The effects of using two varieties of one language on cognition: evidence from bidialectalism and diglossia

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

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Abstract

Although the question of whether and how bilingualism affects executive functions has been extensively debated, less attention has been paid to the cognitive abilities of speakers of different varieties of the same language, in linguistic situations such as bidialectalism and diglossia. Similarly to the bilingual situation, in bidialectalism and diglossia speakers have two language varieties that are active at the same time. However, these situations have been argued to potentially provide varied, and possibly fewer, opportunities for mixing or switching between the varieties, which may in turn lead to different 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 functions, diglossia.

1. Using two languages and its effects on domain general cognition

1.1. Bilingualism

The relationship between bilingualism and cognition has been the subject of considerable research for over two decades. It is generally accepted that, in the bilingual mind, both languages are constantly active (Bialystok, Craik, & Luk, 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 proposed benefits extending beyond language control to enhancements in domain-general cognitive performance, including in Executive Functions (henceforth, EFs) (Kroll & Bialystok, 2013). Miyake and colleagues (2000) identified three types of cognitive abilities as relevant to the assessment of EFs in bilinguals, : a) *Inhibition*, or inhibitory control, often measured by tasks tapping into the ability to suppress attention to, or ignore, irrelevant or distracting stimuli in order to focus on target ones, including the Flanker (Eriksen & Eriksen, 1974), Simon (Martin-Rhee & Bialystok, 2008), and Stroop tasks (Stroop, 1935), which may tap different subcomponents of inhibition (for a discussion see Poarch & van Hell, 2019)[1]; b) S*witching* (or *shifting*), 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, Emerson, Padilla, & Ahn, 2004); c) *Updating*, *which* refers to the ability to monitor and code incoming information and update it in working memory, and is commonly measured using tasks such as the Backward Digit Span (Wechsler & Kodama, 1949)

[1] However, the validity of such tasks remains controversial. For example, Rouder and Haaf (2019) argued that such tasks may not be valid measures of individual differences in cognitive control (see also Paap, Anders-Jefferson, Zimiga, Mason, & Mikulinsky, 2020), while others have argued that such tasks produce more robust results in experimental versus correlational designs (Hedge, Powell, & Sumner, 2018).

and Backward Dot Matrix tasks (Alloway, 2012) (for a recent comprehensive discussion of the EF tasks used in bilingualism research see Poarch & Krott, 2019). Bilingual children (Poulin-Dubois, Blaye, Coutya, & Bialystok, 2011), young adults (Pelham & Abrams, 2014), and older adults (Bialystok, Craik, Klein, & Viswanathan, 2004) have been shown to outperform monolingual controls on a range of tasks tapping the different domains of EFs (for a review, see Valian 2015); claims are particularly strong for effects on inhibition (Bialystok et al., 2012; Emmorey, Luk, Pyers, & Bialystok, 2008; Luo, Craik, Moreno, & Bialystok, 2013; Poarch & van Hell, 2012). When such effects are reported, they are typically called *bilingual advantages,* a term that has received a lot of scrutiny (for a discussion, see Poarch and Krott. 2019).

Nevertheless, these findings remain controversial for a variety of reasons, including low replicability between studies, and the lower likelihood of them being observed in young adults than in children and older adults; in several studies bilingual advantages failed to emerge after controlling for potentially confounding factors such as socioeconomic status, age and education (Duñabeitia et al., 2014; Gathercole et al., 2014; Kousaie & Phillips, 2012; Morton & Harper, 2007). This has led to a vivid debate on whether the advantages actually exist (Paap, Johnson, & Sawi, 2015; Valian, 2015), a position that is supported by recent meta-analyses showing that effects may not be reliable (Gunnerud, ten Braak, Reikerås, Donolato, & Melby-Lervåg, 2020; Lehtonen et al., 2018; Lowe et al., 2021; Paap, 2019). Several explanations for the discrepancies between studies have been put forward, including the variability in linguistic distance between the spoken languages in different studies (Oschwald, Schättin, von Bastian, & Souza, 2018), how bilingual groups are defined in each study, and how comparable groups are in terms of their language and cultural experiences (Calvo & Bialystok, 2014; Pliatsikas, DeLuca, & Voits, 2020; Poarch & Krott, 2019; Surrain & Luk, 2019).

