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The multilingual brain: A critical review of cognitive advantages

Being bilingual, or speaking two languages, has several well-documented cognitive advantages referred to as the 'bilingual advantage'. These advantages have been carefully scrutinised over the past 30 years, with debates about their existence ongoing. The cognitive benefits of multilingualism (speaking three or more languages) are less well known, and it is uncertain whether adding more languages to one's repertoire advantages our cognition or hinders it. The available evidence is complicated by the fact that many studies use the terms 'bilingual' and 'multilingual' interchangeably, thereby blurring the findings. In this review, 14 studies published between 2008 and 2025 that focused on cognitive benefits related to multilingualism were critically reviewed, and the findings were compared to those reported for bilingualism. Available evidence tentatively supports the emergence of multilingual advantages in older age in the form of delays in cognitive decline. These appear concomitant with an early age of acquisition, and regular use, of additional languages (leading to automatisation). In samples of other ages, multilinguals appear not to possess any advantages beyond bilinguals, although they often outperform monolinguals. It is possible that lifelong use of multiple languages is necessary before benefits manifest. The review presents a systematic consideration of the vast array of interrelated individual, task- and language-related factors which shape when, how and whether these advantages may develop.

Significance:

Understanding whether multilingualism advantages cognition contributes to investigations into experiences that engender neuroplasticity. Following from the popularity of the bilingual advantage is an assumption that more languages lead to more cognitive benefits. A critical review of the evidence reveals that the only clear advantage for multilinguals appears to be in the delay of cognitive decline in older age, while other benefits to cognition for multilinguals do not appear to exceed those present for bilinguals. This has implications for cognitive development and healthy ageing.

Introduction

Exploring the effects of multilingualism (proficiency in two or more languages) on the brain is valuable due to the centrality of language in shaping human experience.[1] Among all cognitive activities, language processing stands out as one of the most demanding, continuous and deeply interconnected functions we perform: we use it not only to communicate with others but also to conceptualise and understand information and to plan and regulate our thoughts and emotions;, language processing engages a broad range of brain areas with neural connections between linguistic and non-linguistic cognitive processing.[2] Learning a language provides insights into neuroplasticity, that is, how the brain transforms its structure and function in response to environmental stimuli.[1]

While the relationship between the brain and bilingualism has received considerable research interest, not much is known about how the use of three or more languages impacts cognition.[3,4] The available evidence is muddied by definitional obscurity; while some scholars use the term 'multilingualism' to refer to the ability to understand and speak more than two languages, others define multilingualism as the use of more than one language, thereby confounding bilingual and multilingual findings.[1] In this review, 'multilingualism' is defined as speaking and comprehending more than two languages and is distinguished from 'bilingualism' as the use of two languages.

Most of what is known about multilingual effects on cognition are inferences from bilingual studies.[5] Therefore, this review starts with an overview of what is known about bilingual effects and considers whether these can be extended to multilinguals. Research suggests that bilingual advantages extend from language-related abilities to broader, non-linguistic cognitive processes known as executive functions.[2-4] Executive functions are high-level skills that enable us to control, regulate and manage our thoughts and behaviour to achieve goals. Bilingualism is associated with advantages in several key executive function components, namely inhibitory control, working memory and cognitive flexibility. Inhibitory control is the ability to consciously suppress automated or well-learned responses when they are inappropriate for a particular situation. Bilinguals develop this skill by frequently inhibiting one language while actively using another, preventing interference between languages. The executive function of working memory entails the temporary storage and manipulation of information, which supports tasks such as following instructions, problem solving and reasoning. Managing two linguistic systems places ongoing demands on working memory, possibly strengthening it over time. The third aspect of executive function in which bilingual advantages have been reported is cognitive flexibility or the ability to switch efficiently between different rules, tasks and mental perspectives. The regular switching between languages in which bilinguals engage may develop – depending on context, speaker and/or setting – the capacity to adapt quickly to changing cognitive demands. Reviews and meta-analyses reach varying conclusions about the existence of bilingual advantages in these executive functions[6-10] and debates are ongoing about the size of these effects and whether they are legitimate or a product of publication bias favouring positive research outcomes[11,12].

