the identification of prosodic and/or phonological features that precede language switches (Blanco-Elorrieta and Pylkkänen, 2016). Finally, a general analysis of the whole left hemisphere was conducted. In all tasks, cortical activity was recorded with magnetoencephalography.

2.2 Results of the experiment

The analysed data from the production tasks revealed the following:

Regarding neurological activity before the presentation of the stimulus, cue presentation did not elicit any neurological language switching effect, although the different types of cues did elicit different neurological activity. Specifically, facial cues elicited increased activity in the ACC in comparison with colour cues.

With regards to neurological activity after stimulus presentation, the analysis of the interactions between context (monolingual, bilingual or colour-cued context) and switching (switch or non-switch task) allowed the identification of two clusters of increased neurological activity. The first cluster of increased switch activity was present in the dlPFC and ACC during language switching in colour-cued and monolingual contexts, but not in bilingual contexts. Crucially, the analysis of this first cluster indicates that switch effects were absent only when participants were free to choose their response language. The second cluster of increased activity occurred in the ACC at a later time window than the first cluster, present only in switch trials preceded by a colour cue, not by the monolingual interlocutor or bilingual interlocutor contexts. This second cluster suggests that switching in response to an artificial cue requires more intense neurological engagement than switching in response to facial cues, the more natural and realistic kind of cue.

The behavioural data matched the neural data. Naming was slowest in the colour-cued context, whereas it was significantly the fastest in the bilingual context when participants could answer in either language. The number of errors made by participants also followed this pattern, with participants making the most errors in the colour-cued context and the least in the bilingual context.

The data from the comprehension tasks revealed the following:

As was the case during the production tasks, cue presentation did not elicit any neurological language switching effect. Nonetheless, facial cues elicited increased activity in the ACC in comparison with colour cues.

Unlike in the production tasks in which switch effects were absent in the bilingual interlocutor context, switch effects did not vary as a factor of the three experimental contexts. In other words, language switch effects were equally present in the bilingual interlocutor, monolingual interlocutor and colour cue contexts. Switch effects were observed in the left dlPFC and in the anterior part of the ACC, but not in the auditory cortex.

The neurological data recorded during the natural conversation task revealed that listening to two bilinguals switch naturally during conversation did not elicit any switch effects in either the dlPFC or the ACC. Instead, it elicited a switch-related increase in both auditory cortices, supporting the hypothesis of Blanco-Elorrieta and Pylkkänen (2016) that the auditory cortices play a role in language switch comprehension.

In summary, the results suggest that the presentation of interlocutor identity in itself does not elicit any language switch, but instead interlocutor identity is retrieved upon presentation of the stimulus itself, at which point it facilitates language switching, with more natural cues resulting in reduced neural strain, faster reaction times and fewer errors compared with artificial colour cues. Strikingly, statistically significant switch effects were absent in the dlPFC and the ACC during the production task featuring the bilingual interlocutor context and during the natural conversation task.

2.3 Discussion of the experiment

It is clear from the discrepancy between the results of colour cue context and those of the monolingual interlocutor context that, as switching occurs in a more natural context, the behavioural and neurological costs of language switching are significantly reduced. In addition, the finding that the dlPFC and the ACC are recruited during the monolingual interlocutor context but not in the bilingual interlocutor context offers support to the adaptive control hypothesis of Green and Abutalebi (2013) by demonstrating that the dlPFC and ACC are recruited during switching in situations that require conflict management between two languages, i.e. the dual language context. This suggests that cognitive control processes are adaptive and change from one context to another, as Green and Abutalebi (2013) predict. On the other hand, the same finding can also be interpreted as a contradiction of the adaptive control hypothesis (Green and Abutalebi, 2013). The adaptive control hypothesis proposes that language switching is inherently effortful in the dense code-switching context due to the recruitment of the control process of opportunistic planning, which consists of adapting words from one language to fit the syntactic frame of another

language. However, this study found no signs of cognitive or behavioural effort during the 2 out of the 3 tasks that correspond to the dense code-switching context.

One possible reason for why dlPFC and ACC switch costs did not appear in comprehension of natural conversation as they did in the laboratory comprehension task is that during a natural conversation bilinguals may produce subtle speech cues to indicate an upcoming language switch. This would explain why switch costs were present in the bilingual interlocutor comprehension task, but not in the natural conversation task, given that such speech cues would have been absent in the former but present in the latter.

