The effects of using two variants of one language on cognition: Evidence from bidialectalism and diglossia.

Najla Alrwaita^a (ORCID: 0000-0001-8412-872X), Carmel Houston-Price^a (ORCID: 0000-0001-6368-142X) & Christos Pliatsikas (ORCID: 0000-0001-7093-1773)^{a, b}

^aSchool of Psychology and Clinical Language Sciences, University of Reading, Harry Pitt Building, Earley Gate, Whiteknights Road, Reading, RG6 6AL, UK.

^bFacultad de Lenguas y Educación, Universidad Nebrija, Calle de Sta. Cruz de Marcenado, 27, 28015, Madrid, Spain

Address for correspondence:

Najla Alrwaita
School of Psychology and Clinical Language Sciences,
University of Reading
Reading, UK, RG6 6AL
Email: n.s.s.alrwaita@pgr.reading.ac.uk

Abstract

The question of whether and how bilingualism affects domain general cognition has been extensively debated. Less attention has been paid to the cognitive abilities of speakers of different variants of the same language, in linguistic situations such as bidialectalism and diglossia. Similarly to the bilingual situation, in bidialectalism and diglossia speakers need to use only one variant of the language in a given context. However, these situations provide fewer opportunities for mixing or switching between the variants, potentially leading to different domain general cognitive outcomes than those reported in bilingualism. Here we review the available evidence on the effects of bidialectalism and diglossia on cognition, and evaluate it in relation to theories of the effects of bilingualism on cognition. We conclude that investigations of bilingualism, bidialectalism and diglossia must take into account the conversational context and, in particular, the opportunities for language switching that this affords.

Keywords: bilingualism, bidialectalism, cognition, executive function, diglossia.

Bilingualism and executive functions

The relationship between bilingualism and cognition has been the subject of considerable research for almost two decades. It is generally accepted that, in the bilingual mind, both languages are constantly active (Bialystok *et al.* 2012); consequently, to use the appropriate ('target') language, bilinguals must constantly prevent intrusions from their non-target language according to the context in which they find themselves (Carlson & Meltzoff 2008). This perpetual cognitive challenge has been suggested to enhance inhibition abilities in bilinguals compared to monolinguals, with benefits that extend beyond language control to enhance domain-general cognitive performance, including executive control (Kroll & Bialystok 2013).

Inhibition, switching and working memory are a set of cognitive abilities that underlie executive control (Miyake *et al.* 2000). Each of these abilities is measured with different behavioural tasks. Inhibition, or inhibitory control, is often measured by tasks tapping into the ability to suppress attention to, or ignore, irrelevant or misleading aspects of the task at hand in order to attend to the appropriate stimuli. Common tasks tapping inhibitory control are the Flanker, Simon and Stroop tasks (Eriksen & Eriksen 1974; Martin-Rhee & Bialystok 2008; Stroop n.d.). Switching is often measured using tasks that tap into the ability to switch rapidly from one task to the other, such as the Colour Sorting task (Piper *et al.* 2012) and the Colour Shape task (Miyake *et al.* 2004). Finally, working memory refers to the ability to temporarily hold information in mind for processing purposes, and is commonly measured using tasks such as the Backward Digit Span (Wechsler & Psychological Corporation 1949), and Backward Dot Matrix tasks (Alloway 2015).

In the bilingual literature, all three domains have been tested and inhibition found to be the domain most commonly affected (Bialystok *et al.* 2012; Emmorey *et al.* 2008; Luo *et al.*

2013; Poarch & van Hell 2012). Bilingual advantages in executive function (henceforth EF) have been reported in bilingual children (Poulin-Dubois *et al.* 2011), young adults (Pelham & Abrams 2014), and older adults (Bialystok *et al.* 2004) (for a review, see Valian 2015). Similarly, studies have shown an advantage in *multilingual* adults when compared to monolinguals (Limberger & Buchweitz 2014). More interestingly, while multilingual adults were found to be less likely to develop cognitive impairments than bilinguals (Perquin *et al.* 2013), studies on the multilingual executive function advantage have found no difference between bilingual and multilingual children (Schroeder & Marian 2017). Schroeder and Marian (2017) have noted that this could be because multilingual children have not fully developed the cognitive advantage of multilingualism, or that multilingualism doesn't increase EF demands beyond the level of bilingualism.

Other studies have failed to find a link between bilingualism and EF, sometimes after controlling for factors such as socio-economic situation, age and education (Duñabeitia *et al.* 2014; Gathercole *et al.* 2014; Kousaie & Phillips 2012; Morton & Harper 2007). Several explanations for this discrepancy have been put forward, including how bilingual groups are defined in different studies and how comparable they are in terms of their language and cultural experiences (Calvo & Bialystok 2014; Luk & Surrain 2019). More recently, the linguistic similarity of the bilingual's two languages has been suggested to modulate the effect of bilingualism on cognition. Oswald *et al.* (2018) argue that language similarity modulates the executive control demands for bilinguals, but highlighted that this might work in two opposing directions. On the one hand, if two languages are very similar the cross-language interference might be stronger, meaning executive functions are more heavily taxed; on the other, two languages that share elements of grammar, phonology and lexicality might facilitate each other,

meaning that more dissimilar languages would tax the executive system to a greater extent.

Despite these arguments, the empirical literature to date has largely failed to acknowledge the issue of linguistic similarity, despite some of them having looked at linguistically close language pairs, such as Italian and Sardinian (Garraffa *et al.* 2015), while others have examined more distant language pairs, such as English and Korean or Mandarin (Oh & Lewis 2008; Prior & Macwhinney 2010). The lack of consideration of linguistic distance might account for the mixed results in the literature on the effects of bilingualism on cognition.

Bidialectalism and diglossia

If language similarity affects executive function in either of the ways described by Oschwald *et al.* (2018) it is of interest to examine the cognitive abilities of speakers of two variants of the same language, where language similarity is much higher than for bilingual speakers. The linguistic cases of bidialectalism and diglossia provide such degrees of similarity, yet remain under-researched in terms of their implications for cognition: Both are characterized by the coexistence of a high (standard) and low (social) variety of the language. In both diglossia and bidialectalism, the low variety is used in domains such as the home, with social contacts, when shopping, and sometimes at work, while the high variety is used in formal situations (Masica & Sinha 1986; Scaltritti *et al.* 2017). In both diglossia and bidialectalism the low variety is typically used in more contexts than the high variety ((Masica & Sinha 1986).