The aim of this narrative literature review is to critically consider the current state of knowledge about multilingual effects on cognition and to address the following questions: Are the effects of three or more languages on cognition

the same as for two languages? If they are different, in what way? What factors modulate any cognitive changes in multilinguals?

A search of PsycINFO, Scopus, Web of Science and LLBA (Linguistics and Language Behaviour Abstracts) databases for articles with multilingual or trilingual in the title, abstract or keywords yielded 14 publications (published between 2008 and 2025) that investigated potential cognitive advantages in multilinguals of any age (Table 1). Studies that combined bilinguals and multilinguals into a single group were excluded. Sources included primary research studies and peer-reviewed conference proceedings using any research designs. Systematic or scoping reviews and meta-analyses were not included.

Table 1: Summary of multilingual advantage studies

Study	Country	Participants	Participants' languages	Research methods	Main finding
Perquin et al.[13]	Luxembourg	230 older adults (65 years+)	Luxembourgish, French, German	Non-experimental correlational design; standardised neuropsychological tests and language history questionnaire	Lifelong trilingualism significantly correlated with better cognitive performance than lifelong bilingualism
Kavé et al.[14]	Israel	814 older adults (75–85 years)	Hebrew, Yiddish, Russian, German, Polish, English	Longitudinal (three-year), non-experimental correlational design; Mini Mental Status Exam and Dementia Rating Scale	Speaking more languages significantly correlated with better mental status scores
Cockcroft et al.[15]	South Africa	78 young adult university students (18–22 years)	English, Zulu, Xhosa, Swati, Sotho, Tswana	Non-experimental design comparing monolinguals and multilinguals; working memory, non-verbal IQ and language proficiency measures	Multilinguals showed significant advantages in visuospatial working memory compared with monolinguals
Cockcroft[16]	South Africa	162 young adult university students (18–22 years)	English, Zulu, Xhosa, Swati, Sotho, Tswana	Non-experimental correlational design; working memory, non-verbal IQ and language proficiency measures	Non-verbal IQ, modality and type of assessment all significantly correlated with working memory performance in multilinguals
Espi-Sanchis and Cockcroft[17]	South Africa	189 young adult university students (18–22 years)	English, Zulu, Xhosa, Swati, Sotho, Tswana, Tsonga, Venda	Non-experimental correlational design; working memory, non-verbal IQ and language proficiency measures	Balanced proficiency across languages predicted verbal working memory
Chen et al.[18]	China	62 young adults (16–18 years)	Mandarin, English, Tibetan	Non-experimental design comparing bilinguals and trilinguals; executive control measures	Bilinguals significantly outperformed trilinguals on inhibitory control, working memory and cognitive flexibility tasks
Poarch and Bialystok[19]	Canada	203 children (8–11 years)	English and 22 other languages, e.g. Bengali, Spanish, Mandarin, French, German	Non-experimental design comparing monolinguals, bilinguals and trilinguals; non-verbal IQ, vocabulary and executive control measures	Bilinguals and trilinguals were significantly better at executive function tasks than monolinguals; trilinguals showed no advantages over bilinguals
Poarch and Van Hell[20]	Germany	75 children (5–8 years)	German, English, French	Non-experimental design comparing L2 (second language) learners, monolinguals, bilinguals and trilinguals; executive control measures	Bilinguals and trilinguals showed significantly better inhibitory control and conflict management than monolinguals and L2 learners; trilinguals showed no advantages over bilinguals
Vega-Mendoza et al.[21]	UK	193 young adult university students (18–22 years)	English, Spanish and a variety of third languages, not specified	Non-experimental design comparing monolinguals, bilinguals and trilinguals; non-verbal IQ, verbal fluency and executive control measures	Bilinguals and trlinguals outperformed monolinguals on executive control tasks; language proficiency was significantly related to performance; trilinguals showed no advantages over bilinguals
Humphrey and Valian[22]	USA	264 young adult university students (18–25 years)	English, Spanish, Chinese, Russian, Korean	Non-experimental design comparing monolinguals, bilinguals and multilinguals; language proficiency and executive control measures	Bilinguals and monolinguals showed equivalent executive control; trilinguals were significantly slower but equally accurate compared with monolinguals on executive control
Guðmundsdóttir and Lesk[23]	Iceland	132 adults (18–70 years)	Not stated other than English as L1 (first language) for monolinguals and L2 for bilinguals	Non-experimental design comparing monolinguals, bilinguals and trilinguals; language proficiency and executive control measures	The three language groups performed equivalently on inhibitory control, with trilinguals showing an age-related decline; trilinguals and bilinguals were equivalent on working memory and significantly poorer than monolinguals

