Bilingualism, Culture, and Executive Functions

Subjects: Psychology

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Much research to date exploring whether bilinguals have an advantage over monolinguals in terms of executive functions (EF) often conflates bilingualism with bi/multiculturalism. Here, the researchers review the evidence for why culture should be carefully scrutinised as a critical variable that could mediate bilinguals' EF.

culture bilingualism executive function biculturalism bilingual advantage

1. The Bilingual Advantage in EF Debate

While the exact definition and components of EF are still the subject of much debate (see Miyake and Friedman 2012 for a discussion), the consensus is that EF are higher-order cognitive functions that can be categorised into three core groups: inhibition and interference control (e.g., selective attention and behavioural and cognitive inhibition), cognitive flexibility (i.e., mental flexibility in task and set shifting), and working memory (Diamond 2013; Miyake et al. 2000). EF are believed to be the foundation upon which essential skills such as planning (Collins and Koechlin 2012) and critical reasoning (Lunt et al. 2012) are built. Moreover, they are also found to predict theory of mind in developing children (Sabbagh et al. 2006) and have significant implications for an individual's personal, social, and academic development (Best et al. 2011).

Proponents of a bilingual advantage in domain-general EF argue that the advantage stems from a bilingual's need to direct attention in monitoring speech input and selecting the appropriate language to respond while inhibiting the production of words and phrases in the other language(s). Some studies have suggested that all languages in a bilingual's repertoire are jointly activated (Costa et al. 1999; Marian and Spivey 2003; Thierry and Wu 2007) during listening (Spivey and Marian 1999), reading (Dijkstra and Kroll 2005), and speech (Kroll et al. 2006). The act of "juggling" multiple activated schemas is said to hone domain-general interference and inhibition control (Kroll et al. 2015).

In the recent literature, the researchers can track two dominant views explaining the roots of the bilingual advantage. The first model, put forth by Green (1998), has sometimes been termed the "Inhibition Control Model" proposes that bilinguals' experience in inhibiting the co-activated non-relevant language is present even in monolingual speech contexts. This experience enhances their ability to inhibit distracting or irrelevant stimuli better than monolinguals. Some key studies supporting this view include those of Bialystok et al. (2004) and Kroll et al. (2008). Expanding on this model, Green and Abutalebi's (2013) adaptive control hypothesis argues that different control processes, including goal maintenance, conflict monitoring, interference suppression, cue detection,

response inhibition, task (dis)engagement, and opportunistic planning, are activated depending on the demands of different interactional contexts (single language, dual language, and dense code-switching). Emerging evidence suggests depending on the level of cognitive control, these different contexts could result in varying enhancements of cognitive control (Beatty-Martínez et al. 2020; Ooi et al. 2018). Other researchers have suggested that code-switching between languages intersententially and intrasententially might share similarities with domain-general task switching (Prior and MacWhinney 2009; Hartanto and Yang 2016). Supporting evidence for this hypothesis comes from brain imaging studies which showed an overlap in neural connections and architecture for language switching and domain-general non-linguistic switching tasks (de Baene et al. 2015; Weissberger et al. 2019). Proponents of this model theorise that these "cognitive exercises" augment domain-general EF and confer a bilingual advantage that is evident in children as young as 7 months old (Kovács and Mehler 2009).

The second model takes the view that inhibition and control alone are insufficient to explain the enhancement of bilinguals' cognitive abilities. Bialystok et al. (2010; see also Bialystok 2015, 2017) discussed the possibility that the bilingual advantage in EF may stem from how bilinguals monitor, control, and direct attention and that bilingual exposure may alter how individuals manage these resources (cf. Bialystok et al. 2012; Colzato et al. 2008; Costa et al. 2009). This concept, put forth as attentional control, is thought of as being broader than any single component in Miyake's (Miyake et al. 2000) three-component model of EF (inhibition and interference control, shifting, and working memory). It involves the ability to monitor, suppress, or ignore irrelevant stimuli and direct cognitive resources to either maintain or switch depending on the relevant information (Bialystok 2017). Indeed, Bialystok and Craik (2022) suggested that bilinguals' ability to direct attention has a far-reaching prowess which is enough to "enhance processes of both facilitation and inhibition, as well as processes underlying cognitive flexibility and resource allocation".