Despite their similarities, there are notable differences between diglossia and bidialectalism, particularly in terms of the relationship between the two variants spoken. Bidialectals speak two highly similar variants of a given language, one of which is the standard form, the other often a regional dialect, such as Italian and Venetian (Scaltritti *et al.* 2017). In

diglossia, the two variants are more divergent. The standard (high) form used in written literature and learned through formal education is often highly codified and grammatically complex, while the low variant, used for everyday conversations and learned at home, is often less grammatically complex (Ferguson 1959). Diglossia also differs from bidialectalism in two *functional characteristics* (Masica & Sinha 1986). First, in diglossia, the uses of the two varieties are *exclusive*, while in bidialectalism they are *overlapping*. For example, in diglossia the high variety is strictly used in formal speeches while the low variety is only used in informal settings. In bidialectalism, both the high and the low varieties can be used in formal speeches, depending on the audience. The second functional characteristic that distinguishes these two linguistic situations is the criterion for code selection. In diglossia, code selection is based on the activity (e.g., writing vs. speaking). In bidialectalism the variety to use is determined by situational factors, including whether the addressee understands each variety (Masica & Sinha 1986). Moreover, in diglossia, it is a given that everyone understands the same low variety, and also the high variety (assuming a certain level of education has been achieved), while bidialectalism involves two overlapping speech communities, requiring the speaker to assess whether the addressee understands the regional dialect or not.

There are prominent similarities between bidialectalism/diglossia and bilingualism. Like two distinct languages, different variants of a language may have different lexical, phonetic and syntactic systems (Ross & Melinger 2017; Saiegh-Haddad & Joshi 2014). However, there are both linguistic and socio-cultural differences between these situations. Linguistically, two variants of one language will always be more similar than two distinct languages in terms of their grammar, vocabulary and phonology (Scaltritti *et al.* 2017). From a sociocultural perspective, bidialectal/diglossic individuals often view one of the varieties (typically the low one) as

‘socially stigmatized’ and the other (typically the high one) as ‘prestigious’. In bilingualism the two languages are more likely to have the same social status, although in some countries with a colonial history, such as India or some African nations, the use of a second language is associated with prestige (Mejía 2002).

Perhaps the most important social difference between bidialectalism/diglossia and bilingualism is the nature and amount of code-switching between the two variants or languages (Masica & Sinha 1986). Bilinguals have been argued to have more opportunities to switch between languages in the same context, because bidialectals and diglossics tend to use each variant in a different context (Scaltritti *et al.* 2017). In relation to the contexts defined in the Adaptive Control Hypothesis (Green & Abutalebi 2013), bidialectalism and diglossia may be good examples of *single language contexts*; when speakers switch between the two languages/dialects in different contexts (Masica & Sinha 1986). It is true that individuals with two dialects typically use one dialect in one context (e. g., at work) and another in another context (e.g., at home) (Masica & Sinha 1986). Further, the *dual language context* and *dense-code switching context* are more likely to apply to bilingualism. In the dual language context speakers switch between the two languages with different speakers, while in the dense- code switching speakers switch between languages within the same utterance, for example (-ieren) as in “‘choisieren” is a German particle attached to a French verb (Abutalebi *et al.* 2015).

According to the Adaptive Control Hypothesis, of the three interactional contexts, the dual language context requires the highest levels of language control due to the complexity of the goal maintenance, conflict monitoring and interference suppression requirements of this context. This has been suggested to lead to the enhanced cognitive control skills of bilinguals in dual language contexts compared to those in single language and dense code-switching contexts

(Yang *et al.* 2016). More clearly, in dual language contexts bilinguals engage in more switching between languages; being constantly exposed to the dual language context enhances task switching ability relative to bilinguals in the other two types of context (Green & Abutalebi 2013). Subsequently, bilinguals in the single language context have more enhanced EF skills than bilinguals in the dense-code switching context.

The ACH therefore predicts that bilinguals will show superior cognitive control to bidialectals/diglossics. However, it would be wrong to conclude that bidialectals do not practice dialect inhibition, or that these language situations do not require cognitive control. Even a single language context enforces separation between the two variants of the language, and this may require more control than bilingual contexts where two languages may be used. It is therefore of value to investigate the effects of bidialectalism and diglossia on domain general cognition. The unique nature of the bidialectal/diglossic linguistic environments has led to differing, and sometimes contradicting, accounts of their potential effects on executive functions. Some authors have suggested that the bidialectal/diglossic requirement to acquire two languages that are highly similar in structure, phonology or grammar will lead to stronger demands on EFs (Linck, Kroll, & Hoshino, 2008). Similarly to the case of bilingualism, selection between two similar variants of a language requires effort to inhibit the interference of the non-target variant, to reduce the cost of switching between the variants and to reduce monitoring of working memory content, leading to stronger EF abilities (Barac & Bialystok 2012; Linck *et al.* 2008). Others have suggested that the shared syntax, grammar and phonology of the two variants should facilitate lexical access and language comprehension, reducing the need to engage the EFs relative to bilinguals (Oschwald *et al.* 2018).

In sum, bidialectalism and diglossia present valid test cases of the cognitive effects of juggling two variants of a language, and whether these depend on the similarity between the two variants, the relative usage of each variant, and the amount of switching between them. Crucially, studying bidialectalism/diglossia will add to our understanding of the effects to be expected in single language contexts and whether the inconsistencies in the literature on the cognitive effects of bilingualism might be attributed to the different language contexts in which bilingualism occurs. The remainder of this paper will review the empirical evidence on the effects of bidialectalism and diglossia on cognition. Following the pattern of findings in the bilingual literature, evidence from children and from younger and older adults will be presented separately. Bidialectal studies will be presented first, followed by studies on diglossia. And finally, conclusions will be drawn on how this evidence contributes to theoretical positions on the effects of bilingualism on cognition.

