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Review

Bilingualism, Culture, and Executive Functions: Is There a Relationship?

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Abstract: The relationship between executive functions (EF) and bilingualism has dominated debate in the field. This debate was characterised by optimism for a bilingual advantage until the last decade, when a steady stream of articles reported failure to find a consistently positive effect for bilingualism. In addition to addressing concerns about study quality, this turn of events has spurred research into other variables that may explain the conflicting findings. While recent studies have focused on sociodemographic variables and interactional contexts such as age, code-switching frequency, and socioeconomic class to account for various group and individual differences, the impact of culture is seldom scrutinised. This paper examines the possible effect of culture among bilingual studies on EF by first contextualising how bilingual EF are studied and outlining the absence of culture as a macro variable, followed by a discussion on how culture and language are often conflated. This paper directs attention to the small but emerging research that tracks the importance of culture as a separate variable from language. This review discusses why macro culture and individual monoculturalism or biculturalism need to be carefully elucidated as a factor that can interact with the bilingual experience in shaping EF.

Keywords: culture; bilingualism; executive function; biculturalism; bilingual advantage

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1. Introduction

The last century has seen an acceleration in research interest on the impact of bilingualism on cognition. Depending on the period which we draw our sample of research from, we are likely to get a very different picture of this relationship. Multiple studies in the literature have charted the course of the withering (the 1920s), waxing (1960 onwards), and waning (post 2013) enthusiasm about the bilingual advantage (cf. Antoniou 2019; Lehtonen et al. 2018; Bialystok and Craik 2022 for a recent review on this topic). This review differs from earlier reviews examining the presence or absence of a bilingual advantage by focusing on the variable of culture in studies on bilingualism and executive functions (EF) in the last two decades. We evaluate the small but growing evidence of cultural effects in recent bilingualism studies and argue that there is compelling evidence for culture to be carefully scrutinised as a critical variable that relates to bilingual people's EF.

2. The Bilingual Advantage in EF Debate

Ever since the seminal study by Peal and Lambert (1962), several studies comparing monolinguals and bilinguals seem to have yielded favourable findings regarding bilingual effects, with reports of cognitive advantages for bilinguals across their lifespans. Among the elderly, scholars argue that bilingualism may contribute to a "cognitive reserve" that may delay neurodegenerative diseases such as Alzheimer's and dementia by approximately four years compared with monolinguals (Bak et al. 2014; Bialystok et al. 2007; Calvo et al. 2016). Some researchers have proposed that bilinguals might have an advantage over their

monolingual peers due to constant monitoring, selection, and inhibition of languages. In particular, they argue that bilinguals have an edge even in domain-general, non-linguistic tasks that tap into these cognitive processes (Green 1998; Green and Abutalebi 2013; Bialystok 2017).

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, we 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".

In the ensuing years 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.

3. Conflicting Findings in EF Performance

3.1. 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.

Another extensive experimental study with more than 4500 participants by Dick et al. (2019) also failed to find evidence demonstrating better performance among bilinguals in the Flanker, Dimension Change Card Sort, and Stop-Signal Reaction Time tests, which measure common EF indicators including inhibition, attention, and set-shifting abilities among 9–10-year-old children in the United States. Bilingual participants (n = 1740) were grouped based on three different definitions of bilingualism: bilingual status (if children identified as speaking any language other than English), bilingual degree (ratio of non-English language use to English use), and bilingual use (continuous measure of non-English language frequency with different interlocutors). After controlling for demographic covariates such as socioeconomic status, age, education level, and intelligence, the regression analyses revealed a bilingual disadvantage in terms of poorer English vocabulary, consistent with other studies in the literature (e.g., Martin-Rhee and Bialystok 2008). While the researchers reported a bilingual disadvantage in the Stop-Signal Reaction Time test, no other significant differences were found between the monolingual and bilingual participants. Thus, despite the report of a bilingual advantage in the early 2000s, much of the current discussion is hotly contesting the validity and replicability of such claims.