Since the early 2000s, numerous studies across the field have reported on how bilinguals excel in tasks requiring participants to pay attention to relevant information while suppressing distracting changes to rules or irrelevant cues. These advantages reportedly extend to adults, as evidenced by their greater accuracy and faster resolving of incongruent stimuli in the Simon (Antoniou et al. 2016; Bialystok et al. 2004; Tse and Altarriba 2014), Flanker (Costa et al. 2009), and Stroop tasks (Nayak et al. 2020; Poulin-Dubois et al. 2011). They were also observed among the elderly (above 60 years of age), who showed lower processing costs, suggesting greater efficiency even after considering the typical age-related decrease in performance. This led some scholars to suggest that lifelong bilingualism may mitigate specific age-related declines in cognitive performance when concerning inhibition and control (Bialystok 2021).

Bialystok (2011) argues that bilinguals' ability to switch between languages or language varieties fluidly may enhance their cognitive flexibility, especially in switching and shifting tasks. A seminal study by Prior and MacWhinney (2009), which showed how proficient bilingual college students outperformed monolinguals in reaction time during switch trials but not in non-switch trials, points to a bilingual advantage in cognitive shifting. Similar studies, such as that by Wiseheart et al. (2014), have also reported how bilinguals were better able to resolve ambiguity in stimulus–response associations, resulting in lower global switching costs. Bilinguals are also thought to hone cognitive control as a response to their sociolinguistic environment, with varying levels and types

of code switching (e.g., intersentential vs. intrasentential), resulting in more efficient cognitive processing faculties shown, for example, in reduced switching costs (Yang et al. 2016).

Up till 2010, the evidence for a bilingual advantage in the literature is robust. However, in more recent years, the bilingual superiority effect in EF has not been unanimously reported. In the last decade, many studies have either failed to replicate findings reporting a bilingual advantage or did not come to that conclusion when comparing bilingual and monolingual populations.

2. Conflicting Findings in EF Performance

2.1. Methodological Concerns

In recent years, challenges to the firm conclusion of a bilingual advantage have been highlighted from various perspectives and by different research groups (Hernández et al. 2013; Paap and Greenberg 2013; Paap and Sawi 2014; Paap et al. 2015; Antón et al. 2014; de Bruin et al. 2015; Von Bastian et al. 2016). A vital issue of concern that has been widely discussed is publication bias, where journal publications favour the publishing of significant effects in support of a bilingual advantage (de Bruin et al. 2015). Lehtonen et al.'s (2018) meta-analytic review is, by far, the most comprehensive attempt to synthesise existing studies relating to bilingualism and executive functions in adults. The review involved 152 studies covering a range of 6 executive function domains (inhibitory control, monitoring, shifting, working memory, attention, and verbal fluency). The authors included unpublished doctoral and masters' theses in addition to journal articles while accounting for the various effect sizes of each paper to mitigate the effects of publication bias. They reported that no apparent advantage in any of the six executive function domains provided evidence that bilingual adults were at an advantage compared with their monolingual peers after correcting for publication bias.

Several studies have also been unable to replicate the findings of the original bilingual advantage found in seminal studies for the Stroop (Paap et al. 2018, 2019), Simon (Gathercole et al. 2014), and Flanker tasks (Paap et al. 2019) and switching ability (Goriot et al. 2018), even after matching monolingual and bilingual participants to a number of linguistic and sociodemographic variables. Paap's (2019) comparison of mean reaction time differences in interference-control tasks across 177 studies for "benchmark" tests of interference-control, such as the Simon, Stroop, Flanker and Attention Network Tasks (ANT) also found that more than 80% of studies returned null results. Indeed, such studies raise important questions regarding both study quality and replicability. Furthermore, a recent meta-analysis by Lowe et al. (2021) synthesised data from a profusion of published studies and unpublished data sets to examine the effect of language status (bilingual vs. monolingual) on EF among children. After comparing more than a thousand effect sizes in studies with monolingual and bilingual participants between 3 and 17 years, the researchers detected a small overall effect of bilingual language status on children's EF that was completely attenuated when corrected for publication bias.