More recently, the evidence has been scrutinised with respect to its ecological validity, and the extent to which it takes into consideration real life conversational patterns (Blanco-Elorrieta & Pylkkänen, 2018). Indeed, the language use patterns of the bilingual groups tested in different studies may be key in explaining the observed discrepancies. The extent to which bilingualism represents a challenge to the cognitive control systems is inextricably related to the degree to which a bilingual needs to control, and switch between, their two languages; linguistic environments that promote more switching between languages would be expected to pose greater challenges (Beatty-Martinez & Titone, 2021). Accordingly, in their Adaptive Control Hypothesis (ACH) Green and Abutalebi (2013) proposed three distinct conversational contexts with different language control needs: in *Single Language Contexts* (SLC) bilinguals typically use their two languages in clearly separated contexts, with limited opportunities for switching between them. SLCs are markedly different from the other two contexts described in the ACH. In *Dual Language Contexts* (DLC) speakers switch between the two languages depending on whom they are speaking with, while in *Dense Code-Switching* (DCS) contexts speakers might switch between languages within the same utterance (e.g. using 'choisieren'. a German particle attached to a French verb (Green & Abutalebi, 2013). According to the ACH, of the three interactional contexts, the DLC requires the highest level of language control due to the type and complexity of the language control processes taxed in such contexts. This has been suggested to lead to enhanced cognitive control skills among bilinguals operating in DLC contexts compared to those operating in SLC or DCS contexts (Yang, Hartanto, & Yang, 2016). Hartanto and Young (2020) found exactly this pattern, with bilinguals in DLC contexts showing superior switching abilities to those in SLC and DCS contexts. In addition, bilinguals in DCS contexts showed enhanced inhibitory control abilities compared to those in SLCs (see also Beatty-

Martinez et al., 2020). This is surprising, given that SLCs enforce strict separation between the two languages, involving some control processes (*goal maintenance* & *interference control)*, while DCS contexts are thought to recruit minimal control processes (only *opportunistic planning*), because switches are permitted even within single utterances (Green & Abutalebi, 2013). Hartanto and Young (2020) interpreted this surprise finding with reference to the particular code-switching patterns of their participants, suggesting that the exact characteristics of the conversational context should be looked closely when investigating such effects. Moreover, it is likely that the effects of conversational context interact with other factors related to the bilingual experience, including age of second language acquisition (Ooi, Goh, Sorace, & Bak, 2018) and language usage (Pot, Keijzer, & de Bot, 2018).

Despite the apparent importance of conversational context for cognitive control, the empirical studies and meta-analyses that argue for or against benefits of bilingualism have largely not controlled for, or even acknowledged, the role played by the conversational contexts for the bilingual participants they examined. This oversight may have contributed to the controversy in the field, and this can only be remedied by conducting investigations that isolate bilingual speakers operating in linguistic environments that correspond to the different contexts outlined above. In this paper we focus on linguistic situations with characteristics that do not correspond to the more typical DLCs, namely *bidialectalism and diglossia*. These situations, where individuals speak two *varieties* of the same language instead of two languages, have received very little attention in the literature on the cognitive effects of dual language use. Bidialectalism and diglossia share a lot of commonalities with bilingualism, notably the availability of both varieties of a language and selective inhibition of these, but they also differ in several respects. Notably, the linguistic distance between the two varieties is lower than in

bilingualism, and the opportunities to switch between varieties may differ in quantity and quality, as speakers tend to use each variety in a different context (e.g. at work vs. at home; Masica & Sinha, 1986). The effect of these usage patterns on cognition remains under-researched. A close examination of bidialectal and diglossic situations may also serve to elucidate the discrepancies in the bilingual literature; specifically, if cognitive effects are not observed in these situations, then the effects of bilingualism on cognition might depend not just on knowing two languages, but on using these in conversational contexts with many opportunities to switch between languages. Such a finding would establish the imperative need to assess and characterise the conversational context in future empirical studies.

This paper briefly describes bidialectalism and diglossia and how these differ from bilingualism, reviews the limited available evidence on the effects of these linguistic situations on domain-general cognition, and evaluates this against the predictions of the ACH. We conclude by discussing how evidence from bidialectalism and diglossia helps to resolve the current controversy in the bilingualism literature.

1.2. Bidialectalism and diglossia

As mentioned above, bidialectalism and diglossia uniquely involve the use of two highly similar *varieties of the same language* in distinct contexts. Both are characterized by the coexistence of a high (H- or standard) and low (L- or social) variety of the language, with H used in formal situations and L used at home, with social contacts, when shopping, and sometimes at work (Masica & Sinha, 1986; Muller & Ball, 2005; Scaltritti, Peressotti, & Miozzo, 2017). Both situations might therefore be classified as SLCs according to the ACH.