2.4 Significance for the bilingual advantage hypothesis

The finding of Blanco-Elorrieta and Pylkkänen (2017) that language switching can be effortless in a dense code-switching context, supported by a handful of other studies (Zhu, Blanco-Elorrieta, Sun, Szakay & Sowman, 2022; De Bruin, Samuel & Duñabeitia, 2018), has critical consequences for the bilingual advantage hypothesis. If it is the case that language switching is not inherently effortful, then it does not follow that all bilinguals would possess an equal cognitive advantage. To this respect, the study by Blanco-Elorrieta and Pylkkänen (2017), along with a number of empirical studies which failed to reproduce any cognitive benefits of bilingualism (Paap et al., 2015), suggests that the somewhat vague theoretical basis of the bilingual advantage hypothesis is in need of a thorough revision. However, it could be that the bilingual advantage hypothesis would only apply to bilinguals who frequently find themselves in dual language contexts in which language switching is both common and dependent on external constraints (e.g., Costa, Hernández, Costa-Faidella & Sebastián-Gallés, 2009). The next chapter discusses this possibility, introducing the theoretical review article by Blanco-Elorrieta and Caramazza (2021).

Chapter 3

On the need for theoretically guided approaches to possible bilingual advantages

3.1 Defining the bilingual advantage

Although the cognitive advantages of bilingualism have been empirically studied to an extensive degree, with 2 equally convincing separate bodies of research supporting them and calling them into question, the theory behind the bilingual advantage hypothesis remains underdeveloped. Its general claim is that because bilinguals need to constantly monitor both languages to resolve linguistic conflict during lexical selection, their control mechanisms are more trained than those of monolinguals. This additional training generalises to domain-general cognitive control, offering bilinguals a cognitive advantage in non-linguistic tasks.

3.2 Qualitative differences as the source of a bilingual advantage

As for the source of strain on the control mechanisms of bilinguals, there have been three proposals:

1. Bilinguals constantly need to **inhibit** their non-target language to produce their target language (Green & Abutalebi, 2013). This linguistic suppression generalizes to improved inhibition in nonverbal tasks.
2. Bilinguals constantly need to **monitor** their environment to identify potential cues that signal the intended language (Costa, Hernández, Costa-Faidella & Sebastián-Gallés, 2009). This linguistic monitoring generalizes to improved nonverbal conflict monitoring.
3. Bilinguals need to **both inhibit** their target language **and monitor** environmental cues (Morales, Gómez-Ariza, & Bajo, 2013) leading to improved capabilities in dealing with general interference.

All 3 of these proposals agree on 3 key premises: First, there is a source of conflict between competing linguistic elements. Second, the processes involved

in dealing with this conflict generalizes via a transfer process. Third, this transfer results in enhanced general cognitive control.

Regarding the first premise of the bilingual advantage hypothesis, the source of the bilingual advantage may be a qualitative difference between bilingual and monolingual lexical selection. In other words, this would mean that across-language lexical selection (i.e., selecting from competing translation equivalents) employs different mechanisms compared with within-language lexical selection (i.e., selecting from competing synonyms and registers). According to the Adaptive Control Model (Green & Abutalebi, 2013), this qualitative difference is the inhibition of translation equivalents belonging to the nontarget language. However, if one argues that inhibition is the most efficient mechanism to choose from competing translation equivalents, presumably this would also be true for choosing from competing synonyms and registers, thus equalising any of its cognitive benefits. If instead inhibition is not the most efficient mechanism, then there is no clear reason why it would be recruited in any kind of lexical selection process. There are 3 potential solutions one could adopt to solve this issue:

First, one could develop an explanation for why only bilinguals use this mechanism despite it being the most efficient process of lexical selection. To date, no such explanation has been proposed.

Second, one could argue that both monolinguals and bilinguals recruit inhibition as a tool for lexical selection, but that across-language elements offer more competition than within-language elements, thus enhancing the inhibitory mechanism in bilinguals in particular. However, two further issues remain: If we assume that the language system operates via inhibition and that inhibition is applied at the highest level of selection (i.e., to the whole non-target language), for the bilingual advantage to hypothesis to be applicable it follows that executive control in itself is by definition a process of inhibition and that this initial step of inhibition is strong enough to produce a significant advantage. However, there is no evidence to support that this one step of inhibition could

have such strength and the current literature on cognition generally agrees that executive control consists of many more mechanisms than just inhibition.