2.2. Potential Confounds

Other than the methodological issues raised, some researchers argue that differences in experimental designs and confounds in participant selection have led to discrepancies in findings. Variables such as ethnicity, social background, and social-economic status (Bak 2016; Blom et al. 2017; Morton and Harper 2007), different definitions of early or late bilingualism (Yang et al. 2016), a participant's cultural upbringing (Tran et al. 2015), or immigrant status (Kousaie and Phillips 2012) have not always been well controlled or considered in many studies, showing a bilingual advantage in EF. Interestingly, much of the discussion is very similar to the discussion raised in Peal and Lambert's (1962) watershed report on the effect of bilingualism on cognition. Researchers such as de Bruin (2019) have called for more nuanced studies that consider the complex social variables that influence bilinguals as part of different groups and communities. In the following section, the researchers examine some possible reasons for the contradictory findings and put forth a case for why culture as a variable should be considered in earnest by researchers in the field.

The lack of a bilingual advantage in the abovementioned studies signals the need for closer scrutiny of the variables that may contribute to bilinguals' seemingly variable performance. As Luk and Bialystok (2013) pointed out, the cognitive consequences of bilingualism need to be considered within the broader, multi-dimensional bilingual experience (See also Valian (2014) and de Bruin (2019) for more recent commentaries on how bilinguals' environmental contexts, social interaction habits, and various sociolinguistic variables may influence the findings for EF). Over the years, various sources of variation have been proposed - from age related effects (Abutalebi et al. 2015; Antoniou and Wright 2017; Nickels et al. 2019) to age of acquisition (early vs. late bilingualism, sequential vs. simultaneous bilingualism) (Byers-Heinlein and Lew-Williams 2013), and even issues of language proficiency and balance Tse and Altarriba (2012) ; Yow and Li (2015) .

3. Culture: An Often-Overlooked Factor

Another factor that has seldom been discussed is the effect of culture as a potential confounding variable. Culture is undoubtedly a complex construct that can be defined at many levels. It must encompass the depth and breadth of interactions, behaviours, emotions, mindsets, and ways of being, both tangible and intangible. For the purpose of this research, culture will be taken to refer to the learned and shared system of beliefs, values, preferences, and social norms that are spread by shared activities (Altarriba and Basnight-Brown 2022; Arshad and Chung 2022; Bezin and Moizeau 2017).

Over the years, various operationalisations have been proposed to allow researchers to distinguish between cultures. One highly influential model frequently used to delineate the differences between cultures in cross-cultural psychology is Hofstede's cultural dimensions (Hofstede 1980, 2001, 2011). These cultural dimensions—power distance, individualism vs. collectivism, uncertainty avoidance, masculinity vs. femineity, long-term orientation vs. short-term orientation, and indulgence vs. restraint—allow researchers to make broad-brush generalisations of the cultural traits typical to the residents of different countries and geographical regions (see Varnum et al. 2010 for a review). While this model uses nationality as a proxy for culture and is subject to the ecological fallacy of overgeneralisation on the individual level, scholars have used it extensively over the years to generalise traits for comparisons between participant samples. The researchers felt it necessary to raise this issue at the outset, as

nearly all instances of cultural comparisons in the literature used nationality as a proxy, and the majority made reference to Eastern (East Asian) compared with Western culture (**Table 1**).

Table 1. Some generalised traits of "Eastern" compared with "Western" cultures.

	"Eastern"	"Western"
Power distance	Large	Small
Uncertainty avoidance	High	Low
Individualism-collectivism	Collectivism	Individualism
Orientation	Long term	Short term
Indugence-restraint	Restrained	Indulgence

Zooming in on research at the intersection of bilingualism, cultural differences, and EF, only a dozen or so studies in the past decade have explicitly investigated the impact of culture on bilingualism and EF (see Appendix A for an overview of the key studies). Some of the earliest studies of this nature were a response to Morton and Harper's (2007) argument for the possibility of one's ethnic (and cultural) background accounting for the bilingual advantage previously found in early childhood bilinguals. In the years that followed, several studies attempted to control for the effect of culture on EF by intentionally selecting samples with diverse language and cultural backgrounds based on nationality (e.g., Bialystok and Viswanathan 2009). Others sought to isolate bilingual effects by maintaining cultural homogeneity through sampling bilinguals and monolinguals with similar cultural backgrounds (Yang and Yang 2016). In the following section, the researchers review select articles in the existing literature that have included cultural comparisons in studies of language status (mono- or bilingualism) and EF.