However, there are notable differences between diglossia and bidialectalism, particularly in terms of the relationship between the two spoken varieties. Bidialectals speak two highly similar varieties of one language, usually the standard (H) form and a regional dialect, such as Italian and Venetian (Scaltritti et al., 2017). In diglossia, which is seen most frequently in the Arab-speaking world (Kaye, 2001), the two varieties are more divergent: H, used in written literature and learned through formal education, is often highly codified and grammatically complex, while L, used for everyday conversations and learned at home, is typically less grammatically complex (Ferguson, 1959). Rowe and Grohman (2013) identified three criteria that separate diglossia from bidialectalism: (a) bidialectalism occurs when H is becoming more commonly used than L, and used for both formal and informal purposes, while in diglossia H is used only for formal purposes and L for informal purposes; (b) the 'native speaker test': in bidialectalism, native speakers do not encourage outsiders to acquire L, as this would be regarded as 'encroachment' or 'intrusion' on the group's identity. In diglossia, there are no 'native' speakers, and everyone is expected to acquire both L and H; (c) prestige: in bidialectalism, parents may avoid teaching their children L, because H is a marker of education; in diglossia, everyone is expected to acquire and use both L and H in the appropriate domain, and avoidance of L is discouraged as that might suggest 'anti-ethnicity' or denial of 'cultural heritage'. Thus, in diglossia, L is un-stigmatized despite H being associated with prestige (Rowe & Grohmann, 2013). Crucially, these criteria also suggest that bidialectalism does not always classify as an SLC, especially where the use of H has replaced L in some contexts. While it has been argued that the two situations form a continuum of use (Rowe & Grohmann, 2013), the distinctions above clearly indicate that they are not identical linguistic situations, and that their

different contexts may invite different usage patterns and switching needs, which in turn may differ from those observed in bilingualism.

1.3. Bidialectalism/diglossia vs. bilingualism

There are obvious similarities between bidialectalism/diglossia and bilingualism. Similar to two distinct languages, different varieties of a language may have different lexical, phonetic and syntactic systems (Ross & Melinger, 2017; Saiegh-Haddad & Joshi, 2014). However, there are also both linguistic and socio-cultural differences between these situations. Linguistically, two varieties of one language are always more similar than two distinct languages in terms of their grammar, vocabulary and phonology (Scaltritti et al., 2017). From a sociocultural perspective, while bidialectal/diglossic individuals often view one of their varieties (typically H) as 'prestigious' and the other (typically L) as 'socially stigmatized', whether higher value is placed on languages in bilingualism might depend on the country's colonial history and educational systems etcetera. (for a discussion, see de Mejía, 2002). For the current discussion, the most important social difference between bidialectalism/diglossia and bilingualism is the nature and amount of code-switching that occurs between the two varieties or languages (Masica & Sinha, 1986), which has been shown to be related to the perceived social status of each language (Blokzijl et al., 2017). Bilinguals are argued to have more opportunities to switch between languages in the same context, because, as described in the previous section, bidialectals and diglossics typically use each variety in different contexts (Scaltritti et al., 2017), clearly delineated by social or other norms. This is particularly true in diglossia, which is the clearest case of an SLC, as defined by the ACH; specifically, while everyone is expected to speak both varieties, the use of these, and when it is appropriate to switch between them, are heavily

restricted by context. On the other hand, in bidialectalism, usage patterns might vary significantly across contexts; in societies where H has taken over L and strict separation between them is socially stigmatised, more frequent switching would be expected (Rowe and Grohman, 2013), and usage patterns might resemble DCS contexts, as defined by the ACH.

In sum, bidialectalism and diglossia present useful test cases of the cognitive effects of juggling two varieties of a language that are linguistically closer than two separate languages, and whether these effects depend on the relative usage of each variety and the amount of switching between them. This paper now turns to the empirical evidence on the effects of bidialectalism and diglossia on cognition, and evaluates this against the predictions of the ACH for these contexts. Our review includes all available studies in which (a) speakers use two varieties of the same language, and (b) the EFs of these bidialectals/diglossics were tested and compared against those of bilinguals and/or monolinguals. Evidence on diglossia comes from a small number of studies conducted in Cyprus, where the separation of the two varieties of Greek is assumed to be strict. Other linguistic environments are classified as bidialectal, and the two varieties are less separated in usage. We chose to include Frisian-Dutch bilingualism in the latter group because of the small linguistic distance between the two languages and because usage patterns closely resemble those in bidialectalism (e.g. switching patterns) (Blom, Boerma, Bosma, Cornips, & Everaert, 2017; Muysken, 2000). Following on typical reporting in the bilingual literature, evidence from children and from younger and older adults is presented separately. This is because effects of bilingualism are more commonly reported in children and older adults; the relative lack of such effects in young bilinguals has been attributed either to them being at their cognitive peak, where no further ‘enhancement’ is possible (Kroll & Bialystok, 2013), or to them being involved in other activities that produce effects similar to

those of bilingualism (Valian, 2015). Studies on bidialectalism are presented first, followed by studies on diglossia. Based on the definitions of our contexts of interest and the predictions of the ACH, we hypothesised the following: in contexts that resemble SLCs, cognitive benefits will be limited and seen only in tasks tapping processes required in such contexts, namely goal maintenance and interference control, as measured by tasks such as the Flanker and Stroop tasks. This prediction is stronger for diglossic than bidialectal environments, as the former are more likely to be 'pure' SLCs (see discussion above). For the purposes of this review, we follow the authors of the original studies in using the term 'advantage' in cases where bilingual/bidialectal/diglossic groups outperform monolingual controls. However, we reiterate here that the use of this term remains controversial given the mixed results and limited evidence of impact on real-life outcomes, and note recent suggestions that it should be abandoned (Poarch and Krott, 2019).