The third possible solution is the proposal that across-language elements offer more competition than within-language elements and that inhibition is applied at the individual word level rather than at the whole language level. This would result in inhibition being continuously applied for every word produced. This solution could plausibly enhance inhibitory skills in bilinguals but faces a problem of inefficiency. Inhibition at the single-word level seems unnecessarily taxing given that, outside of laboratory language-switching tasks, bilinguals would rarely need to constantly re-evaluate the target language and inhibit the non-target language at the utterance of each word. There is no obvious sufficiently common and realistic context in which inhibition at the single-word level would be beneficial to the bilingual speaker and as such, it is unlikely that a bilingual advantage could develop as a consequence of this possibility.

3.3 Quantitative differences as the source of a bilingual advantage

Given that the possibilities that the difference between monolingual and bilingual lexical selection being qualitative do not seem plausible, one can proceed to consider potential quantitative differences. For these to be plausible, two fundamental premises are required: First, both monolinguals and bilinguals recruit executive control in their lexical selection process. Second, this process must be recruited to a greater extent in bilinguals than monolinguals. One way to satisfy these two requirements is to incorporate Roelofs' notion of competition (Roelofs, 1992) into the bilingual advantage hypothesis. According to this proposal, a choice between competing lexical elements is more difficult the more similar these elements are, requiring executive control to decide which is the most appropriate alternative. For monolinguals, this competition would be limited to synonyms, whereas for bilinguals this competition would be present for translation equivalents as well as synonyms, meaning that executive control would be recruited significantly more to discriminate between the vast variety of similar lexical options a bilingual individual possesses. It follows that as a result of this increased recruitment, a bilingual advantage could emerge.

Assuming that this proposal is correct, it would still be possible that competing lexical elements could be selected randomly, without the recruitment of executive control. For this reason, there must be an external constraint which identifies the need of the target language, the most obvious option being the linguistic context in which a given bilingual individual finds themselves in, as proposed by Green and Abutalebi (2013). In a dense code-switching context, known languages can be used freely, eliminating the need for the recruitment of executive control to make any strenuous choices between competing elements. As such, a bilingual advantage could not emerge from the dense code-switching context. In a single-language context, the monolingual interlocutor's linguistic profile would act as the necessary external constraint to potentially require executive control involvement. However, it is reasonable to expect that, given enough background knowledge of the monolingual interlocutor, the bilingual speaker's activation levels for elements belonging to the non-target language would be lower than those for the shared language, eliminating the need for executive control intervention. However, such unequal activation levels would be counterbalanced in the case of bilinguals with limited proficiency in their second language, because their native language would have higher activation levels by default. Although it is theoretically possible that a bilingual advantage could emerge from the single-language context, in reality the advantage could only develop within a very delicate and narrow combination of requirements, making this eventuality unlikely or rare. On the other hand, in a dual-language context, activation levels of both languages would be equal, thus requiring the intervention of execute control to act as a moderator between equally competing across-language elements. For this reason, a bilingual advantage could plausibly emerge from dual-language contexts.

3.4 The problem of Transfer and Generalization

Assuming that executive control is recruited in linguistic production, a further consideration to be resolved is how this enhanced process transfers to general executive control and how it is applied to non-linguistic tasks. The nature of executive cognitive control in general remains elusive and poorly characterized

in the existing literature or, as Monsell described it, *"a somewhat embarrassing zone of almost total ignorance"* (pp.93, Monsell, 1996), but we can consider two possible characterizations of it: unitary or heterogenous (Roberts, Robbins & Weiskrantz, 1998). The first possibility is that executive control could act as a single engine which blindly applies itself in its entirety to all tasks requiring its involvement. With this holistic conceptualization of executive control, it follows that improvements in executive control via language mediation would automatically result in improved performance of all tasks requiring executive control. Second, executive control could be multifaceted, consisting of a central engine exercising each of its separate mechanisms specifically within the requirements of particular tasks. If this conceptualization is correct, a clear explanation of the process through which language-specific control transfers to the central executive control engine is required.

