Is Bilingualism Associated with Enhanced Executive Functioning in Adults: A Meta-Analytic Review

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The authors synthesized comparisons of bilinguals' and monolinguals' performance in six executive domains using 891 effects size from 152 studies on adults. Before correcting estimates for observed publication bias, our analyses revealed a small bilingual advantage for inhibition, shifting, and working memory, but not for monitoring or attention. No evidence for a bilingual advantage remained after correcting for bias.

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a small bilingual advantage for inhibition, shifting, and working memory, but not for monitoring or attention. No evidence for a bilingual advantage remained after correcting for bias. For verbal fluency, the analyses indicated a small bilingual disadvantage. The available evidence does not provide systematic support for that bilingualism is associated with benefits in cognitive control functions in adults.

- Executive functions (EF) is an umbrella term for high-level cognitive control functions that are involved in all complex mental activities, and therefore are of particular importance to human behaviour.
- The most frequently postulated EF components are working memory, inhibition, and set shifting.
- The field has not reached consensus on the nature and extent of the putative bilingual advantage.
- Theoretically, the bilingual advantage is assumed to stem from the demands that the use of two languages places on the cognitive control system.
- Previous meta-analysis and systematic reviews on the relationship between bilingualism and particular aspects of EF have reported varying results.

The study

In this meta-analysis, the currently available literature on bilingualism and EF in adults was reviewed. Compared to previous systematic reviews, this meta-analysis is considerably more wide-ranging in the number of included studies and in the domains, tasks, and background variables investigated, and unpublished studies were included.

Research questions:

1. In which EF domain do we observe a bilingual advantage?
2. Are possible advantages specific to some task paradigms?
3. Are possible advantages of different magnitude in verbal or nonverbal tasks?
4. Are observed advantages affected by how participant groups have been matched for age, SES, vocabulary knowledge, or IQ?
5. Is there a larger advantage in older than younger bilingual adults?
6. Does age of acquisition (AoA) or proficiency in L2 or immigration status moderate the advantages?
7. Does the country in which the study was conducted or language pairs of the bilinguals moderate the effects?

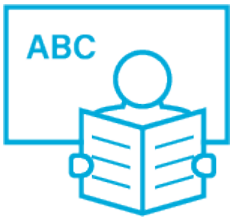
The data included a total of 891 effect sizes from 152 studies.

Findings

- Before corrections, a small positive effect size in favour of bilingual groups was found, g = 0.06 [0.01, 0.10], p < .05, QE [868] = 2,139.79.
- After corrections, the corrected effect size was negative, g = -0.08 [-0.17, 0.01], p = .099, but not statistically significant.
- Cognitive domain was found to moderate the outcomes.
- The moderator analysis indicated a small bilingual advantage for inhibition, shifting, and WM, and a small bilingual disadvantage for verbal fluency.
- For monitoring and attention, the analysis indicated neither an advantage nor a disadvantage.
- After correction of the analysis, statistically

significant negative outcomes were found for attention and verbal fluency. Other outcomes were not statistically significant.

- Whether the task was verbal or nonverbal moderated the outcomes in three domains: monitoring, shifting, and WM. The effect sizes were larger in nonverbal tasks.
- When analyses were performed only with data including tasks performed in the L1 of the bilinguals; the overall bilingual advantage was small and not statistically significant, g = 0.07 [-0.05, 0.18], p = .276, QE [108] = 336.90.
- For studies matching for vocabulary size, the previously estimated bilingual disadvantage for verbal fluency disappeared.
- For studies matching for intelligence and those matching for age, the estimated positive effect sizes in inhibition and shifting were slightly larger than previously.
- Samples with later acquisition of L2 showed a smaller difference between monolinguals and bilinguals in WM, g = 0.02 [-0.09, 0.12], p = .735, compared to samples with early acquisition, g = 0.23 [0.07, 0.39], p < .01. However, analysis corrected the outcome for early acquisition toward null, 0.02 [-0.26, 0.29], p = .912.
- L2 language proficiency or immigrant status did not moderate any of the results.



Conclusions

- No systematic evidence was found of a bilingual

advantage in adults in any of the EF domains after correcting for an observed publication bias.

- More specifically, the initial analysis across all EF domains estimated a small positive difference in favour of bilinguals, corresponding to less than 1% of the explained variation in outcomes, and this difference was the likely result of bias that remained in the data after removing outliers.
- After correcting for the remaining bias, the analysis across all EF domains no longer estimated any difference between monolinguals and bilinguals.
- Before accounting for bias in the data, the analysis focusing on each EF domain separately estimated small differences in favour of bilinguals for inhibitory control, shifting, and WM, and a small difference in favour of monolinguals was estimated for verbal fluency.
- After correcting for bias, no bilingual advantages were seen in any of the investigated EF domains.
- In fact, only a small bilingual disadvantage for verbal fluency and a smaller bilingual disadvantage for attention remained.