Studies of executive functions in bidialectalism

Children

To date, four studies have investigated executive function in bidialectal children (see Table 1). Ross & Melinger (2017) tested English monolingual, Gaelic-English bilingual and Southern English bidialectal children speaking Standard English and Dundonian Scots. Children were between the ages of 6 to 9 and lived in Scotland or England. In experiment one, groups of children were tested using the Flanker Task and Simon task. In experiment two, a subset of the same children were tested using an age-appropriate version of the Dimensional Change Card Sort (DCCS) test. The results revealed that the groups performed similarly across tasks, except for the Simon task, where bilingual children showed higher accuracy than the other groups. The study concluded that there was no evidence for a bilingual or bidialectal advantage across the three tasks, and the authors suggested that the bilingual advantage may be both task-specific and age-specific, as others have also reported advantages in Simon tasks for bilingual children around 5 years of age (Morales *et al.* 2013). This might explain the very mixed results of studies that have investigated bilingual advantages in childhood (Kapa & Colombo 2013; Poarch & van Hell 2012). With respect to the group of particular interest here, the authors attributed the null finding of a bidialectal advantage to the close similarity of the two dialects. Although the Standard English does differ from the Dundonian dialect, the authors noted that Standard English is not commonly spoken in Scotland. Instead, Scots switch between Dundonian and a form of *Scottish Standard English*, which is more similar to Dundonian Scots. Second, the Dundonian dialect is comprehensible to speakers of non-Scottish dialects. This indicates that the bidialectal

situation in this study does not resemble the bidialectal situations in countries where the local dialect substantially differs from the standard dialect. Ross and Melinger argue that, the more different the regional dialect is from the standard dialect, the more effort is needed to prevent interference, and the greater the demands on executive function abilities. They therefore suggested that future studies should involve bidialectal groups who speak distinctively different dialects.

Using more distant dialect pairs, (Blom *et al.* 2017) investigated potential cognitive advantages in bidialectal children and how they are modulated by dialect use. Four groups of participants were included: monolingual Dutch, two groups of bidialectal Dutch children who spoke regional dialects of Frisian or Limburgish, and Dutch bilinguals who were exposed to a migrant language (Polish). All participants were aged 6 to 7 years and were assessed using a battery of executive function tasks including working memory, measured by Backward Digit Span and Backward Dot Matrix, inhibition, measured by the Flanker task, and selective attention, measured by the visual Sky Search task. Parents completed the Questionnaire for Parents of Bilingual Children (Tuller 2015), which asks about parental educational level, language input, and language use at home. Parents of monolingual children completed a short version of the same questionnaire. Results revealed no significant differences between groups on most tasks, except for selective attention measured by the Sky task, where Frisian-Dutch bidialectals outperformed Limburgish-Dutch bidialectals. Surprisingly, children in all groups showed a negative Flanker effect, taking longer to respond to congruent trials than incongruent trials. This effect was significantly larger for the monolingual group than for the other three groups. The Frisian-Dutch bidialectals again showed cognitive benefits relative to the Limburgish-Dutch bidialectals

On neither task were the advantages shown by the Frisian-Dutch bidialectals modulated by children's proficiency in their respective dialects. Rather, Blom *et al.* (2017) attributed their findings to the different conversational contexts and language uses of the two bidialectal groups. Specifically, Frisian is the language of instruction for Frisian-Dutch children, is taught at school for at least one hour per week, and is the language used between classmates. In contrast, Dutch is the dominant language and the language of instruction for Limburgish-Dutch bidialectals, while Limburgish is the language more widely used in the community and between students. Thus, the Frisian-Dutch situation resembles the single language context while the Limburgish-Dutch bidialectal situation resembles the dense code-switching context. If dense code switching is less associated with cognitive control than the single language or the dual language context, as claimed by Green & Abutalebi (2013), the Frisian-Dutch advantage is as expected.

Dialect use and its effects on EFs might also be modulated by dialect proficiency. Bosma *et al.* (2017) examined this by assessing Frisian-Dutch bidialectals in different language domains including receptive and expressive skills. The scores of the language assessments were used to divide the participants into two groups: Dutch-dominant and balanced Frisian-Dutch. Balanced bidialectals performed similarly in Dutch and Frisian across tasks and Dutch-dominant bidialectals performed better on Dutch versions of the tasks. As expected, the groups also differed in their exposure to Frisian at home, with Dutch-dominant children having less exposure to Frisian. The two groups were assessed on the Flanker task, a verbal working memory task (Digit Span), and a visuospatial working memory task (Backward Dot Matrix). While balanced bidialectal children significantly outperformed Dutch-dominant bidialectals in the Digit Span task, the groups performed similarly in the other tasks. Bosma and colleagues suggested that the bidialectal advantage might therefore be task-specific. However, the lack of monolingual or

bilingual control groups, to compare bidialectals with, makes it difficult to draw conclusions in regard to the bidialectal advantage.

Using similar methods, Bosma *et al.* (2019) went on to investigate firstly whether the degree of bidialectalism, defined as balanced proficiency in the two dialects, can predict children's performances on EF tasks over a 3-year period, and secondly whether home exposure to the regional dialect (Frisian) predicts EF ability, and whether this relationship is modulated by the degree of bidialectalism. The latter question was influenced by previous studies indicating that only children exposed to Frisian at home become proficient in both Frisian and Dutch (Dijkstra 2013.) Frisian-Dutch children were tested annually over three years, starting at age 5 to 6 years. The degree of bidialectalism was measured in terms of children's proficiency in receptive vocabulary and expressive morphology in both Frisian and Dutch. Receptive vocabulary was measured using the Dutch version of the *Peabody Picture Vocabulary test* (PPVT) (Dunn *et al.* 1997) and a Frisian adaptation of the PPVT (Green & Abutalebi 2013). Morphology was measured using the word formation subset of the *Language Assessment all Children* in both languages (Verhoeven & Vermeer 2002.) Executive function measures included the Flanker test of inhibition, the Sky Search task for selective attention, and Backward Digit Span and Dot Matrix working memory tasks.

Results revealed a significant correlation between the degree of bidialectalism and performance on the Sky Search task. However, this correlation was found only at the youngest age tested (5-6 yrs), with a borderline significant correlation at age 6 to 7 years and no correlation at 7 to 8 years. There were no between-group differences in inhibition or working memory tasks. The authors consider the possibility that the bidialectal effect is lost at age 6 when children start school because Dutch is the dominant language at school, leading to reduced

opportunities for switching between dialects. However, the finding that the balance in children's Dutch and Frisian proficiency did not change over the three years of the study (as measured by receptive vocabulary and expressive morphology) undermines this account. The study also showed that both the intensity of exposure to Frisian at home and the degree of bidialectalism predicted EF scores. Intensity of exposure to Frisian predicted the degree of bidialectalism at all three ages and intensity of exposure to Frisian at home correlated with performance on the Sky Search task in the younger two age groups. After controlling for the degree of bidialectalism, results showed no correlation between intensity of exposure to Frisian at home and performance on the Sky Search task, indicating that bidialectalism mediated this relationship. The authors concluded that selective attention, rather than inhibition, is the core skill that benefits from bidialectalism, but that this effect is not long-lasting and seen only briefly in early childhood.