3.2. Hidden 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, we 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. This view is further echoed by Valian (2014) and de Bruin (2019), who argue that diverse differences between bilinguals' environmental contexts, social interaction habits, and various sociolinguistic variables may influence the findings for EF.

First, the age group of the participants may play a role in detecting a significant bilingual advantage. Some articles suggest that the bilingual advantage seems to be most pronounced among young children and the elderly (Bak et al. 2014; Luo et al. 2010), while the differences between monolingual and bilingual young adults may sometimes show insignificant or no group differences, possibly because young adults are at the zenith of their cognitive functioning (Bialystok et al. 2004). Hence, bilingual effects may not be as pronounced in young adults compared with the elderly (for a counter perspective, see Samuel et al. 2018), as ageing has been found to take a toll on cognitive and executive function processing, and

differences in performance among older bilinguals could be attributed to the cognitive reserve built up from lifelong bilingualism (Abutalebi et al. 2015; Antoniou and Wright 2017; Nickels et al. 2019).

Another possible source of variation involves the definition and classification of bilinguals based on their age of acquisition and fluency. Researchers in the field do not all agree on how "early" or "late" bilingualism may be unambiguously classified due to disagreement on the exact age range of the critical period for language acquisition (Byers-Heinlein and Lew-Williams 2013). Consequently, these different yardsticks can result in different conclusions. For example, Martin et al. (2013) suggested that early bilinguals (AoA: between 2 and 4 years) had the edge over late bilinguals. In contrast, Pelham and Abrams (2014) reported that while bilingualism had a facilitative effect on conflict resolution in incongruent trials over the monolinguals in their study, no differences in executive control were found between early (AoA: 7 years or younger) and late bilinguals (AoA: age 13 and above). When adopting the age of acquisition as a continuous variable in a mixed model regression, Von Bastian et al. (2016) could not detect a bilingual advantage in EF between participants for a broad range of tasks measuring inhibitory control, shifting, conflict monitoring, and general cognitive abilities. Indeed, such methodological differences can lead to dissonant findings and be an important source of variation in whether a difference in EF tests is found.

Additionally, concerns have also been raised regarding self-rated language proficiency when it is used to compare groups from different cultural or geographical backgrounds. Tomoschuk et al. (2018) found that self-rated proficiencies and picture-naming test scores were not consistently correlated among different bilingual populations, with Chinese-English bilinguals performing better in the picture-naming task compared with Spanish-English bilinguals who had identical self-rated proficiency scores. Notably, even grouping participants by language dominance (other language vs. English) did not remove these discrepancies. These findings indicate potential confounds, as the subjective, self-rated scores in one population may be conceptualised differently than another group of participants due to different social environments and upbringings, ages of acquisition, and language dominance, even if they are taken from the same community (e.g., college students).

In fact, there is evidence that it is not only language proficiency but how balanced the bilingual is in terms of proficiency and use in both languages that can impact performance in tests of EF. A seminal study by Tse and Altarriba (2012) involved administering a Stroop task on 110 bilingual adults to determine the effects of language proficiency on their attentional control system. The researchers reported that responses to the Stroop task were positively correlated to second-language proficiency and that bilinguals who were more balanced in both language proficiencies were more efficient at conflict resolution in incongruent trials. In particular, they argued that a bilingual's language proficiencies honed aspects of attentional control (conflict resolution and goal maintenance) that explained the different performance in the Stroop task. Similarly, Yow and Li (2015) found that bilinguals who were both proficient and balanced in their use of both languages outperformed those who were less balanced in terms of use and proficiency in tasks of inhibition and set-shifting.

These studies, we think, provide compelling arguments to consider the issue of balance when assessing bilingual proficiency. While most studies offer some measure of proficiency, problems with validity and comparability can still arise as a result of methodological differences that can potentially mask the effects of a bilingual advantage in EF.