<Insert Table 1 about here>

2. Studies of executive functions in bidialectalism

2.1. Children

Four studies have investigated EFs 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 years and lived in Scotland or England. Bilingual children reported significantly more frequent use of their second language than bidialectals reported using their dialect. In experiment one, children were tested using Flanker and Simon tasks. In experiment two, a subset of the same children were tested using an age-appropriate version of the Dimensional Change Card Sort (DCCS) task. The groups performed similarly across tasks, except for the Simon task, where bilingual children showed higher accuracy than other groups. The study concluded that there were no bilingual or bidialectal benefits across the three tasks, and that any effects may be both task-specific and age-specific, as others have also reported benefits in Simon tasks for bilingual children around 5 years of age (Morales, Calvo, & Bialystok, 2013). This specificity might explain the very mixed results of studies exploring bilingual advantages in childhood (Duñabeitia et al., 2014; Poarch & van Hell, 2012). With respect to the bidialectal group, the authors attributed their null findings to the close similarity of the two dialects: Although Standard English differs from the Dundonian dialect, the authors noted that Standard English is not commonly spoken in Scotland; rather, Scots use *Scottish Standard English,* which is more similar to Dundonian Scots. Second, the Dundonian dialect is comprehensible to speakers of non-Scottish dialects, making the bidialectal situation in this study quite dissimilar to situations in countries where the local dialect differs substantially from the Standard dialect. Ross and

Melinger (2017) argued that the more different the regional dialect is from the Standard dialect, the more effort is needed to prevent interference, leading to greater demands on EFs. They therefore suggested that future studies should involve bidialectal groups speaking dialects that are distinctively different.

Using more distant dialect pairs, Blom et al. (2017) investigated potential cognitive differences between four groups of participants: monolingual Dutch, two groups of bidialectal Dutch children who spoke the regional dialects of Frisian or Limburgish, and Dutch bilinguals who used a migrant language (Polish). All participants were 6 to 7 years, had comparable exposure to Dutch and were assessed using a battery of EF tasks tapping working memory, (Backward Digit Span & Backward Dot Matrix), inhibition, (Flanker), and visual selective attention (Sky Search). Results revealed no significant differences between groups on most tasks, except for selective attention, where the Frisian-Dutch bidialectals and a subgroup of proficient Polish-Dutch bilinguals outperformed monolinguals. 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 better performance than the Limburgish-Dutch bidialectals.

The benefits shown by the Frisian-Dutch bidialectals were not modulated by children's proficiency in their respective dialects. Blom and colleagues (2017) attributed their findings to the different conversational contexts and language uses of the two bidialectal groups. Specifically, while Dutch is the most important language of instruction for both groups, Frisian is also a language of instruction for Frisian-Dutch children, taught at school for at least one hour per week, while Limburgish is the language more widely used in the community by Limburgish-

Dutch bidialectals. Thus, it is possible there is clearer language separation in the Frisian-Dutch context (i.e. this is an SLC) and more language mixing in the Limburgish-Dutch context (resembling a DCS context). If contexts that allow frequent code-switching are less associated with cognitive control than those that impose stricter separation between languages, as claimed by Green & Abutalebi (2013), the observed advantage for Frisian-Dutch speakers is to be expected.

Dialect use and its effects on EFs might also be modulated by dialect proficiency. Bosma, Blom and Versloot (2017) examined this by assessing Frisian-Dutch bidialectals in different language domains including receptive and expressive skills. A language assessment battery was used to divide participants into two groups: Dutch-dominant, who performed better on the Dutch versions of the tasks, and balanced Frisian-Dutch, who performed similarly in both Dutch and Frisian tasks. As expected, the groups 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), a visuospatial working memory task (Backward Dot Matrix), and the Sky Search task. Balanced bidialectal children significantly outperformed Dutch-dominant bidialectals in the Digit Span task and the Sky Search tasks only, leading Bosma and colleagues to suggest that any benefits related to bidialectalism may be task-specific. However, the lack of monolingual or bilingual control groups makes it difficult to interpret these effects as bidialectal advantages; if anything, these effects argue for effects of balanced used of two languages/dialects on cognition.

Using similar methods, Bosma, Hoekstra, Versloot and Blom (2017) investigated whether the degree of bidialectalism, defined by balanced proficiency in the two dialects, predicts children's performance on EFs tasks over time. They also investigated whether the

intensity of home exposure to the regional dialect (Frisian) predicts EF ability, based on 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, at ages 5-6, 6-7 and 7-8. The degree of bidialectalism was measured in terms of children's proficiency in receptive vocabulary and expressive morphology in both Frisian and Dutch. EF measures included the Flanker test, the Sky Search task, and the Backward Digit Span and Dot Matrix tasks.