Young adults

Only two studies have looked at cognition in bidialectal young adults (see Table 1). Scaltritti *et al.* (2017) investigated the roles of dialect familiarity and switching on cognition. Experiment 1 involved young adults (mean age = 23 yrs) who were native speakers of Italian and a Venetian dialect found in Padua and neighbouring regions (some participants also spoke other Italian dialects). Participants' responses to a questionnaire about their exposure to Italian and Venetian in different contexts (e.g., family, school, friends) were used to compute a dialect familiarity score. These subjective measures of dialect familiarity failed to predict performance in the Flanker and Simon tasks. Specifically, estimates of daily exposure to dialects failed to predict either the congruency effect, or the global effect (across congruent & incongruent trials).

More objective measurements of dialect familiarity were taken in a second study that compared Italian-Venetian bidialectals to Italian monolinguals. Participants completed the same questionnaire as in Experiment 1, but their proficiency in the Venetian dialect was additionally assessed via a sentence completion (receptive language) task, and a spontaneous speech (expressive) task. EFs were assessed using the Flanker task. There were no between group differences on the Flanker task, and dialect familiarity scores failed to predict performance on the Flanker task. The authors attributed the lack of bidialectal advantage in their studies to the limited opportunities for switching between Venetian and Italian, reinforcing the view that bidialectalism in this region corresponds to a single language context.

Poarch, Vanhove, & Berthele (2019) tested the hypothesis that more balanced usage of two dialects leads to better inhibitory control in a sample of bidialectal Swabian-German adults (mean age=23 yrs). Dialect use was assessed using the Bilingual Language Profile (BLP) questionnaire (Birsong *et al.* 2012), a self-report measure of German-English bilingualism that has been adapted to measure bidialectalism. BLP responses were used to split participants into two groups according to their dialect use, Swabian-dominant and balanced Swabian-German bidialectals. Participants were assessed using two inhibitory control tasks, Simon and Flanker. Contrary to the authors' predictions, the Swabian-dominant bidialectals showed significantly smaller Flanker and Simon effects than the balanced German-Swabian bidialectals. This finding led Poarch *et al.* (2019) to conclude that EF advantages arise from using the non-standard dialect more often than the standard dialect. However, this conclusion was not supported by any theoretical justification and it contradicts other studies which indicated that dialect balance modulates EFs (Bosma *et al.* 2019; Poarch *et al.* 2019)

Older adults

To date, only one study has investigated the potential cognitive advantages associated with bidialectalism in older adults (Table 1). Kirk *et al.* (2014) compared performance on a Simon task between Gaelic-English bilinguals, bilingual immigrants to the UK who were speakers of English and an Asian language (including Bengali, Gujarati, Hindi Malay, Punjabi & Urdu), Dundonian Scots-English bidialectals, and English monolinguals, all over the age of 60 years. Participants completed an adapted version of the LEAP-Q: Language Experience and Proficiency Questionnaire (Marian *et al.* 2007), as an assessment of their proficiency in the tested dialects, and the vocabulary subset of the Wechsler Abbreviated Scale of Intelligence (Wechsler & Psychological Corporation 1949), as an assessment of their English proficiency. Results showed no group differences. Kirk *et al.* (2014) explained their null finding in terms of participants' schooling contexts, which they use as a proxy for the interactional contexts defined by Green & Abutalebi (2013). The Gaelic-English bilinguals had been educated only in English, and the Asian language-English bilinguals had completed their education in just their first language, both providing a single language context. Kirk *et al.* (2014) argued that, if the interactional context plays a role in enhancing EFs, single language contexts, with their lack of opportunities for dual-language use, might not result in domain-general cognitive advantages. However, the authors did not provide information about the schooling context of bidialectals, or use this to explain the results for this group.

Studies of executive functions in diglossia

Children

Only one study has investigated the effects of diglossia on executive functions in children. Antoniou *et al.* (2016) investigated the diglossic situation in the Republic of Cyprus, where Cypriot Greek (CG) is the low language variety and Standard Modern Greek (SMG) is the high variety. 136 Children were divided into three groups: CG-SMG diglossics recruited from schools which offered traditional Greek-speaking programs; multilingual CG-SMG diglossics who were also speakers of English (and, in some cases, additional languages), recruited from schools in Cyprus; and monolingual SMG children, who were recruited from schools in Greece. Participants were assessed on measures of working memory (Background Digit Span & Corsi block task), inhibition (Soccer task), and switching (Colour-Shape task). Multilingual children performed better in the EF tasks than diglossic and monolingual children, which the authors attributed to the bilingual/multilingual's joint activation ability, the ability to jointly recruit different executive control components (Green & Abutalebi 2013). Second, when differences in language proficiency were controlled for, diglossic children were also found to outperform monolingual children in all of the EF tasks. The authors propose that diglossic children have an advantage in their ability to recruit different EF components, but to a lesser extent than multilinguals. The authors propose that the diglossic advantage may be more similar to the bilingual advantage than to the multilingual advantage. However, as the study did not include a bilingual group, this hypothesis remains untested. The study concluded that cognitive advantages could be achievable through the acquisition and use of language variants (dialects) as well as through the learning of more than one language.

Young adults:

Antoniou & Spanoudis (2020) closely followed the methods of Antoniou *et al.* (2016) when examining the effects of speaking more than one language or dialect on EFs in young adults. Their study design allowed them to explore whether a bilingual/diglossic advantage affects all, or only some, components of executive control. Seven EF tasks were administered to three groups of participants: 46 multilingual participants (speaking CG, SMG & another language), 72 diglossic participants (speaking CG & SMG), and 47 monolingual SMG speakers, with the latter group being Greek citizens who live in Cyprus but who had worked or studied in Greece. Inhibition was tested using the Stroop and Flanker tasks. Working memory was tested using Nback, Rotation Span and Corsi Blocks tasks. Switching was assessed using the Color-Shape and Number-Color tasks. All participants completed a Socioeconomic Status and Language Background Questionnaire, developed by the authors for the purpose of the study to establish language use in different domains, along with socioeconomic status and educational level. Participants also completed the Mill Hill Vocabulary Scale test (Raven *et al.* 1956) as an index of their proficiency in SMG. To explore the bilingual/diglossic advantage, an ANCOVA was performed with group as a between-subject factor, EF task (WM, Inhibition, Switching) as within-subject factor, and vocabulary as a covariant. The results replicated those reported in Antoniou *et al.* (2016); multilinguals and diglossics with a high level of SMG proficiency outperformed monolinguals across the various EF tasks. When vocabulary ability was controlled for, there was no group by component interaction, confirming that the multilingual/diglossic advantage is found broadly across the EF sub-domains. The authors indicated that the groups did not differ in age, educational level, or socioeconomic status eliminating any concerns that these factors could have influenced the results.