4. 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 article, 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. We 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, we review select articles in the existing literature that have included cultural comparisons in studies of language status (mono- or bilingualism) and EF.

4.1. 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 (see Appendix A for a breakdown of the bilingual or cultural effects reported among key studies). 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 plausible 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. Further research is needed to elucidate what conditions might reveal cultural effects (i.e., beyond "East vs. West" distinctions, integrating other measures of culture such as long-term orientation vs. short-term orientation instead of only individualism vs. collectivism) that could have knock-on effects on EF components such as attention, especially since most existing studies have only examined the effect of culture and language on inhibition control.

4.2. 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.

In summary, while many of these studies on young children yielded mixed results, when the critical studies were examined (Appendix A), only four reported a complete absence of cultural effects. Indeed, Bialystok and Craik (2022) acknowledged that culture could be a possible confound to the bilingual advantage in tests on EF, although they highlighted several studies that have shown language effects overriding cultural effects. Yet, there seems to be a growing body of research suggesting that the effect of culture may be more pronounced when examining adult populations. We hypothesise that cultural effects might be more evident in adulthood due to the prolonged experience of honing their cultural selves and may also result from their exposure to multiple cultures and the acquisition of bicultural or multicultural identities. Indeed, this growing body of research suggests that culture as a variable of interest should be given a second look (e.g., Altarriba 2008).

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

It has been standard practice that individuals recruited for bilingualism studies are matched by the languages they profess to know. In fact, it is not uncommon to include individuals from different language backgrounds, nationalities, races, and ethnicities so long as they broadly speak the same language, broadly because most studies typically report large language "families" instead of specific language varieties or dialects (e.g., English speakers may refer to speakers of any English dialect (American English, British English, Singapore English, Indian English, etc.)). However, this does not capture a sufficiently nuanced perspective of the cultural diversity among bilingual populations.

In recent years, scholars such as Grosjean (2015) have argued that bilingualism and biculturalism are often conflated in research on bilingualism. This is not a new idea, as Soffietti (1960) 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. Grosjean (1992) argues that some Europeans may be multilingual, having studied two or more languages in a school setting. However, they are monocultural as they only work and stay in a country and a single cultural setting. On the other hand, individuals can be monolingual but multicultural by immersing themselves in different cultures across their

social contacts but choosing not to learn their languages (Schwartz et al. 2017; Shih and Sanchez 2005).

While Grosjean (2015) limited his discussion of biculturalism and bilingualism to identity and personality, we believe it is critical to consider the implications of culture and biculturalism on cognition. Up until now, research has 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 (Legare et al. 2018; Ling et al. 2018; Norenzayan et al. 2002; Imada et al. 2012). To fully appreciate the distinction between bicultural and monocultural bilinguals, we first need to account for culture as a variable associated with cognition and particularly EF. We will first unpack the relevance of cross-cultural differences in shaping EF and then situate these differences in bicultural individuals.

5.1. Macro-Scale Cultural Differences and EF

An area of cross-cultural comparison that has received much attention over the last two decades pertains to the so-called "East-West difference". Individuals from East Asian countries who are of East Asian descent or have been exposed to East Asian culture and values from a young age are commonly considered to embody Eastern cultural values. They are viewed as being more collectivist, having higher power distances in relationships with authority, being more likely to avoid uncertainty, and having a stronger sense of interdependence (Markus and Kitayama 1991, 2010; Oyserman and Lee 2008) compared with Americans who epitomise Western culture in their desire for individual autonomy, egalitarian relationships, and willingness to take risks (Triandis 1989, 2001; Harkness et al. 2000). The differences in Eastern and Western cultures have been well documented and shown to influence parents' thoughts on how to raise their children (Chen et al. 1998; Bornstein 2013), socialisation and personality (Varnum et al. 2010), self-evaluation (Kim et al. 2009), individual's ethics and moral values (Garcia et al. 2014; Jia and Krettenauer 2017), as well as self-regulation (Imada et al. 2012; Jaramillo et al. 2017; Krassner et al. 2016) and emotion (Kitayama et al. 2006; Masuda et al. 2008; Pavlenko 2005). Clearly, these distinctions may characterise many individuals. However, it is important to maintain that there is a broad range of these variables throughout any given group or culture; that is, they always reside as a distribution within and among these populations.