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Study	Country	Participants	Participants' languages	Research methods	Main finding
Brito et al.[24]	Spain	36 infants (18 months)	Spanish, Catalan, English, French, German	Non-experimental design comparing monolinguals, bilinguals and trilinguals; memory generalisation and flexibility tasks	Trilinguals' performance did not differ significantly from that of bilinguals or monolinguals
Chertkow et al.[25]	Canada	284 older adults (67–81 years)	English, French, Hebrew, Italian, Polish, Russian, Spanish	Non-experimental, correlational design of age of onset of Alzheimer's Disease in monolinguals, bilinguals and trilinguals; Montreal Cognitive Assessment	Trilinguals were diagnosed later than bilinguals and both groups later than monolinguals
Engel de Abreu[26]	Luxembourg	106 children (6–8 years)	Luxembourgish, German, French, Portuguese	Non-experimental design comparing monolinguals, bilinguals and trilinguals; working memory tasks	Trilinguals and bilinguals outperformed monolinguals on working memory tasks when verbal ability was controlled

From bilingual to multilingual advantages

The bilingual advantage refers to the frequent use of two languages resulting in neural changes that benefit cognition. Advantages include improved higher-order cognitive (or executive) functions, such as enhanced inhibitory control, working memory and cognitive flexibility, which form the foundation for other higher functions like problem solving, decision-making, goal setting and creativity.[2,7] Interest in the topic originated with the discovery that bilinguals outperformed monolinguals on inhibitory control tasks in which cognitive effort must be applied to prevent an automatic response.[2] These effects were proposed to be a spillover from bilingual language processing where both languages remain active to varying degrees (referred to as the interactive activation model[27]) and/or when inhibitory control is exercised to deal with competition between languages and to filter out irrelevant information (the adaptive control model.)[28] To achieve fluent linguistic performance, bilinguals experience greater demands on their executive control systems than do monolinguals, effectively strengthening these systems through frequent use.[2]

For these advantages to manifest, bilinguals should be proficient in their languages to the extent that they are automatised, so that the changes occur not only in the language representations and brain structures that underlie language processing but are also generalised to other areas of cognition, particularly executive functions. These advantages are manifest in how flexibly a person can control their attention, shift between rules and focus on relevant, and ignore irrelevant, content.[2,7] In support of this, infant, toddler and preschooler bilinguals consistently outperform monolinguals in tasks related to selective attention and cognitive flexibility.[7] However, in bilinguals aged 6 years and older, the evidence is more equivocal. Advantages are reported in bilingual children and younger and older adults, with suggestions that these are more likely in those with earlier ages of acquisition of their second language (L2) and/or in those who switch more frequently between languages.[7,11,28,29] However, separate meta-analyses of bilingual effects on inhibitory control[9,30], working memory[10] and cognitive flexibility[31] suggest that these effects are very small, barely above chance ($p = 0.528$). Recent evidence suggests that the bilingual advantage may not manifest in any of the aforementioned executive functions, but rather in selective attention and disengagement of attention (switch costs when moving attention between tasks) which underlies these executive functions.[2] Bialystok[2] argues that bilingual experience progressively adapts these attentional systems which allow the bilingual to more easily disengage attention from one task and to rapidly reorient attention to a new task. Consequently, improved performance on executive function tasks is argued to be a downstream effect of more efficient attentional disengagement.