Bidialectalism and diglossia as single language contexts

As discussed earlier, any effects of using two languages (or two varieties of a language) on domain general cognition might depend on the opportunities different contexts provide to switch between them. The studies reviewed above provided little evidence of effects of bidialectalism on cognition, but more promising evidence of advantages for diglossia. The common denominator of bidialectalism and diglossia is that they correspond to single language contexts, defined by Green & Abutalebi (2013) as situations where the two variants of a language are reserved for different contexts, with minimal opportunities for language mixing and/or switching. If a cognitively challenging, long-term experience like controlling two languages that can be used interchangeably can have an effect on executive functions, as shown by several studies of bilingualism, this review suggests that these effects should not be expected in single language contexts such as those provided in bidialectalism and diglossia, especially in situations where the two dialects are kept separate. Indeed, this seems to be supported by the majority of studies to date, at least those on bidialectalism: Scaltritti *et al.* (2017) argued that Venetian-Italian bidialectals engage in much less switching between dialects than Catalan-Spanish bilinguals, and Blom *et al.* (2017) pointed out that the use of Limburgish in the Netherlands is limited to the home and the community, with minimal use in formal channels, whereas Frisian is frequently mixed with Dutch. There are few studies investigating the effects of using dialects equally, or in a “balanced manner,” on EFs. While such studies are important for establishing that dual language contexts, indicated by equal usage of both variants, can lead to advanced EF skills, some studies have shown the opposite (Bosma *et al.* 2019; Poarch *et al.* 2019), suggesting further study is warranted.

In contrast to bidialectalism, the two studies that have looked at the effects of diglossia on cognition have found advantages in children (Antoniou *et al.* 2016) and young adults (Antoniou & Spanoudis 2020). The discrepancy in the reported effects of bidialectalism and diglossia on cognition could be attributed to functional differences between the two situations: specifically, in diglossia each variant is used in a special context, with the formal (high) variant used for writing purposes and the spoken (low) variant used for spoken language and everyday communication (Masica & Sinha 1986). These functional distributions should translate into more rigid application of the single language context than is the case in bidialectalism, and as a result, more limited need for language control, and less of a cognitive advantage. However, the results of the two available studies (Antoniou *et al.* 2016; Antoniou & Spanoudis 2020), suggest the opposite pattern. This emphasizes the need for more studies investigating the effects of diglossia on cognition.

It is important to note that no study to date has explored the differences between diglossia and bidialectalism, or how these impact on EFs (Masica & Sinha 1986). Our limited knowledge of diglossia is accompanied by only a vague understanding of how speakers in diglossic environments use their high and low varieties, which may vary across contexts. While the two available studies on diglossia have reported a diglossic advantage in EFs (Antoniou *et al.* 2016; Antoniou & Spanoudis 2020), both studies were conducted in Cyprus and Greece. It is important to highlight that speakers across different diglossic societies may vary considerably in terms of their exposure to a particular variant and the criteria they use for switching between the two variants. Madau *et al.* (1996) has reported that the Telegu community in India use a high variant to write poetry and articles but never for speaking purposes (Madau *et al.* 1996). In Greece, a high variant of Greek, *katharevousa*, was used until recently for formal speeches, but now the

low variety, *demotiki*, is used across the board and the high variety is becoming extinct (Kaye 2001). In contrast, both low and high varieties of Arabic are used for composing poetry in the Arab world (Kaye 2001). The amount of exposure a speaker has to the high variety may be an important factor as it has been argued that diglossia can sometimes border on bidialectalism and even bilingualism, depending on how speakers are exposed to the high variety (Kaye 2001). This strengthens our hypothesis that not all diglossic environments would produce the same results as Antoniou *et al.* (2016) or Antoniou & Spanoudis (2020), because exposure to the two variants differs from one diglossic environment to another. It has been argued that less exposure to a certain variety would lead to less switching between the two varieties, which may lead to less executive control ability (Kirk *et al.* 2014; Scaltritti *et al.* 2017).

One of the examples of a diglossic society where speakers are not often exposed to the high variety is the Arab world. It has been suggested that some native speakers of Arabic would find it difficult to understand complicated essays written in the high variety, and an illiterate person in the Arab world would barely understand the high variety. It has also been suggested that even an educated Arab would find it hard to carry on a conversation entirely in the high variety without needing to switch to low variety (Kaye 2001). Therefore, a study investigating the diglossic advantage in the Arab world might not replicate the pattern in Cyprus or Greece (Antoniou *et al.* 2016; Antoniou & Spanoudis 2020).

The previously mentioned factors highlight the need for research in diglossic environments to take account of the level of familiarity speakers have with high and low varieties, and the conversational contexts in which participants use these dialects. While both bidialectalism and diglossia belong to the single language context, the results of this review are highly suggestive of executive function advantages in diglossia that are not seen in

bidialectalism. This may be due to the greater syntactic and grammatical separation between the two dialects in diglossia, or to the conversational context in diglossic environments being more similar to the dual language context than to the single language context. However, as both studies of diglossia were conducted in Cyprus, we cannot rule out the possibility that Cyprus might present a unique language context, and that the findings of these studies are not representative of diglossia in general. Further research with other dialect pairings is clearly required.

Implications for theories of cognitive advantages in bilingualism

If the context in which languages are used is key in explaining the lack of cognitive advantages in bidialectal studies, the inconsistent results of studies of bilingual speakers might be explained in a similar way. In fact, similar suggestions have already been put forward. For example, the lack of advantages in bilingual immigrants, especially those who reside in an English-speaking country, has been attributed to the lack of switching in their conversational context (Kirk *et al.* 2014; Scaltritti *et al.* 2017). Immigrant bilinguals are likely to have acquired their first language from their parents and to use this language exclusively at home but rarely at work or in public, effectively operating in single language contexts (Kirk *et al.* 2014). This suggests that the single language context, rather than the dual language context, applies to many bilingual environments. For example, Gaelic-English bilinguals, who often use English for formal, official and technical subject matters and Gaelic for informal conversations in domestic settings (Lamb 2008; MacAulay 1982; Macaulay 1993) do not show bilingual advantages (Kirk *et al.* 2014; Ross & Melinger 2017). The same is true of Sardinian-Italian bilinguals; Sardinian is

used only for writing purposes, and Italian for spoken purposes, offering few opportunities for switching between languages, and effectively a single language context. Therefore, it is hardly surprising that studies have failed to find any bilingual advantage in executive functions in Sardinian-Italian bilinguals (Garraffa *et al.* 2015; Lauchlan *et al.* 2013).