These very cultural differences have been theorised to influence cognition. Cultural value systems such as individualism vs. collectivism, tolerance towards uncertainty, sociolinguistic factors about when formal schooling should begin, as well as culture-specific parenting attitudes related to child autonomy, expected discipline, level of parental control, and emotional socialisation are critical determinants in shaping EF (Sarma and Thomas 2020).

Over the years, various studies have sought to distinguish the effects of culture on EF. In a seminal study, Masuda and Nisbett (2001) reported differences in memory recall for East Asians compared with Americans due to different cultural upbringings. The researchers reported that East Asian adults could remember more background information in the visual stimuli and became less accurate when background cues were changed compared with their American counterparts. The authors hypothesised that these differences could result from different modes of attentional direction and focus emphasised by Eastern and Western cultures. Another study investigating how different cultural backgrounds would influence cognition by Sabbagh et al. (2006) examined the interaction between EF and theory of mind in 5-year-old children from America and China. The researchers found that the Chinese children outperformed the American children in all EF tests, such as the Dimensional Change Card Sort and Stroop tasks. In the same vein, Oh and Lewis (2008) found that Korean preschoolers performed significantly better at inhibition and task switching than British children of a similar age, while no differences were found in the measures of working memory. More recently, Imada et al. (2012) presented further evidence relating differences in EF to cultural differences. They compared 175 children from America and Japan and found that sensitivity to contextual cues was highly correlated with performance in EF tasks. Specifically, the children from Japan

outperformed American children in the set-shifting Dimension Change Card Sort Test but were also more likely to peek on impulse during a delayed gratification task, indicating poorer impulse control.

One influential theory that has emerged at the forefront to explain the cultural effect on EF proposes that differences between cultures could stem from the disparity in cultural values and upbringing (including family and societal education strategies) that influence what individuals from contrasting cultures focus on (Nisbett and Masuda 2003, 2006). According to this theory, the subdivision between Eastern and Western cultures in cross-cultural studies has been correlated with different types of attentional focus and cognitive processing. Individuals brought up with Eastern, collectivistic cultural influences tend to have attentional processing tuned to focus on contextual cues (e.g., non-verbal cues, more holistic, and distributed attention), while Western cultures direct attention to process-specific, individualised information (Nisbett et al. 2001; Nisbett and Masuda 2003). In a series of four studies examining how culture mediates statistical learning, Kiyokawa et al. (2012) found differences in local and global perceptual biases in their British and Japanese participants, respectively, even after manipulating participants' familiarity with the sequence elements (strings of large (global) letters made out of small (local) letters). Their results provide evidence that cultural differences can influence the type of unconscious knowledge being learned (see also Kiyokawa et al. 2010 and Ling et al. 2018 for additional studies). Thus, scholars have hypothesised that with the emphasis on greater "general sensitivity", Eastern cultures may have an advantage in recognising and reacting to stimuli that are displayed when reaction time is measured (Nisbett and Miyamoto 2005; Miyamoto et al. 2006; Kuwabara and Smith 2012).

Consequently, the evidence above suggests that even broad-brush cultural differences in nationality or ethnicity are associated with different performances in EF tasks in cross-cultural comparisons. Extending this to our discussion on bilingualism and EF, this indicates that comparisons of participants based on language status (bilingual or monolingual) may not be directly comparable around the world, even if factors such as socioeconomic status and other sociolinguistic variables are controlled for. It is perhaps even more important to distinguish between society-level culture and the cultural identities and values an individual adopts. This will be discussed in the following section on micro-level cultural factors.