Bialystok's[2] account may explain why bilingual advantages are most consistently observed in older adults[29]. Proficiency in speaking two languages appears to change attentional and/or executive function systems in the prefrontal cortex, protecting the areas that are vulnerable to ageing.[32,33] Relative to monolinguals, bilinguals seem to be behaviourally protected from neural changes resulting from Alzheimer's dementia. Despite similar levels of Alzheimer's dementia in brain scans, those who were proficient in two languages from childhood appeared functionally much better off, often behaving like a person without dementia. These findings have been replicated and suggest a delay of 5 years in the manifestation of cognitive decline in bilinguals relative to monolinguals.[34] Thus, it is theorised that bilingualism contributes to cognitive reserve, or is a protective factor that mitigates the effects of cognitive decline in older age.[35] However, as with the executive function benefits mentioned earlier, not all studies report this benefit, especially prospective studies that followed healthy adults (in contrast to retrospective studies that investigated the onset of dementia in Alzheimer's dementia patients).[36]

The evidence for similar cognitive advantages when more than two languages are spoken is limited. Adding more languages creates greater cross-linguistic interference, which could either strengthen executive control or create greater confusion and difficulty in language processing.[28] For both bilinguals and multilinguals, cognitive effects seem to be modulated by individual variations in a complex interplay between individual, task- and experience-related factors.[37,38] The interaction between these factors is likely responsible for the varied findings concerning cognitive advantages in bilinguals and multilinguals, and each is discussed below by comparing what is known for bilinguals and multilinguals.

Factors that influence multilingual advantages

Language-related factors

These range from relatively simple factors such as the number of languages spoken, to more complex aspects, such as the linguistic environment and extent of proficiency in each language. Although each is discussed separately, this is an artificial separation as they are closely related.

Number of languages spoken

Speaking at least two languages appears to offer some protection against cognitive decline related to Alzheimer's dementia by strengthening executive function networks and/or by developing alternative networks that compensate for those lost due to ageing and/or pathology.[32-35] Trilingualism reportedly offers seven times more protection against cognitive decline relative to bilingualism, and if two of the trilinguals' languages were acquired simultaneously and early in life, the protection almost doubles.[13] While some research suggests that these protective benefits of multilingualism peak at three languages learnt early in life, there is evidence that lifelong use of four or more languages predicts mental status in older adults (75 years+) independently of other demographic variables.[13,14]

In younger multilingual samples, the number of languages spoken is not consistently related to enhanced cognitive control skills.[15,16,30] This may be because multilingualism as a categorical variable does not capture the complexity and variability of the phenomenon (e.g. balanced or

sequential, frequency of use, and proficiency in, each language etc), and these aspects appear more strongly related to cognitive advantages in younger bilinguals. Variations in these factors undoubtedly contribute to inconsistencies in findings.[10,16,39] It is also possible that prolonged use of multiple languages is needed for advantages to manifest, resulting in effects only becoming evident in older age.

Age of acquisition

Earlier age of acquisition of an L2 is associated with better executive function outcomes (inhibitory control and working memory) in bilinguals.[40-42] Multilinguals also show this advantage relative to monolinguals, but do not appear to possess an added advantage to bilinguals.[17,40,43] The supply-and-demand mismatch hypothesis[43] proposes that executive function advantages are governed by a 'supply–demand' balance in which advantages emerge only when language-control demands are high, yet manageable with age of acquisition and proficiency moderating the relationship. This suggests that advantages would occur for those who learn their additional languages sequentially rather than simultaneously. The reason for this is that the demands on executive functions would occur gradually in sequential bilinguals and this progressive, stepwise increase in difficulty is key in cognitive training, as the demands on cognition are more manageable and within the capacity of available cognitive supply as opposed to the large increases in demand faced by simultaneous language learners.[43] However, recent data show that adult bilinguals outperform late sequential trilinguals on inhibitory control, working memory and cognitive flexibility tasks, suggesting that a later acquired L3 does not increase executive function benefits.[18] This may be a function of the languages (Tibetan, Chinese and English in this case – see later section on this topic) that may not make sufficiently high demands on language control, while different results may arise with other language combinations.