3.1. Studies in Young Children

As indicated earlier, over the years, multiple studies have emerged where bilinguals were found to have a global advantage in tasks of executive control (Bialystok 1999; Bialystok and Viswanathan 2009; Bialystok et al. 2010; Barac and Bialystok 2012; Tran et al. 2015, 2018; Yang et al. 2011; Yang and Yang 2016). Nevertheless, an effect of culture was found despite it not overriding the effect of bilingualism in many of these articles. For example, while Yang et al.'s study in 2011 reported an overall bilingual advantage in terms of accuracy and reaction time, as well as in conflict resolution for the Attention Network Task (ANT), they also found that the overall accuracy of Korean monolinguals from Korea was higher than that of Korean or English monolinguals from the USA. Interestingly, both Korean and English monolinguals from the USA performed similarly. This suggests that an effect of culture, unrelated to the languages spoken, could be evident even in 4-year-old children.

Similarly, Tran et al. (2015) also found a similar effect in East Asian children who outperformed Western and Latin American children in terms of reaction time and accuracy, despite the bilingual advantage over monolinguals still

prevailing overall. Another longitudinal study of Vietnamese, Argentinian, and American children by Tran et al. (2018) uncovered a global, bilingual cognitive advantage in their longitudinal study of 96 3-year-old children as well as a cultural effect where Eastern (Vietnamese) children outperformed Western (USA) and Latin American (Argentinian) children on the day/night task, which measures verbal response inhibition.

Some studies also suggest that cultural effects may modulate advantages in EF over bilingualism. Recent research seeking to disentangle the effects of language and culture among preschoolers matched participants on a measure of "country of origin" as a proxy for culture. Cho et al. (2021) tested Korean monolinguals (Korea), Korean-English bilinguals (Canada), and English monolinguals (Canada) on a modified colour and word Stroop task as a measure of inhibition control. The researchers found that while Korean-English bilinguals outperformed English monolingual children in terms of accuracy in incongruent trials, Korean-English bilinguals performed no differently than Korean monolinguals after controlling for age and SES. Critically, they found that the country of origin was the key modulating variable predicting accuracy in incongruent trials after controlling for demographic variables and performance in congruent trials.

Taken together, it seems that cultural upbringing could play an important role in early EF development. In particular, cultural differences seem to be most evident in executive control tasks, possibly interacting with bilingual experience in shaping EF. One conjecture that could explain the inconsistencies reported could stem from differences in the cultural expectations of children regarding obedience and following directions. These expectations could be ingrained in children in different cultural contexts at a much earlier age. For example, children in East Asian cultures are typically expected to follow the rules more closely and practice response inhibition from a younger age than children from America (Kelkar et al. 2013; Lan et al. 2011). These could provide possible explanations for why the country of origin (as a loose proxy for "culture") could help to explain the variability reported in the literature. Nevertheless, with the current dearth in this vein of research, the exact nature of the interaction between culture and language with EF among young children remains an open question.

3.2. Studies in Adults

Contrary to studies conducted with children, examining the effect of cultural differences in the EF of bilingual adults seems to paint a different but clearer picture. In a study disambiguating the effect of cultural background and language, Samuel et al. (2018) tested inhibition control using a Simon task on 211 adult participants from three cultural backgrounds: British, Korean, and mixed nationalities (drawn from 33 countries). Bilingualism was taken as a continuous measure of three factors: L2 proficiency, language dominance, and code-switching frequency. Analysis using linear mixed-effects regression revealed that Koreans outperformed the British group in every measure (RT, accuracy, and smaller Simon effect) and in every model while performing faster overall than the mixed group in two out of three models. The mixed nationality group also outpaced the British participants in nearly all measures across every model. This provides critical evidence that even macro-level cultural effects can possibly account for the different levels of performance on common tasks of inhibition and control, especially among adult participants.