5.2. Micro-Level Cultural Factors: Individual Acculturation and Bilingualism

Individual biculturalism describes an individual's exposure and internalisation of two or more cultures as part of their identity (Nguyen and Benet-Martínez 2007, 2012). According to LaFromboise et al. (1993), multicultural individuals typically possess a certain degree of multicultural competence, be it in terms of explicit cultural knowledge, a tacit understanding of cultural scripts (culturally appropriate etiquette) and values, or friends and family within the other culture, and are often able to communicate in languages associated with the different cultures. In this paper, we define bicultural individuals more narrowly, as individuals who possess more than one cultural identity in their repertoire and can shift between cultural mindsets (frames) in their repertoire, choosing the appropriate actions, values, and norms when they interact with individuals and groups from other cultures (Benet-Martínez et al. 2002; Hong et al. 2000).

Early studies on biculturalism often focused on migrants' and immigrants' acculturation processes (Berry 1997). These studies have generated significant interest among cultural psychologists as they delineate how acculturation to a new culture can occur. One of the most influential models, Berry's Acculturation Model (Berry 1997, 2003), investigates how individuals acculturate to the host society. Specifically, the model proposes that individuals acculturate through two main processes: cultural maintenance and contact and participation. Individuals typically adopt one of four distinct acculturation strategies that result in either cultural assimilation, integration, separation, or marginalisation (Table 2). Of relevance to our discussion is how this model delineates various acculturation outcomes and shows a distribution of outcomes ranging from monocultural to bicultural (e.g., Schwartz et al. 2017; Meca et al. 2017). This has an important bearing on a bilin-

gual's profile, as those who are more culturally integrated (i.e., more balanced) are likely to consider themselves more bicultural compared with bilinguals who do not identify as integrating (separating, assimilating, or marginalising), thus considering themselves more monocultural.

Table 2. Four possible outcomes from Berry's Acculturation Model (Berry 1997, 2003).

	+ ← Maintenance of heritage culture → −	
	Integration	Assimilation
+ ← Cultural Adaptation → −	Separation	Marginalisation

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 automatically, 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 control 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 monocultural 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 we reviewed.

6. Future Directions

Evidence within the literature suggests that a comparison of cultural effects, be it generalisations based on nationality or a more individual scale (individual mono- or biculturalism), is associated with differences in EF. Among scholars interested in the intersection of languages and EF, it is essential that we consider how cultural variables can be a mediating factor when describing bilinguals' EF.

Here, we 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, we 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. Thus far, studies have conflated bilingualism and biculturalism, with biculturalism subsumed within the construct of bilingualism or not considered a variable. This situation poses a problem when looking at the effects of language status and EF, as they may be separate constructs. 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. One such example is that of participants who are second- or third-generation immigrants. While previous studies have addressed the importance of distinguishing between immigrant and non-immigrant populations (Mezzacappa 2004; Fuller-Thomson and Kuh 2014), most bilingual studies do not typically consider the "carryover" cultural effects for second- or even third-generation immigrants. Although these second-generation immigrants may be citizens of the host country, those whose parents (first-generation immigrants) come from a very different culture may find it difficult to reconcile the differences between the cultures within and outside the home. In fact, social and cultural psychologists have long been studying the different acculturation struggles of second-generation immigrants and the influence on their multicultural identity.

For example, Stroink and Lalonde (2009) reported on how some second-generation Asian-Canadian immigrants found it difficult to integrate the differences between their Eastern family culture with the general Western culture in the larger society, resulting in a conflicting bicultural identity. 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, we 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, we 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, we 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.