Proficiency

Earlier age of acquisition is typically correlated with higher proficiency, making it difficult to separate their effects, but many studies measure only one or the other. Some propose that, to accrue benefits from bilingualism, there should be balance, or equivalent proficiency, among languages, because, at lower levels of proficiency, words from both languages compete for activation, while greater proficiency results in greater automatisation of cognitive processes.[31] This is supported by evidence in bilinguals that processing linguistic information by late L2 learners requires more cognitive resources.[44] However, there is also evidence for no effects of balanced proficiency in bilinguals.[45] Differences in findings could be related to variations in conceptualising and measuring balanced language proficiency.

The impact of balanced proficiency among multilinguals' languages has been explored in terms of its impact on working memory.[17] As language processing relies on working memory, more proficient, balanced multilinguals may strengthen and automatise this function through repeated practice in shifting between languages. The results suggest that multilinguals need to be highly balanced in proficiency across their languages for multilingual advantages in verbal working memory to manifest.[17]

Exposure and language environment

The attentional, switching and inhibitory control exerted when bilinguals and multilinguals use one of their languages appears dependent on the context.[4,28,37,46-48] Linguistic contexts vary between single-language, dual-language and dense code-switching. In the former, language use is separated by contextual cues (e.g. one language at school and another at home) and there is minimal to no switching between languages. In dual-language contexts, language choice is determined by the speaker, rather than the context, whereas in dense code-switching contexts, all speakers are at least bilingual and can use those words and grammatical structures that are most available to express themselves, i.e. code-switching often occurs within sentences resulting in language integration rather than inhibitory control. South Africa features the latter two linguistic contexts, which is typical of highly multilingual contexts.

These varying linguistic contexts determine the type of cognitive control required, with each hypothesised to strengthen different neural substrates through frequent use.[4,49] The adaptive control hypothesis[4] predicts that multilinguals in single-language contexts will show the smallest effects in the cognitive processes of goal maintenance and interference control, while those in dual-language contexts will show large changes in these aspects, but small changes in others, except opportunistic planning (i.e. making use of whatever words and grammatical structures are available), the latter which is mostly affected by dense code-switching environments. No multilingual studies have explicitly linked features of the linguistic environment to cognitive advantages, but this is demonstrated with bilinguals.[47,48,50]

Similarity between languages

The linguistic relatedness between a multilingual's languages can affect language organisation and processing. Greater similarity between languages may improve speed of processing between languages due to the stronger inhibitory control required[51], or may result in more conflict between languages and a slower processing speed[52]. In bilinguals, there is evidence of a relationship between higher orthographic overlap between languages and stronger cognitive control, as well as null effects once proficiency, task choice and sampling are controlled.[53,54] This aspect has yet to be systematically explored in multilinguals.

Task-related factors

A range of task-related qualities likely impacts whether, and how, cognitive advantages manifest in multilinguals. These include the particular cognitive functions investigated, the type of task used to tap those functions and the task modality.

Cognitive functions assessed

The cognitive functions most evaluated for bilingual advantages are the executive functions of inhibitory control, cognitive flexibility and working memory. The biggest effects seem to be for inhibitory control in bilinguals, with mixed evidence of effects on working memory and cognitive flexibility.[43] This is because multiple language use places demands on inhibitory control above those faced by monolinguals, as potentially interfering words from the non-target language must be inhibited. With multilinguals, it would be reasonable to expect even greater demands on inhibitory control because of the additional cross-linguistic interference. However, studies with trilingual children and young adults suggest that, while they perform significantly better than monolinguals, there are no additional cognitive gains relative to their bilingual peers.[19-21] For example, when monolinguals, bilinguals and trilinguals between 5 and 8 years old were assessed on inhibitory control, trilinguals and bilinguals fared significantly better than the monolinguals, but trilinguals showed no advantages over bilinguals.[20] In a similar study with a slightly older sample (monolinguals, bilinguals and trilinguals between 8 and 11 years old) the same results emerged.[19] This pattern was replicated with young adults[21,22,54], and in a larger study comparing bilingual and trilingual adults (18–70 years)[23]. The latter study also found that monolinguals' and bilinguals' inhibitory control remained unchanged with age, but there was an age-related decline in trilinguals that was not predicted by age of acquisition or extent of language use. This suggests that monolingualism and bilingualism, but not trilingualism, may minimise age-related deterioration in inhibitory control.[23]