In one of the few studies that explicitly separated multicultural identity and its effect on language and executive function, Treffers-Daller et al. (2020) found a bilingual advantage in a reduced Flanker conflict effect when comparing bilinguals and monolinguals. Notably, they reported that multicultural identity styles (Ward et al. 2018) were the key explanatory variable in explaining EF variance among bilingual subjects at an individual level in their model. Similarly, Xie and Ng (in preparation) also found a significant effect in resolving conflict in a Flanker task among high-proficiency bicultural bilinguals who differ in their frequency of cultural switching in their daily lives.

Preliminary evidence also suggests that activating different cultural frames could be associated with different performance in inhibition control tasks. Ye et al. (2017) reported a bilingual advantage in incongruent trials for a Flanker task in mixed cultural contexts. High-proficiency Mandarin-English bilinguals outperformed participants with high proficiency in Mandarin but low English proficiency when filler slides showed both Western (British and American) and Eastern (Chinese) cultural icons. Interestingly, the bilingual advantage was not replicated in single cultural contexts (e.g., fillers with only Eastern cultural icons) or in congruent trials. The authors speculated that the tasks may not be challenging enough to elucidate an advantage in conflict resolution. Further analyses also showed that bicultural contexts attenuate proficient bilinguals' cognitive performance significantly when examining the results of both the mixed cultural and single cultural conditions for proficient bilinguals. Indeed, findings such as these beg the question as to whether existing inconsistencies reported in the literature about bilinguals' (dis)advantage in EF could be explained by differences in individual participants' cultural milieus, or if it is their cultural switching habits that have shrouded the "true" performance in tasks relating to EF.

4. Is There a Need to Disambiguate Cultural Effects from Language Effects in Studies on Executive Functions?

In recent years, scholars such as () have argued that bilingualism and biculturalism are often conflated in research on bilingualism. This is not a new idea, as () made a case for the reality that culture and language status are distinct, where bilinguals could be monocultural or bicultural and monolinguals could be monocultural or bicultural. Indeed, the reality is somewhat complex as just as there is a whole spectrum of bilinguals from dominant bilinguals to balanced bilinguals, simultaneous bilinguals, receptive bilinguals, etc., an entire range of bi- or even monocultural bilinguals exists. While Grosjean limits his discussion of biculturalism and bilingualism to identity and personality, the researchers believe it is critical to consider the implications of culture and biculturalism on cognition. Up until now, reports have suggested that cross-cultural differences influence the development of EF even among preschool children as early as the age of three, where cultural variation in the development of EF is seen in various tasks of inhibition and cognitive flexibility (; ; ;).

Research by social psychologists has drawn a theoretical link between how acculturating to different cultures can hone an individual's cognitive abilities. The acculturation complexity model by Tadmor and Tetlock (2006) proposes that the level of immersion in new cultures (indexed by the willingness to acculturate) can hone an individual's cognitive skills differently. Specifically, cognitive abilities such as selective attention and inhibition can be developed, resulting from the pressures of resolving diverse cultural complexities and the necessity of being able to behave "appropriately" among interactants of different cultures. These differences in an individual's cultural

preferences are thought to influence such cognitive gains, as individuals who prefer to use only one of the two cultures more frequently are less likely to experience and have fewer opportunities to resolve conflicts arising from cultural differences compared with someone with an equal preference for both cultures.

Over the years, research has suggested that bicultural people who integrate both cultures are able to provide more complex descriptions of each culture compared with monocultural people or bicultural people with a distinct preference for one culture (Benet-Martínez et al. 2006) and that a bicultural person's acculturation strategies impact cognition through instances of conflict mitigation and behavioural inhibition (Crisp and Turner 2011). Recently, Spiegler and Leyendecker (2017) showed how Turkish-German immigrant children with a balanced view of both cultures outperformed their peers, who favoured one culture over the other in terms of cognitive flexibility. Indeed, converging evidence suggests that individuals who identify as bicultural frequently integrate different sets of cultural knowledge, or as Cheng et al. (2014) described it, "bicultural individuals possess 'two cultural minds'—two sets of cultural knowledge, use two cultural schemas to guide their thoughts and behaviour, and can activate these two cultural frames of references" (p. 279).