7. Conclusions

Although a plethora of evidence contradicting a bilingual advantage in EF exists, some papers still suggest that bilinguals might have the edge over monolinguals in specific contexts. We believe the disparity motivates questions about why there is so little consensus surrounding this complex set of topics, as well as establishing that it is unlikely that a single variable can fully explain the wide variability in findings. Hence, possible confounding variables such as an individual's cultural affiliation and level of multiculturalism should be carefully considered. While culture's exact implications and complex effects on EF in bilingual populations are still being examined, growing evidence suggests that cultural variables may mediate bilingual individuals' cognitive abilities. We believe that greater emphasis needs to be placed on understanding the effects of broad, macro-level cultures, the influences of bicultural switching, and the broader impacts of biculturalism in future studies of a bilingual person's cognitive advantage. Only by first considering the individual differences and sociolinguistic factors and broadening the current boundaries of what constitutes bilingual people's interaction context will we be able to arrive at a better understanding of the unique contribution of bilingualism to EF.

In this paper, we argue that cultural variation and biculturalism deserve greater attention from scholars interested in the cognitive effects of bilingualism. Here, we suggest that a more nuanced view of culture needs to be considered, as cultural effects are seldom accounted for or explicitly manipulated in studies of bilingualism. As recent studies comparing important demographic and sociolinguistic factors are making headway in unravelling the puzzle that is bilingual people's cognition, we hope that this paper takes a small step towards a clearer picture of the exact role that language plays in relation to EF.

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Appendix A

Table A1. List of key publications explicitly discussing culture in studies on bilingual EF. Asterisk (*) indicates a note about the participant sample.

Publication	EF Task(s)	Type of Participants (Country or Nationality, M_{age})		Presence of Bilingual Advantage	Cultural Effects
		Bilinguals	Monolinguals		
(Sabbagh et al. 2006)	Stroop (day/night and grass/snow), bear/dragon, Dimension Change Cart Sort Task (DCCS), tower building, whisper, and Kansas Reflection-Impulsivity Scale for Preschoolers (KRISP)	-	109 Chinese (China, 4 y.o.) 107 English (USA, 4 y.o.)	-	Among the monolingual children tested, Eastern preschoolers (China) outperformed Western preschoolers (USA) in all measures of executive functioning
(Morton and Harper 2007)	Simon Task	17 English-French (Canada, 6.8 y.o.)	17 English (Canada, 6.8 y.o.)	No BL advantage or disadvantage in either congruent or incongruent trials	Authors suggested that matching by ethnicity (cultural background) and socioeconomic variables mitigated bilingual advantage
(Bialystok and Viswanathan 2009)	Anti-saccade task (faces task)	30 English-combination (Canada, 8.5 y.o) 30 English-Tamil or Telugu (India, 8.6 y.o.)	30 English (Canada, 8.5 y.o.)	BL advantage in conditions based on inhibitory control and cognitive flexibility, but there was no significant difference between groups in response suppression	No group differences between bilingual groups (Canadians vs. Indians)
(Bialystok et al. 2010)	Luria's tapping task, opposite worlds, reverse categorisation, ANT (Flanker), and mutual exclusivity	27 English-combination (Canada, 3.5 y.o.)	40 English (Canada, 3 y.o) 20 French (France, 3.5 y.o.)	BL advantage in all executive control (Conflict) tasks	No significant cultural effects reported
		29 English-combination (Canada, 4.5 y.o.)	29 English (Canada, 4.5 y.o) 17 French (France, 4.5 y.o.)		
(Yang et al. 2011)	Attention Network Task (ANT)	15 Korean-English (USA, 4 y.o.)	15 English (USA, 4 y.o.) 13 Korean (USA, 4 y.o.) 13 Korean (Korea, 4 y.o.)	Bilingual advantage over monolingual groups in accuracy and RT, as well as in conflict resolution (Executive control)	Overall accuracy of Korean monolinguals from Korea higher than Korean or English monolinguals in the USA, though RT was slower. (Korean MLs in the USA performed similarly to English MLs in the USA.)
Barac and Bialystok (2012)	Colour-shape task switching	30 Chinese-English (5.9 y.o.) 28 French-English (6.2 y.o.) 20 Spanish-English (6.2 y.o.)	26 English (5.9 y.o.)	Bilingual advantage with smaller global task-switching costs	No significant cultural effects reported
		* Note: Participant location not specified. Only "large multicultural city" was mentioned (p. 416).			