Results revealed a correlation between the degree of bidialectalism and performance on the Sky Search task, which was significant at the youngest age tested (5-6 yrs.), and bordered on significance at age 6-7 years. No effects were reported in any of the other tasks for any age group. Bosma and colleagues (2017b) argued that the developmental pattern in performance might be due to the age of introduction of formal literacy classes in Dutch, which might have affected the performance of children after the first measurement. Alternatively, children may have become more proficient in both language, and their bilingual monitoring more automatic as a result of their formal education, with no further enhancement of EFs expected. The study also showed that intensity of exposure to Frisian was correlated with the degree of bidialectalism at all three ages, and with performance on the Sky Search task in the younger two age groups; however, the latter effect disappeared after controlling for degree of bidialectalism. The authors concluded that the level of exposure to the minority language at home relates to degree of bidialectalism, which in turn predicts children's cognitive abilities. The authors also concluded that selective attention, rather than inhibition, is the core skill affected by bidialectalism, however, this effect is not long-lasting, and disappears after early childhood.

2.2. Young adults

Two studies have looked at cognition in bidialectal young adults (see Table 1). Scaltritti and colleagues (2017) investigated the effects 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., at home, school, with friends) were used to compute a dialect familiarity score. This score failed to predict participants' performance in the Flanker and Simon tasks, an effect that the authors attributed to the subjectivity of the collected measures. In a follow up study (Experiment 2), Scaltritti et al. compared Italian-Venetian bidialectals to Italian monolinguals on the Flanker task. Bidialectals completed the same questionnaire as in Experiment 1, and their proficiency in the Venetian dialect was additionally assessed via sentence completion (receptive language) and spontaneous speech (expressive language) tasks. No between-group differences were reported on the Flanker task, and dialect familiarity and proficiency scores failed to predict bidialectals' performance. The authors attributed the lack of bidialectal benefits to their limited opportunities for switching between Venetian and Italian, reinforcing the view that bidialectalism in this region corresponds to an SLC.

Poarch, Vanhove and 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.), who reported to experience a range of SLC/DLC type usages. Dialect use was assessed using an adapted version of the Bilingual Language Profile (BLP) questionnaire (Gertken et al., 2014), which yielded a measure of language dominance ranging from Swabian-

dominant to balanced Swabian-German speakers. Participants were assessed on the Simon and Flanker tasks. Contrary to the authors' predictions, dialect dominance was negatively correlated with performance, in that the stronger the Swabian dominance the smaller the Flanker and Simon effects (i.e. the better the cognitive control). This finding led Poarch and colleagues to conclude that performance on EF tasks is not related so much to balanced usage of the two dialects, but to the amount of exposure to the minority language (in this case, Swabian), a finding that is in line with Bosma et al (2017b). Poarch and colleagues (2019) point out that bidialectal children are likely to be literate only in the majority language, which might have an effect on patterns of language use and performance, and consequently, any observable effect of these patterns on cognition. Poarch and colleagues (2019) also highlighted that authors take different approaches to statistical analysis (e.g., whether to transform the data; whether to exclude some data points). In their conclusion, the authors recommend that future studies should minimize these arbitrary decisions, to reduce the inconsistencies in their results.

2.3. Older adults

Three studies have investigated potential cognitive effects of bidialectalism in older adults (Table 1). Kirk, Fiala Scott-Brown and Kempe (2014) compared performance of five groups of participants aged 60 years or above on a Simon task. In descending order of language/dialect switching frequency, the groups were: 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; Gaelic-English bilinguals; Dundonian Scots-English monodialectals (functionally monolingual); and English monolinguals. Results revealed no differences between the groups. Kirk and colleagues (2014) explained their null findings in terms

of participants' schooling environments, which they use as a proxy for the interactional contexts defined by Green & Abutalebi (2013). Specifically, 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 an SLC. Kirk and colleagues (2014) argued that, if the interactional context plays a role in enhancing EFs, SLCs, with their lack of opportunities for dual-language use, might not result in domain-general cognitive benefits. However, the authors did not provide information about the bidialectals' schooling or use this to explain the findings for this group.

Houtzager, Lowie, Sprenger, and de Bot (2017) investigated whether life-long experience of bidialectalism can result in enhanced switching abilities. Crucially, Houtzager and colleagues also took into account working memory capacity, which is known to decline with age and might therefore affect participants' performance in the switching task. Fifty Frisian–Dutch bidialectals and 50 functional monolinguals were administered a cued Colour–shape switching task and a Corsi blocks working memory task. Participants were further divided into 'middle-aged' (35–56 years) and 'elderly' (65–85 years) groups, which were matched on demographic factors such as socio-economic status, as indicated by educational and occupational levels. Bidialectals exhibited lower switching costs than monolinguals in the Colour–shape task, and the effect was more pronounced in the elderly group. No effects of bidialectalism were reported for the Corsi blocks task. Houtzager and colleagues interpreted their results as evidence for a bidialectal advantage in task-switching, and suggested that this is caused by life-long experience of using two dialects.