Studies investigating executive functions in bilingualism have also given little attention to the role of balance in the *use* of the bilingual's languages. According to (Green & Abutalebi 2013), it is language use that distinguishes the three contexts. It is reasonable to assume, then, that balanced bilinguals will have equal usage of the two languages and more switching, which is demonstrated in the dual language context, On the other hand, dominant bilinguals would be expected to function in single language contexts because using one language in a dominant manner is likely to require less switching between languages and more separation between them. Indeed, Guerrero *et al.* (2015) have reported that bilingual children who speak their two languages at home in a balanced manner show smaller switching costs in tasks measuring attention and switching, compared to bilingual children who speak one language in a more dominant manner at home. Further, bilingual children who live in a home where their parents speak both languages have been shown to outperform bilingual children whose parents speak only one language at home on a battery of inhibitory control tasks (Verhagen *et al.* 2017). This particular finding corroborates the finding by Bosma *et al.* (2017) that bidialectal children whose parents spoke both dialects at home performed better in the digit span task than dominant bidialectal children whose parents spoke only one dialect at home. It has been also found that bilinguals operating in dual language contexts show smaller switching costs than bilinguals in single language contexts (Hartanto & Yang 2016). These studies support the view that balanced language use plays a crucial role in the strengthening of EF abilities. The previously mentioned

examples indicate that bilinguals who belong to a dual language context are more likely to show a bilingual advantage than bilinguals who belong to a single language context; therefore, language context needs to be taken into account. In sum, our review of the available studies on bidialectalism and diglossia strongly suggests that conversational contexts play an important role in modulating executive function. Most importantly, we recommend that bilingual studies should consider the role of conversational contexts; as this can solve the long debate found in literature regarding the bilingual advantage.

Conclusion

This review suggests that the conversational context in which speakers use their two languages, or the two variants of a single language, modulates the effects of their language status on executive functions. The bidialectal and diglossic situations are similar to the single language context, which is suggested to affect EFs less than the dual language context (Green & Abutalebi 2013). Having reviewed the empirical evidence on bidialectal and diglossic advantages in inhibition, working memory and switching, we conclude that bidialectalism does not appear to result in consistent advantages in domain general cognition, likely due to the similar linguistic systems of the dialects and/or the single language context of the bidialectal speaker. However, although the evidence is somewhat limited, the same conclusion may not apply to the diglossic situation. We argue that the conversational context of a language community may be a crucial factor in determining how speakers perform on executive function tasks. This finding has implications not only for the study of bidialectalism/diglossia, but also for interpreting the literature on cognitive advantages in bilingualism, which has yielded mixed results. Future

research on bilingualism, bidialectalism and diglossia should take into account the conversational contexts in which languages/variants are used, the type and amount of code-switching between languages/variants and the domains in which this is practiced, and the similarity between languages/variants, as all of these can modulate the need for control and inhibition. Detailed descriptions of participants' language backgrounds are needed to support such investigations. The combination of these measures will result in carefully controlled designs that will further our understanding of the subtleties in the effects of speaking two languages on cognition.

Reference:

- Abutalebi, J., Canini, M., Della Rosa, P. A., Green, D. W., & Weekes, B. S. (2015). The neuroprotective effects of bilingualism upon the inferior parietal lobule: A Structural Neuroimaging Study in Aging Chinese Bilinguals. *Journal of Neurolinguistics*, **33**, 3–13.
- Alloway, T. P. (2015). *AWMA-2-NL: Alloway Working Memory Assessment 2nd edition : Nederlandse bewerking*, Pearson.
- Antoniou, K., Kambanaros, M., Grohmann, K. K., & Katsos, N. (2016). Is Bilectalism Similar to Bilingualism? An Investigation into Children's Vocabulary and Executive Control Skills, 14.
- Antoniou, K., & Spanoudis, G. (2020). An Investigation of the Multilingual and Bi-dialectal Advantage in Executive Control, 8.
- Barac, R., & Bialystok, E. (2012). Bilingual Effects on Cognitive and Linguistic Development: Role of Language, Cultural Background, and Education: **Language, Culture, Education, and Bilingualism**. *Child Development*, **83**(2), 413–422.
- Bialystok, E. (2011). Reshaping the mind: The benefits of bilingualism. *Canadian Journal of Experimental Psychology/Revue Canadienne de Psychologie Expérimentale*, **65**(4), 229–235.
- 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**(2), 290–303.
- Bialystok, E., Craik, F. I. M., & Luk, G. (2012). Bilingualism: consequences for mind and brain. *Trends in Cognitive Sciences*, **16**(4), 240–250.

- Birsong, D., Gertken, L., & Amengual, M. (2012). Bilingual Language Profile | An Easy-to-Use Instrument to Assess Bilingualism. Retrieved August 26, 2020, from <https://sites.la.utexas.edu/bilingual/>
- Blom, E., Boerma, T., Bosma, E., Cornips, L., & Everaert, E. (2017). Cognitive Advantages of Bilingual Children in Different Sociolinguistic Contexts. *Frontiers in Psychology*, **8**, 552.
- Bosma, E., Blom, E., Hoekstra, E., & Versloot, A. (2019). A longitudinal study on the gradual cognate facilitation effect in bilingual children's Frisian receptive vocabulary. *International Journal of Bilingual Education and Bilingualism*, **22**(4), 371–385.
- Bosma, E., Blom, E., & Versloot, A. (2017). Language balance and cognitive advantages in Frisian-Dutch bilingual children. In *Bilingualism and Minority Languages in Europe: Current Trends and Developments*, Cambridge Scholars Publishing.
- Calvo, A., & Bialystok, E. (2014). Independent effects of bilingualism and socioeconomic status on language ability and executive functioning. *Cognition*, **130**(3), 278–288.
- Carlson, S. M., & Meltzoff, A. N. (2008). Bilingual experience and executive functioning in young children. *Developmental Science*, **11**(2), 282–298.
- Dijkstra, J. (n.d.). Growing up with Frisian and Dutch, 193.
- Duñabeitia, J. A., Hernández, J. A., Antón, E., ... Carreiras, M. (2014). The Inhibitory Advantage in Bilingual Children Revisited: Myth or Reality? *Experimental Psychology*, **61**(3), 234–251.
- Dunn, L. M., Dunn, L. M., & American Guidance Service. (1997). *PPVT-III: Peabody picture vocabulary test*, Circle Pines, MN: American Guidance Service.