Table A1. *Cont.*

Publication	EF Task(s)	Type of Participants (Country or Nationality, M_{age})		Presence of Bilingual Advantage	Cultural Effects
		Bilinguals	**Monolinguals**		
(Tran et al. 2015)	ANT	13 Spanish-English (USA) 15 Vietnamese-English (USA) 16 Vietnamese-Cantonese (Vietnam)	14 English (USA) 19 Spanish (Argentina) 20 Vietnamese (Vietnam)	BL advantage in accuracy and RT over monolinguals	Eastern children have faster RT and greater accuracy than Western or Latin American children. Significant culture and ANT network interaction. Main effect of culture on task performance. Cultural background plays a vital role in the development of the alerting and executive control networks.
		* Longitudinal study. Children were initially M_{age} 38.8 months old (3 y.o.) and tested at 5 time points 6 months apart.			
Yang and Yang (2016)	ANT	32 Korean-English BL (USA, second-generation immigrants, 5–6 y.o.)	31 English (USA, 5–6 y.o.)	BL advantage in global performance, accuracy, and RT ANT: No BL effects on network efficiency scores	No specific cultural effects seen. Cultural differences controlled by studying culturally homogenous children and adults.
		20 Korean-English (Korean undergraduates who arrived at 10 y.o., currently 19.9 y.o)	19 English (USA, 20.7 y.o.)	BL advantage in global performance + reaction time ANT: BL advantage in + orienting + executive control	
(Ye et al. 2017)	Flanker Task	18 Mandarin-English (China, 21 y.o.,)	18 Mandarin (China, 21 y.o.) * Not a completely monolingual: English exposure present, but without passing college English tests	Some evidence that high-proficiency bilinguals outperformed low-proficiency bilinguals	More demanding mixed cultural context cues bring out advantage in incongruent trials for high-proficiency bilingual participants.
(Samuel et al. 2018)	Simon Task	78 British (21 y.o.) 64 Korean (23 y.o.) 69 mixed nationalities (23 y.o.) * Level of bilingualism taken as continuous variables based on L2 proficiency, dominance, and code-switching frequency		No BL advantage	East Asian (Korean) participants outperformed Western (British) participants on RT and accuracy regardless of monolingual or bilingual status.

Table A1. *Cont.*

Publication	EF Task(s)	Type of Participants (Country or Nationality, M_{age})		Presence of Bilingual Advantage	Cultural Effects
		Bilinguals	**Monolinguals**		
(Tran et al. 2018)	DCCS, day/night Stroop, bear dragon, and gift delay	13 Spanish-English (USA) 15 Vietnamese-English (USA) 20 Vietnamese-Cantonese (Vietnam)	13 English (USA) 19 Spanish (Argentina) 20 Vietnamese (Vietnam)	BL advantage in DCCS, day/night, and gift delay task and advantage in inhibition and shifting	Eastern children (Vietnamese) outperformed Western and Argentinian children in the day/night task. Cultural effect in response inhibition.
		* Longitudinal study. Children were initially M_{age} 38.7 months old and tested every 6 months.			
(Treffers-Daller et al. 2020)	Flanker Task	29 Turkish-English (Turkey, 32.5 y.o.) 28 Turkish-English (Cyprus, 25.25 y.o.) * All BL participants were immigrants	30 English (UK, 32.3 y.o.)	BL advantage in inhibition (reduced conflict effect)	Among BLs, multicultural switching style (alternating or hybrid) was the key explanatory variable for variance in EF performance.
(Cho et al. 2021)	Colour and Word Stroop Task	33 Korean-English (Canada, 4.7 y.o.)	36 English (Canada, 4.4 y.o) 43 Korean (Korea, 4.3 y.o)	No BL advantage (no disadvantage)	BL East-Asians show higher accuracy on inhibitory control than ML Canadian children.

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