Of the available studies exploring multilingual advantages in working memory, none found significant advantages for multilinguals over bilinguals, while evidence for an advantage of multilinguals over monolinguals is mixed. Trilingual infants (18 m) showed no memory advantages relative to monolinguals or bilinguals.[24] In young adults, multilinguals outperformed their monolingual peers on visuospatial working memory tasks, but no bilinguals were included in this study.[15] In a comparison of working memory performance of monolingual, bilingual and trilingual adults (18–70 years), bilinguals and trilinguals were at a significant disadvantage compared to monolinguals, but did not differ from each other.[23]

As for bilingual advantages in executive functions, the evidence for multilingual advantages is equivocal, with differences in findings likely resulting from the divergent methods and conceptualisations of bilingualism and multilingualism, as well as a tendency to use categorical definitions of these constructs that do not capture the diverse continuum of ways in which language is used.[10]

Modality and task type

Bilingual advantage studies use a range of executive function measures with considerable differences between them in terms of stimuli and procedures (even within the same type of task, e.g. inhibitory control (Flanker, Simon task) and working memory (n-back, digit span, symbol span). The issue is complicated by the task impurity problem, i.e. executive function tasks never measure a single executive function process as they are so intertwined, and also involve non-executive processes (e.g. processing speed).[45] Using working memory as an example, bilingual advantage studies report a variety of 'working memory' tasks which also draw on inhibitory and attentional control to different degrees.[55] While all tap working memory capacity, these complex span tasks require varying levels of executive control and impose different cognitive loads.[56] In contrast, simple span or short-term memory tasks (often used in working memory studies) measure passive storage, without processing, and exert lower cognitive loads.[15] Similarly, auditory-verbal measures of working memory tap processes different from those for visuospatial working memory, yet the two measures are often used interchangeably.[57] This may explain the heterogeneous findings in this field, as researchers use a range of executive function tests.[10,16]

Individual differences

A primary reason for the mixed results in multilingual and bilingual advantage studies is that various individual differences (verbal ability, intelligence, age, gender, socio-economic status) may influence whether, and to what extent, advantages in executive function and related domains are observed.

Verbal ability and intelligence

Few bilingual or multilingual advantage studies measure verbal ability, which is concerning given that bilinguals and multilinguals are at a disadvantage relative to monolinguals on verbal tasks, particularly those assessing vocabulary size, verbal fluency, naming and speed of access to lexical items.[2,15,58,59] This is because additional languages interfere with, and slow down, the production of an appropriate verbal response, in addition to which, weaker links may be formed between lexical items the more languages that are spoken.[60,61] The verbal disadvantage has been challenged, however, as it tends to disappear when vocabulary is statistically accounted for[32,62], and may be more evident in childhood, at points when verbal skills are developing, or a feature of the timing of L2 acquisition[58].

The role of intelligence in bilingual and multilingual advantages is similarly under-researched. In multilingual young adults, it was the strongest and most consistent predictor of working memory – even stronger than language-related variables – highlighting the importance of including pre-existing cognitive abilities as covariates.[16]

Gender

There is no consistent evidence for gender differences in bilingual or multilingual advantages (a demographic that is seldom explored), although language may be represented differently in male and female individuals, and female individuals tend to acquire vocabulary faster than male individuals.[16,37] However, these differences disappear in late childhood and/or are related to task-specific strategies.[63]