More recently, Hsu (2021) investigated whether bidialectal benefits are consistent across verbal and non-verbal tasks of differing levels of difficulty. Hsu tested 20 Mandarin

monolinguals (mean age= 67.7, SD= 4.3) and 20 unbalanced bidialectals with Mandarin as the non-dominant language (10 Minnan- Mandarin bidialectals (mean age= 68, SD=4.7), 10 Hakka-Mandarin bidialectals (mean age=68.7, SD=4.5)) in two experiments. In Experiment 1, four non-verbal tasks were administered at differing difficulty levels, including a Flanker task (easy), a Simon Colour-shape task (easy), a spatial 1-back task (intermediate) and a Stroop colour-word task (difficult). Bidialectals were overall faster than monolinguals in the Stroop colour-word task, but not in any of the other tasks. Hsu interpreted this effect as evidence for a bidialectal advantage and attributed it to the particular difficulty of the Stroop task, where the target and the distractor are merged in one stimulus, making it difficult to avoid interference from the distractor (Chen, 2003; Hsu, 2021). In Experiment 2, the same groups were tested on four verbal tasks of varying levels of difficulty: Number Stroop (easy), Stroop colour-word (intermediate), Stroop day-night (intermediate), and Stroop picture-naming (very difficult). Bidialectals were faster than the monolinguals on the two intermediate-level tasks. Hsu concluded that bidialectal advantages similar to those reported for bilingualism may only be found in tasks tapping attentional and inhibitory control at appropriate levels of difficulty (not too easy but not excessively difficult). Nevertheless, strong conclusions cannot be drawn from this study, given the small sample size .

3. Studies of executive functions in diglossia

3.1. Children

Only one study has investigated the effects of diglossia on EFs in children. Antoniou et al. (2016) assessed EFs in 136 children in Cyprus, where Cypriot Greek (CG) is the L variety and Standard Modern Greek (SMG) the H variety. Children were divided into three groups: CG-

SMG diglossics, recruited from schools offering traditional Greek-speaking programs; multilingual CG-SMG diglossics who also spoke English, recruited from schools in Cyprus; and monolingual SMG children, recruited from schools in Greece. Participants were assessed on measures of working memory (Background Digit Span & Corsi Blocks), inhibition (Soccer task), and switching (Colour-shape task). Multilingual children performed better than diglossic and monolingual children on all tasks, which the authors attributed to the bilingual/multilingual's ability to jointly recruit different EF components (Green & Abutalebi, 2013). Interestingly, when differences in language proficiency were controlled for, diglossic children were found to outperform monolingual children on all tasks. The authors proposed that diglossic children have an enhanced ability to recruit different EFs components, albeit to a lesser extent than multilinguals. The study concluded that cognitive advantages are achieved through the acquisition and use of language varieties (dialects) as well as through the learning of more than one language.

3.2. Young adults

Antoniou & Spanoudis (2020) adopted the methods of Antoniou and colleagues (2016) to examine the effects of speaking more than one language or dialect on EFs in young adults. Seven EF tasks were administered to three groups of participants: 46 multilinguals (speaking CG, SMG & another language), 72 diglossics (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. The three groups were matched on age, educational level, and socio-economic status. Inhibition was tested using the Stroop and Flanker tasks, working memory was tested using the Nback, Rotation Span and Corsi Blocks tasks, and switching was assessed using the Colour-

shape and Number-colour tasks. The results largely replicated those reported in Antoniou et al., (2016); multilinguals and diglossics with a high level of SMG proficiency showed similar performance across the various EFs tasks and outperformed monolinguals. When vocabulary size in SMG was controlled for, there was no group by task interaction, confirming that the multilingual/diglossic benefit is found broadly across the EF sub-domains.

4. Bidialectalism and diglossia as interactional language contexts

As discussed earlier, any effects of using two languages (or two varieties of a language) on domain-general cognitive control might depend on the opportunities different contexts provide to switch between them. While a cognitively challenging, long-term experience like controlling two languages that can be used interchangeably can affect EFs, as shown by studies of bilingualism, similar effects should not be expected where there are minimal opportunities for language mixing and/or switching. This paper has reviewed the evidence from bidialectalism and diglossia, where the two language varieties are reserved for different contexts; on the assumption that these situations broadly correspond to SLCs, benefits would not be expected, or at most should be limited to components of EF that are relevant to such contexts, such as goal maintenance and interference control. Our survey produced mixed results in relation to this prediction. While the majority of the studies involving bidialectal groups provided little evidence for effects on EFs, some studies found limited benefits, usually in contexts where the two dialects were used equally, or in a *balanced* manner. Such contexts may more closely resemble DLC or even DCS contexts as defined by the ACH, if balanced use is a result of opportunities to use both dialects across a range of contexts, and lead to enhanced EFs as a result. However, other

studies found opposite patterns of results (Bosma et al., 2017b; Poarch et al., 2019), suggesting that further study is warranted.