- Emmorey, K., Luk, G., Pyers, J. E., & Bialystok, E. (2008). The Source of Enhanced Cognitive Control in Bilinguals: Evidence From Bimodal Bilinguals. *Psychological Science*, **19**(12), 1201–1206.
- Eriksen, B. A., & Eriksen, C. W. (1974). Effects of noise letters upon the identification of a target letter in a nonsearch task. *Perception & Psychophysics*, **16**(1), 143–149.
- Ferguson, C. A. (1959). Diglossia. *WORD*, **15**(2), 325–340.
- Garraffa, M., Beveridge, M., & Sorace, A. (2015). Linguistic and Cognitive Skills in Sardinian–Italian Bilingual Children. *Frontiers in Psychology*, **6**. doi:10.3389/fpsyg.2015.01898
- Gathercole, V. C. M., Thomas, E. M., Kennedy, I., ... Jones, L. (2014). Does language dominance affect cognitive performance in bilinguals? Lifespan evidence from preschoolers through older adults on card sorting, Simon, and metalinguistic tasks. *Frontiers in Psychology*, **5**. doi:10.3389/fpsyg.2014.00011
- Green, D. W., & Abutalebi, J. (2013). Language control in bilinguals: The adaptive control hypothesis. *Journal of Cognitive Psychology*, **25**(5), 515–530.
- Hartanto, A., & Yang, H. (2016). Disparate bilingual experiences modulate task-switching advantages: A diffusion-model analysis of the effects of interactional context on switch costs. *Cognition*, **150**, 10–19.
- Kapa, L. L., & Colombo, J. (2013). Attentional control in early and later bilingual children. *Cognitive Development*, **28**(3), 233–246.
- Kaye, A. S. (2001). Diglossia: the state of the art. *International Journal of the Sociology of Language*, 117–129.
- Kirk, N., Fiala, L., Scott-Brown, K., & Kempe, V. (2014). No evidence for reduced Simon cost in elderly bilinguals and bidialectals.

- Kousaie, S., & Phillips, N. A. (2012). Ageing and bilingualism: Absence of a “bilingual advantage” in Stroop interference in a nonimmigrant sample. *Quarterly Journal of Experimental Psychology*, **65**(2), 356–369.
- Kroll, J. F., & Bialystok, E. (2013). Understanding the consequences of bilingualism for language processing and cognition. *Journal of Cognitive Psychology*, **25**(5), 497–514.
- Lamb, W. (n.d.). Scottish Gaelic Speech and Writing: Register Variation in an Endangered Language, 332.
- Lauchlan, F., Parisi, M., & Fadda, R. (2013). Bilingualism in Sardinia and Scotland: Exploring the cognitive benefits of speaking a ‘minority’ language. *International Journal of Bilingualism*, **17**(1), 43–56.
- Limberger, B. K., & Buchweitz, A. (2014). Os efeitos do bilinguismo e do multilinguismo nas funções executivas. *Fórum Linguístico*, **11**(3), 261.
- Linck, J., Hoshino, N., & Kroll, J. (2008). Cross-language lexical processes and inhibitory control. *The Mental Lexicon*, **3**(3), 349–374.
- Luk, G., & Surrain, S. (2019). *The Perceptions of Bilingualism Scales* (preprint), PsyArXiv. Retrieved from <https://osf.io/s32zb>
- Luo, L., Craik, F. I. M., Moreno, S., & Bialystok, E. (2013). Bilingualism interacts with domain in a working memory task: Evidence from aging. *Psychology and Aging*, **28**(1), 28–34.
- MacAulay, D. (1982). Register range and choice in Scottish Gaelic. *International Journal of the Sociology of Language*, **35**, 5–48.
- Macaulay, D. (Ed.). (1993). The Scottish Gaelic Language. In D. macaulay, *The Celtic Languages*, Cambridge England ; New York: Cambridge University Press.

- Madau, P., Ferguson, H. C., Dickinson, M. E., Giavalisco, M., Steidel, C. C., & Fruchter, A. (1996). High-redshift galaxies in the Hubble Deep Field: colour selection and star formation history to z 4. *Monthly Notices of the Royal Astronomical Society*, **283**(4), 1388–1404.
- Marian, V., Blumenfeld, H. K., & Kaushanskaya, M. (2007). The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing Language Profiles in Bilinguals and Multilinguals. *Journal of Speech, Language, and Hearing Research*, **50**(4), 940–967.
- Martin-Rhee, M. M., & Bialystok, E. (2008). The development of two types of inhibitory control in monolingual and bilingual children. *Bilingualism: Language and Cognition*, **11**(1), 81–93.
- Masica, C. P., & Sinha, A. K. (1986). *South Asian Languages: Structure, Convergence and Diglossia : 2nd International Conference on South Asian Languages and Linguistics : Selected Papers*, Motilal Banarsidass.
- Mejía, A.-M. D. (2002). *Power, Prestige, and Bilingualism: International Perspectives on Elite Bilingual Education*, Multilingual Matters.
- Miyake, A., Emerson, M. J., Padilla, F., & Ahn, J. (2004). Inner speech as a retrieval aid for task goals: the effects of cue type and articulatory suppression in the random task cuing paradigm. *Acta Psychologica*, **115**(2–3), 123–142.
- 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**(1), 49–100.

- Morales, J., Calvo, A., & Bialystok, E. (2013). Working memory development in monolingual and bilingual children. *Journal of Experimental Child Psychology*, **114**(2), 187–202.
- Morton, J. B., & Harper, S. N. (2007). What did Simon say? Revisiting the bilingual advantage. *Developmental Science*, **10**(6), 719–726.
- Oh, S., & Lewis, C. (2008). Korean Preschoolers' Advanced Inhibitory Control and Its Relation to Other Executive Skills and Mental State Understanding. *Child Development*, **79**(1), 80–99.
- Oschwald, J., Schättin, A., von Bastian, C. C., & Souza, A. S. (2018). Bidialectalism and Bilingualism: Exploring the Role of Language Similarity as a Link Between Linguistic Ability and Executive Control. *Frontiers in Psychology*, **9**, 1997.
- Pelham, S. D., & Abrams, L. (2014). Cognitive advantages and disadvantages in early and late bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, **40**(2), 313–325.
- Perquin, M., Vaillant, M., Schuller, A.-M., ... on behalf of the MemoVie Group. (2013). Lifelong Exposure to Multilingualism: New Evidence to Support Cognitive Reserve Hypothesis. *PLoS ONE*, **8**(4), e62030.
- Piper, B. J., Li, V., Eiwaz, M. A., ... Mueller, S. T. (2012). Executive function on the Psychology Experiment Building Language tests. *Behavior Research Methods*, **44**(1), 110–123.
- Poarch, G. J., & van Hell, J. G. (2012). Cross-language activation in children's speech production: Evidence from second language learners, bilinguals, and trilinguals. *Journal of Experimental Child Psychology*, **111**(3), 419–438.