However, neither of these two possible conceptualizations appear to be compatible with the current research literature surrounding executive control. For example, recent research on the benefits of video games has concluded that in the majority of cases training in one domain does not transfer to enhanced cognitive ability (Sala, Tatlidil & Gobet, 2018). Likewise, the supposed Mozart effect, the theory that classical music could improve cognitive performance, has since been dismissed on similar grounds (Pietschnig, Voracek & Formann, 2010). Concerning the two conceptualizations of executive control proposed previously, these findings have two significant consequences: First, they suggest that the conceptualization of executive control as a unified blind engine to be false, given that if it were correct, the research literature would have identified improvements in all skills involving executive control, which has not been the case. Second, if skills belonging to other domains of cognition do not generalise, one would either have to present a convincing argument to explain why language would be any different or one would have to remove the need for skill generalisation and propose that the source of the linguistic advantage possessed by bilinguals is their exact same source of general cognitive advantage.

Chapter 4

Conclusion

The purpose of this dissertation was to analyse and discuss the recent empirical advances in the study of language switching, their impact on pre-existing theoretical models and the theoretical basis behind the bilingual advantage hypothesis in order to direct future research towards fruitful lines of investigation.

From the research article discussed in Chapter 1, two conclusions are apparent. First, it is clear that the naturalism of the experimental paradigm employed in language switch studies is crucial. To obtain results that are both more consistent and more externally valid, future research can benefit from the methods proposed by Blanco-Elorrieta and Pylkkänen (2017). Second, future research should make a clear distinction between the 3 interactional contexts of Green and Abutalebi (2013) in order to accurately identify a more nuanced and multifaceted understanding of the costs of language switching.

However, before any major progress in the empirical search for a bilingual advantage can occur, a stronger theoretical basis for the bilingual advantage hypothesis must be developed. Namely, the relationship between language and executive control must be identified in order to establish how a linguistic advantage transfers to a cognitive advantage. For this potential proposal, a clearer conceptualization of executive control itself is required. The very essence and nature of executive control is still insufficiently clear and, for this reason, progress in the study of the bilingual advantage hinges on the progress of cognitive psychology in general. Furthermore, the relationship between language and executive control demands attention, as either it relies on some unique properties of language that allow for skill generalization, or it suggests an intersection between language and executive control at their very source.

If one were to support the bilingual advantage proposal that appears most plausible to Blanco-Elorrieta and Caramazza (2021) as discussed in chapter 2, 3 predictions naturally follow and demand empirical inquiry. The first prediction,

which follows from Roelofs' notion of competition (Roelofs, 1992), is that lexical selection between synonyms is more demanding than lexical selection between unrelated words. The second prediction is that lexical selection between both synonyms and translation equivalents requires the recruitment of executive control. The third prediction is that, if competition between translation equivalents in addition to synonyms is the source of a bilingual advantage, individuals who speak more than 2 languages possess a greater cognitive advantage than bilinguals, given that they are faced with an even larger pool of competitive translation equivalents from which they make their selection. In other words, we can expect that on average, the more languages an individual speaks, the greater their cognitive advantage in comparison with monolinguals.

Given the problematic theoretical underpinnings on which a bilingual advantage could plausibly emerge coupled with the inconsistent results of empirical studies on language switching, it may appear that the bilingual advantage hypothesis may be dismissible entirely. After all, Blanco-Elorrieta and Caramazza (2021) propose that selection could also occur on the basis of whichever competing element receives the highest level of activation, thus eliminating the need for an inhibition mechanism in a lexical selection model. If indeed the bilingual advantage is a myth, this relies on concluding that the empirical results supporting the bilingual advantage hypothesis are in fact nothing more than false positives. However, "if all reports of bilingual advantages were simply false positives, one would expect an equal number of false positives of a monolingual advantage" (pp.95, Poarch & Krott, 2019). This contradicts the research literature on the bilingual advantage in which results that suggest a monolingual advantage are far rarer than those that suggest a bilingual advantage (Poarch & Krott, 2019). For this reason, the results seem to be identifying some kind of bilingual advantage. On the other hand, the relatively large number of results supporting the bilingual advantage hypothesis may be due to a publication bias in favour of research with positive results, as identified by De Bruin, Treccani and Della Sala (2015). Given how mixed the empirical results on the topic are, further research on language switching may benefit from adopting the innovative paradigm proposals of Blanco-Elorrieta and Pylkkänen (2017) as well

as from further developing the theoretical framework on which the bilingual advantage relies. Despite being a highly debated topic for the past two decades, this line of research remains worthy of attention and continues to show promise.

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