Research building on this hypothesis posits a theory of cultural frame switching relevant to bilingualism studies and EF. Cultural frame switching is a term coined from the observation that individuals with multiple cultural identities are able to switch across cultural frameworks (or their various cultural minds) depending on the cultural cues being presented. In seminal studies by Hong et al. (2000) examining this phenomenon, the researchers found that bicultural individuals behaved differently depending on the cultural primes used. For instance, when bicultural individuals (Chinese Americans) were primed with icons representing the Chinese or American cultures (e.g., a dragon as an icon of Chinese culture or the American flag as an icon of American culture), the participants' appraisal of an ambiguous situation tended to embody specific cultural values of the culture associated with the prime. In these studies, the participants were asked if they thought an animated video of a fish swimming in front of a school of fish was being chased by the other fish (an external push factor) or if it was leading other fish (an internal factor). When primed with Chinese cultural primes, bicultural participants were comparatively more confident that the fish was being chased (an external attribution). When primed with American primes, they were more confident that the fish was leading the school (internal attribution).

The researchers argued that bicultural individuals could tap into different systems and schemas of cultural meaning and switch between them depending on the environment and context. Building on this, further research supported bicultural individuals' ability to switch unconsciously and seamlessly (Benet-Martínez et al. 2002) and even change identities based on cultural cues (Luna et al. 2008). Cultural frame switching often occurs when there is a significant difference in the interactant's environment, such as when moving between the public and private spheres. For instance, Suárez-Orozco et al. (2008) brought attention to the situation of immigrants in Boston and San Francisco in their longitudinal study of 470 immigrant children from countries such as Mexico, Central America, and China. Using parental interviews, test scores, and case studies, the authors exemplify the different ways in which children cope with the disparity between their heritage culture and the broader American culture and how intentional switching between cultural frames may be observed when moving between these different domains.

Extending the theory of cultural frame switching to bilingualism, Ramírez-Esparza et al. (2006) reported that Spanish-English bilinguals presented different personality traits depending on the language in which they answered self-reporting personality questionnaires. In particular, they showed increased extraversion, agreeableness, and conscientiousness when answering in English compared with Spanish. Another study by Chen and Bond (2010) provided further evidence for bilingual personality switching in examining how the interviewer's ethnicity can influence the way interlocutors present themselves. Bilingual interviewers (two Caucasian and two Chinese) interviewed 76 Chinese-English bilinguals, and observers were asked to rate participants' personalities by the traits of extraversion and openness. Each participant was interviewed by a Chinese and a Caucasian interviewer, both of whom used English and Chinese separately. The researchers found that the participants displayed increased extraversion and were more willing to speak about experiences with Caucasian interviewers compared with Chinese interviewers, regardless of the language mode used for the interviews. This highlights how bilingual and bicultural people have the resources to switch between cultural frames implicitly, often without conscious effort, depending on the appraisal of the social speech context and cultural environment.

In summary, these studies on bilingualism and culture support the idea that bicultural individuals have different cultural systems that are selected and inhibited fluidly and auto- matically, depending on the situational context. In addition, bicultural individuals may need to direct cognitive resources to monitor the situational context and choose the appropriate cultural values, attitudes, and ideologies which are relevant while inhibiting inappropriate behaviour when switching between cultures. These processes seem to mirror how a bilingual person's language system is hypothesised to function in terms of language inhibition and con- trol and in terms of directing attention for monitoring and language selection. If this is indeed the case, the cultural frame switching that bicultural bilingual people participate in could influence the development of executive functions in a similar fashion to how bilingualism hones the executive functions system. This is a crucial issue to resolve as to date, bilingual research has frequently conflated bilingualism and biculturalism (Grosjean 2015). Moreover, the reality is somewhat complex. Just as there is a whole spectrum of bilinguals from dominant bilinguals to balanced bilinguals, simultaneous bilinguals, receptive bilinguals, etc., an entire spectrum of bi- or even monocul- tural bilinguals exists. According to Grosjean (1992), some Europeans may be multilingual, having studied two or more languages in a school setting. However, many are predominantly monocultural, as they only work and stay in one country and a single cultural setting. On the other hand, individuals can be monolingual but multicultural by immersing themselves in other cultures in their social contacts but choosing not to learn their languages (Padilla 2006). This nuanced view that forms a bilingual-bicultural separation is an aspect that was absent in nearly all of the literature the researchers reviewed.