In contrast, the two studies that looked at the effects of diglossia on cognition found benefits in both children (Antoniou et al., 2016) and young adults (Antoniou & Spanoudis, 2020). We argued above that diglossic environments are more typical examples of SLCs than bidialectal environments, and should therefore, at best, yield benefits in goal maintenance and interference control. However, the evidence does not support these predictions, as evidence for diglossic benefits was seen across all EF domains. The specific linguistic situation of Cypriot-Greek, which has been identified by Rowe and Grohmann (2013) as "diglossic transitioning into type B diglossia or '*diaglossia*'" might account for the discrepancy; the use of H is no longer restricted to written purposes, but also extends to oral communications, meaning code-switching depends more on the situation than the modality (speaking/writing) (Auer, 2005), as in bilingualism. The increasing tendency to use H where L would historically have been expected negates the clear separation between the two varieties seen in more typical diglossia, allowing for more switching between dialects than one would see in traditionally defined diglossia. Indeed, switching between the two varieties happens frequently and naturally in Cypriot Greek, sometimes even unintentionally (Pavlou, 2004). This brings into question whether language usage in Cyprus should be treated as diglossic, and what studies from it can reveal about the effects of SLCs on cognition. For this reason, we are cautious to not overinterpret these findings.

Further research with other diglossic dialect pairings is clearly required. Our limited knowledge of diglossia is accompanied by only a vague understanding of how speakers in diglossic environments use H and L. Speakers in different diglossic societies vary considerably in terms of their exposure to a particular variety and the criteria they use for switching between

the two varieties. For example, in Greece, a high variety of Greek, *katharevousa*, was used until recently for formal documents and speeches but is now becoming extinct, with the low variety, *demotiki*, becoming used for all purposes (Kaye, 2001). Countries in the Arab-speaking world may be more typically diglossic. It has been suggested that educated speakers of Arabic would find it hard to carry on a conversation in H without switching to L, many native speakers of Arabic would find it difficult to understand complicated texts written in H, and an illiterate person would barely understand H at all (Kaye, 2001). The amount of exposure a speaker has to H may be an important factor in determining whether what appears to be a case of diglossia is actually closer to bidialectalism or even bilingualism (Kaye, 2001). There are therefore grounds to argue that not all diglossic environments would produce the pattern of results reported by Antoniou et al. (2016) and Antoniou & Spanoudis (2020): exposure to the two varieties differs from one diglossic environment to another, and Cyprus may not constitute a typical diglossic environment.

5. Implications for theories of cognitive benefits in bilingualism

The literature reviewed suggests that diglossia (as experienced in Cyprus) affects domain general cognitive control, both in children and in young adults, while evidence from bidialectal contexts is mixed, with benefits more likely to be seen in older samples (echoing the pattern in studies with bilinguals) and immersive bidialectal environments (e.g. Frisian-Dutch contexts). If the contexts in which language varieties are used is key in explaining the lack of consistency in the bidialectal literature, the inconsistent results of studies involving bilingual speakers might benefit from similar consideration. This suggestion has been put forward previously. For example, the lack of cognitive benefits in bilingual immigrants, especially those residing in

English-speaking countries, has been attributed to the lack of opportunity for switching in the new 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 SLCs (Kirk et al., 2014). An SLC, rather than a DLC, may apply 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, 1993) do not show bilingual benefits (Kirk et al., 2014; Ross & Melinger, 2017). The same is true of Sardinian-Italian bilinguals; Sardinian is used only for writing and Italian for speech, offering few opportunities for switching between languages, and creating an SLC. It is hardly surprising that studies have failed to find any bilingual benefits in EFs in Sardinian-Italian bilinguals (Garraffa, Beveridge, & Sorace, 2015; Lauchlan, Parisi, & Fadda, 2013). Such examples strengthen the argument that knowing two languages is *not* the key factor in modulating EFs; rather, it is how speakers of a community use each language/variant in different interactional contexts that strengthens EFs (Green and Abutalebi, 2013).