Age

In contrast to infants, children and young adults, for whom the evidence is mixed, older bilingual and multilingual adults show superior performance in executive function tasks more consistently.[64,65] Multiple language experience may offer protection against the gradual decline in brain volume associated with ageing by contributing to cognitive reserve, or the ability to effectively use existing cognitive processes and brain networks to adapt to, and compensate for, brain damage, disease or ageing.[66] It is possible that prolonged exposure to several languages is needed before such advantages manifest, and these may interact with other features (e.g. level of education) so that these effects only become evident in older adults with lifelong multiple language use. For example, Chertkow et al.[25] compared the onset of Alzheimer's dementia in trilinguals, bilinguals and monolinguals and found that trilinguals were diagnosed later than bilinguals, and the latter two groups were diagnosed later than monolinguals. Similarly, Perquin et al.[13] found that multilinguals developed dementia later than bilinguals, with a stepwise delay (the more languages spoken, the later the onset). Bilinguals also showed a delay compared with monolinguals, but the effect was stronger in multilinguals. This protective effect was independent of education and other demographics (socio-economic status and gender).

Socio-economic status

The benefits of bilingualism and multilingualism on executive functions may stem from correlated socio-economic status effects. For example, in bilinguals, both socio-economic status and bilingualism independently predict executive function and language skills, with those from backgrounds of higher socio-economic status performing best.[67,68] This suggests that some 'bilingual advantages' may be due to differences in socio-economic status, and that, if not included as a covariate, socio-economic status could amplify or mask cognitive benefits. In contrast, there is evidence of bilingual and trilingual children from backgrounds of low socio-economic status outperforming monolingual peers on working memory tasks, even when verbal abilities were matched. This suggests that bilingualism may develop cognitive resilience in socio-economically disadvantaged groups.[26]

Studies of multilinguals often include immigrant or minority groups, who sometimes have lower socio-economic status, without attempting to control for these effects.[1] This complicates interpretation because multilingualism may correlate with disadvantages related to socio-economic status (e.g. educational access and literacy).[69] A lifespan review[43] suggests that, just as in bilinguals, socio-economic status moderates whether multilingual advantages in executive function or cognitive reserve are observed. However, systematic evidence still is scarce.

Conclusion

In response to the questions posed at the outset of the review, there is no ubiquitous multilingual advantage, as it is dependent on an array of interrelated individual, task- and language-related factors, the combination of which shapes whether, and which, cognitive advantages develop. Multilinguals show some advantages beyond those for bilinguals, which appear most consistently in older adults in terms of added protection against cognitive decline.[25,66] In terms of executive function benefits, multilinguals have an advantage relative to monolinguals, but this advantage does not appear to differ from that for bilinguals.[19-21] It is possible that extended use of multiple languages across the lifespan is required before advantages manifest, which is why they are most evident in older adults.

The vastly varying methodologies employed by studies in the field made synthesising these findings difficult. Methodologically, research on this topic is limited by a reliance on correlational research designs in which pre-existing neural and cognitive differences may determine multilingual outcomes.[2,14] These hidden moderators (verbal ability, intelligence) of performance on executive function tasks are seldom measured in studies of multilingual advantages. Longitudinal studies are essential to track the complex relationship between cognition, its development and decline, and language usage to fully investigate the issue. Further, studies using behavioural (psychometric and/or experimental tasks) and physiological (neuroimaging and/or electrophysiological methods) assessments yield differing results due to the varying sensitivity of these measures, and the inclusion of both in the same study would provide more comprehensive data on the topic.[4,31] Finally, most multilingual studies sample trilinguals and very little is known about cognitive effects for speakers of four or more languages, or how the linguistic context influences cognition for multilinguals.

This review demonstrates that there is no simple linear relationship between knowing more languages and accruing more cognitive advantages. Instead, how often languages are used, how balanced/proficient speakers are, the ages at which languages are acquired, as well as the qualities of the languages and linguistic contexts shape which cognitive processes are exercised and whether measurable advantages are likely to emerge.

Data availability

There are no data pertaining to this article.

Declarations

I have no competing interests to declare. I have no AI or LLM use to declare.

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