5. Future Directions

Here, the researchers would like to propose a few directions that the field could take to examine the effect of culture on bilinguals' EF in greater detail. Most existing studies incorporating an aspect of culture within experiments looking at bilinguals' EF have typically used a general "East vs. West" distinction for contrast. Future studies should move beyond the assumption that an individual's culture is based on their nationality or that they belong to a particular culture simply due to being born and raised in his or her country of origin. With most existing

studies matching participants based on geography or where they currently reside as an earmark for culture, the researchers may be making assumptions about macro-level culture based on citizenship, nationality, and ethnicity, all of which may not necessarily reflect the individuals' cultural affiliations or identities.

Similarly, research distinguishing the effects of bilingualism on different populations should elucidate bilinguals' cultural allegiances, examine if they are bicultural, and test if they can switch between various cultural frames. Most studies examining the cognitive effects of bilingualism do not mention their participants' cultural or bicultural affiliations. Critically, researchers in the field need to be aware of and differentiate the cultural statuses of their participants, namely whether they are monocultural or bicultural and whether they have frequent practice in switching between cultural identities. In particular, bicultural switching effects may explain the discrepancies in the results among certain participant samples who adopted significantly different cultural behaviours at home and at work or school. For example, Lee and Kim's (2014) qualitative study on second-generation Korean immigrants in Germany detailed different coping mechanisms and shifting strategies for bridging Eastern and Western cultures in their daily lives such that individuals could "blend into both Korean and German societies, similar to a chameleon" (p. 97). As such, the researchers hypothesise that if switching between cultural frames occurs both commonly and frequently (e.g., in day-to-day life and interactions), bicultural switching could hone domain-general inhibition control and task-switching. The impact of bicultural switching might thus show similar EF gains reported among code-switching bilingual speakers, such as in the work of Hartanto and Yang (2016). Consequently, the level of bicultural switching (or non-switching) could be distinguished among samples of bilingual and monolingual participants to examine if bicultural switching might interact with the bilingual experience in shaping EF.

As bicultural individuals can select, inhibit, and switch from one cultural mindset (frame) to another depending on their interactional context, the researchers hypothesise that similar cognitive processes may be involved, and its effects on executive control may be analogous to code-switching in bilinguals. According to the adaptive control hypothesis (Green and Abutalebi 2013), it is proposed that "language control processes themselves adapt to the recurrent demands placed on them by the interactional context" (p. 515). In particular, the researchers hypothesised that different interactional contexts (single language, dual language, and code- switching) will impose varying demands on the cognitive control system. For instance, using two languages separately, such as in school and at home (single-language context), is believed to require inhibition of a bilingual person's other language. However, using two languages in the same context with different speakers (dual-language contexts) requires the most stringent cognitive control processes, such as monitoring, interference, and response inhibition. Finally, frequent code-switching in the same interactional context is hypothesised to require less cognitive suppression and control, as it allows for "opportunistic planning" to freely use lexical items from either language. Similarly, the researchers hypothesise that the process of selecting, juggling, and switching between multiple cultural mindsets may engage—and thus enhance—cognitive control mechanisms, including inhibitory control, monitoring, and shifting (Spiegler and Leyendecker 2017). While some aspects of EF have been compared in the existing literature on bilingualism, the few studies that have discussed the effects of culture on language and EF have mainly examined response inhibition control (e.g., the Simon and Stroop tasks) and attention-related tasks (e.g., the

Attention Network Task). This leaves room for other components, including memory and cognitive flexibility (switching), to be further explored.

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