Studies of EFs in bilingualism have also given little attention to the role of *balance* in the use of the bilingual's languages. Bilinguals with balanced use of their two languages can be assumed to have more opportunities to use and switch between, them compared to those with imbalanced use, where one language is likely to be restricted to certain contexts and/or interlocutors, with limited opportunities for code-switching. Indeed, Guerrero et al., (2015) reported that bilingual children who speak two languages at home in a balanced manner show smaller switching costs in tasks measuring attention and switching than bilingual children for whom one language is more dominant at home (Hartanto & Yang, 2016). Further, bilingual

children whose parents speak both languages at home have been shown to outperform bilingual children whose parents speak only one language on a battery of inhibitory control tasks (Verhagen, Mulder, & Leseman, 2017). This particular finding corroborates Bosma et al.'s (2017a) report that balanced bidialectal children performed better in a digit span task than Dutch-dominant bidialectal children. Again, if balanced language use plays a crucial role in the strengthening EFs, patterns of language/variety use must be taken into account in studies of bilingualism, bidialectalism or diglossia. Usage patterns can be assessed using tools measuring everyday code-switching patterns (Hofweber at al. 2019) or via measures of language entropy (Gullifer & Titone, 2020). Such measures can be used to characterise a conversational context, to separate participants of a study into defined language context groups, and/or as continuous predictors of the effects of bilingual experience (Pliatsikas et al., 2020). In sum, our review of the available studies on bidialectalism and diglossia strongly suggests that the balance of language/variety use across conversational contexts plays an important role in modulating EFs. Most importantly, we recommend that studies of dual language use, including bilingualism, bidialectalism, diglossia or any other complex language situation, should pay attention to the role of conversational context. We suspect this may solve the long-running debate in the literature regarding the cognitive effects of bilingualism.

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

Group	Study	Language groups	Age (years), and SES controls		Tasks	Results
Children	Antoniou et al. (2016)	47 MUL (CG, SMG, other) 64 DI, (CG, SMG), 25 MON (SMG)	4–12, SES controlled for	Inhibition, Updating Switching	Soccer, Background Digit Span, Corsi block, Colour–shape	All tasks: Both DI and MUL outperformed MON
Children	Blom et al. (2017)	44 BIL (Dutch, Polish) 44 BID (Dutch, Frisian and Dutch, Limburgish) 44 MON (Dutch)	6–7, SES controlled for	Inhibition, Updating, Selective attention	Flanker, Backward Digit Span, Backward Dot, visual Sky Search	Sky Search: BIL and Frisian–Dutch BID outperformed MONO
Children	Bosma et al. (2017a)	30 balanced BID (Frisian, Dutch) 30 Dutch dominant BID (Frisian, Dutch)	6–7, SES matched	Inhibition, Updating, Attention	Flanker-backward dot, Matrix, Sky Search	Digit Span and Sky Search: balanced BID outperformed dominant BID.
Children	Bosma et al. (2017b)	120 BID (Frisian, Dutch)	5-8, SES controlled for	Inhibition, Updating, Selective attention	Flanker, Backward Digit Span, Dot Matrix, Sky Search task	Sky Search: Degree of bidialectalism predicted performance at ages 5-6.

Children	Ross & Melinger (2017)	Study 1: 54 BIL (Gaelic, English) 48 BID (Dundonian Scots, English) 45 MON (English) Study 2: 49 BIL, (Gaelic, English) 21 MON, (English) 20 BID, (Dundonian Scots, English)	6–7, SES matched	Inhibition, Switching	Simon, Flanker, Dimensional Change Card Sort DCCS	Simon: BIL outperformed DI and MON in accuracy only
Young Adults	Antoniou and Spanoudis (2020)	46 MUL (CG, SMG, other) 72 DI (CG, SMG), 47 MON (SMG)	18–30. SES matched	Inhibition, Updating, Switching	Flanker, Stroop, Nback, Corsi block, Rotation Span, Colour–shape, Number–colour	Across all EF components: MUL and DI outperform MON
Young Adults	Poarch et al. (2019)	34 BID (Swabian, German)	18–26, SES controlled for	Inhibition	Flanker, Simon	Flanker and Simon effects negatively correlated to a measure of dialect dominance.
Young Adults	Scaltritti et al. (2017)	Experiment 1: 55 BID (Italian, Venetian) Experiment 2: 56 BID (Italian, Venetian), 41 MON (Italian)	22–23, SES kept constant	Inhibition Inhibition	Simon, Flanker Flanker	Performance not predicted by a dialect familiarity score No significant differences between the groups .
Older Adults	Houtzager et al. (2017)	50 BID (Frisian, Dutch) 50 MON (German or English)	35-85, SES matched	Switching, Updating	Colour-shape switching, Corsi block	Colour-shape switching: BID outperformed MON

Older Adults	Hsu (2021)	20 BID (Minnan, Mandarin, or Hakka, Mandarin) 20 MON (Mandarin)	61–71, SES kept constant	Inhibition, Updating	Nonverbal EF tasks of increasing difficulty Verbal EF tasks of increasing difficulty	Nonverbal tasks: Stroop colour–word (intermediate difficulty): BID outperformed MON Verbal tasks: Stroop colour–word and Stroop day–night (intermediate difficulty): BID outperformed MON
Older Adults	Kirk et al. (2014)	16 BIL (English, other) 16 BIL (Gaelic, English) 16 BID (Dundonian Scots, English) 16 monodialectals (functionally monolingual- English) 16 MON (English)	80–89, SES controlled for	Inhibition	Simon	No between-group differences

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