- Poarch, G. J., Vanhove, J., & Berthele, R. (2019). The effect of bidialectalism on executive function. *International Journal of Bilingualism*, **23**(2), 612–628.
- Poulin-Dubois, D., Blaye, A., Coutya, J., & Bialystok, E. (2011). The effects of bilingualism on toddlers' executive functioning. *Journal of Experimental Child Psychology*, **108**(3), 567–579.
- Prior, A., & Macwhinney, B. (2010). A bilingual advantage in task switching. *Bilingualism: Language and Cognition*, **13**(2), 253–262.
- Raven, J. C., Court, J. H., & Raven, J. E. (1956). *Raven's progressive matrices and vocabulary scales*, San Antonio, Tex.: Harcourt Assessment.
- Ross, J., & Melinger, A. (2017). Bilingual advantage, bidialectal advantage or neither? Comparing performance across three tests of executive function in middle childhood. *Developmental Science*, **20**(4), e12405.
- Saiegh-Haddad, E., & Joshi, R. M. (2014). *Handbook of Arabic Literacy: Insights and Perspectives*, Springer Science & Business Media.
- Scaltritti, M., Peressotti, F., & Miozzo, M. (2017). Bilingual advantage and language switch: What's the linkage? *Bilingualism: Language and Cognition*, **20**(1), 80–97.
- Schroeder, S. R., & Marian, V. (2017). Cognitive consequences of trilingualism. *International Journal of Bilingualism*, **21**(6), 754–773.
- Stroop, J. R. (1974). STUDIES OF INTERFERENCE IN SERIAL VERBAL REACTIONS, 20.
- Tuller, L. (2015). 11. *Clinical Use of Parental Questionnaires in Multilingual Contexts. Assessing Multilingual Children*, Multilingual Matters, pp. 301–330.
- Valian, V. (2015). Bilingualism and cognition. *Bilingualism: Language and Cognition*, **18**(1), 3–24.

- Verhagen, J., Mulder, H., & Leseman, P. P. M. (2017). Effects of home language environment on inhibitory control in bilingual three-year-old children. *Bilingualism Bilingualism: Language and Cognition*, **20**(1), 114–127.
- Verhoeven, L., & Vermeer, A. (2002). Verantwoording Taaltoets Alle Kinderen (TAK), 49.
- Wechsler, D., & Psychological Corporation. (1949). *Wechsler intelligence scale for children: manual*, New York: Psychological Corp.
- Yang, H., Hartanto, A., & Yang, S. (2016). The Complex Nature of Bilinguals' Language Usage Modulates Task-Switching Outcomes. *Frontiers in Psychology*, **7**.
doi:10.3389/fpsyg.2016.00560

Table 1: *Studies of the effects of bidialectalism and diglossia on executive functions*

Group	Study	N	Language Pairs	Age	EF	Tasks	Results
Children	Antoniou et al., (2016)	47 MUL 25 MON 64 DI	MULT: CG+SMG+ other language. MON: SMG DI: CG-SMG	4.-12	Inhibition WM Switching	The Soccer task- Background Digit Span- Corsi block- Color-Shape Task	Diglossic children performed better than monolinguals but less well than multilingual children.
Children	Blom et al., (2017)	44 BIL 44 MON 44 BID	BIL: Dutch-Polish MON: Dutch BID: Dutch-Frisian. BID Dutch-Limburgish	6-7	Inhibition, WM, selective attention.	Flanker, Backward Digit Span, Backward Dot, visual Sky Search task	Sky Search: Frisian Dutch Bidialectals performed better than both groups. WM: No between group differences. Flanker: Monolinguals responded faster to incongruent trials than congruent.

Children	Bosma et al., (2017)	30 balanced BID 30 Dutch dominant BID	Frisian-Dutch	6-7	Inhibition WM	Flanker-backward dot Matrix task	Digit span: Dutch dominant monolinguals performed better than both groups. Matrix task/Flanker: No between group differences. Dialects -balance (proficiency) does not modulate EFs
Children	Bosma et al., (2019)	120BID	Frisian-Dutch	Time1: 5-6 Time2: 6-7 Time3: 7-8	Inhibition, WM, selective attention	Flanker, Backward Digit Span, Dot Matrix, Sky Search task	Sky Search: degree of bidialectalism predicted performance at time (1) only. Flanker, WM: No effect.
Children	Ross and Melinger (2017)	54 BIL 45 MON 48 BID 49 BIL 21 MON	BIL: Gaelic-English. MON: English BID: Southern England dialects.	6-7	Inhibition Switching	Simon, Flanker, DCCS	No between groups differences except for Simon accuracy where bilinguals performed better. No between groups differences

20 BID							The more distant the two dialects the higher EFs.
Young Adults	Antoniou & Spanoudis (2020)	46 MUL 72 DI 74 MON	MUL:CG, SMG+ other language. DI: CG+ SMG MON: SMG	18-30	Inhibition, WM, Switching	Flanker, Stroop, Nack, Cosri block, Rotation Span, Color-shape task, Number-Color task.	Multilingual and diglossics with high SMG vocabulary perform better than monolinguals. This advantage is not component specific, it is found across all EF components.
Young Adults	Poarch et al., (2019)	34 BID	Swabian-German	18-26	Inhibition	Flanker-Simon	Using the non-standard dialect more than the standard leads to better EFs.

Young Adults	Scaltritti et al., (2017)	55 BID 41 MON 56 BID	BID: Italian+ Venetian + other dialect. MON: Italian. BID: Italian + Venetian.	22-23	Inhibition	Simon-Flanker	No between groups differences Level of familiarity of the dialect doesn't correlate with higher EFs. No between groups differences
					Inhibition	Flanker	
Old Adults	Kirk et al., (2014)	23 BIL 32 MON 16 BID	BIL: English +other language. MON: English. BID: Dundonian Scots-English	80-89	Inhibition	Flanker Simon	No between groups differences

Note: BIL: bilinguals, MUL: multilingual, MON: monolinguals, BID: bidialectals, DI: diglossics, SMG: Standard Modern Greek, CG:

Cypriot Greek