

Evidence for executive function advantages in low SES bilingual children. But why do they arise? A commentary on Grote, Scott and Gilger (2021).

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Abstract

In a study comparing executive functions amongst US Spanish-English bilinguals from low socio-economic (SES) backgrounds to monolinguals of each language, Grote et al. (2021) find that bilingual advantages already manifest themselves in pre-school children. This commentary recommends building on this finding, and further investigate the causes underlying the observed EF modulations in child bilingualism. A closer investigation of bilingual children's dominance profiles and their bilingual practices, such as code-switching, may shed light on how bilingualism shapes the developmental trajectory of executive functions. The commentary also challenges the notion of "monolingualism", and discusses whether bilingualism variables should be operationalised in a continuous or in a categorical manner.

1. The observed effects of bilingualism on executive functions

In a study comparing executive functions (EFs) amongst US Spanish-English bilinguals from low socio-economic (SES) backgrounds to monolinguals of each respective language, Grote et al. (2021) attest that bilingual advantages already manifest themselves in pre-school children. The authors detect bilingualism effects across several domains of EFs, namely working memory, visuo-spatial memory and attentional control. This confirms (a) the internal validity of EF tasks, and (b) the broad nature of the effects of bilingualism. Crucially, Grote et al. (2021) confirm previous findings of bilingual advantages amongst children (Blom et al., 2014; Carlson & Meltzoff, 2008) for the under-studied context of low-SES bilingualism. Although the individual sub-groups investigated were small (N=20 in each group), table 1 shows that the effect sizes associated with the reported χ^2 values are of medium to large size, suggesting replicability.

Table 1 Effect sizes of monolingual-bilingual group comparison by task¹

Task	EF component	χ^2	R	Effect	p-value
Concentration	Visuo-spatial memory	89.46	1.22	large	<.001
Colourforms	Visuo-spatial memory	22.29	0.61	medium	<.001
Day-Night Task	Inhibition	51.33	0.92	large	<.001
Embedded Figures	Attentional control	29.17	0.70	medium	<.001

These findings are in line with adult bilingualism studies which have demonstrated that bilingualism effects occur irrespective of SES, and may even be stronger in low SES samples (Calvo & Bialystok, 2014). Hence, Grote et al. (2021) provide convincing counter-evidence for the stance that "bilingual advantages in executive functioning either do not exist or are restricted to very specific and undetermined circumstances" (Paap et al., 2015: 265). Contrary to this statement, Grote et al. (2021) reveal broad effects of bilingualism in a clearly defined context and age group, namely that of low-SES Spanish-English bilingual children. Importantly, this study is impactful for because a non-

¹ The R coefficient was calculated based on the following online effect size calculator. NB: The calculation may result in R values greater than 1. <https://www.campbellcollaboration.org/escalc/html/EffectSizeCalculator-R5.php>

negligible proportion of 22% of school children in the USA are bilingual, and most of those are Spanish-English bilingual².

2. Exploring the causes underlying the observed effects of bilingualism on executive functions

Whilst Grote et al.'s (2021) study provides compelling evidence THAT bilingualism effects on EFs occur in the context investigated, i.e., low-SES Spanish-English bilingual children, further research is needed to explain WHY these effects occur, i.e., to identify the bilingual practices that give rise to the observed EF modulations. The current consensus in bilingualism research is that the origins of bilingual EF modulations are to be sought in bilinguals' individual profiles, and that the diverse nature of bilinguals' backgrounds and language usage patterns may explain inconsistencies in previous findings (Bak, 2016). Bilingualism is a multi-faceted phenomenon shaped by many factors. Grote et al. operationalised their variables of interest, i.e., age and SES, in a categorical manner using group comparisons. Future research could operationalise such variables in a more continuous fashion in line with current theoretical conceptualisations of bilingualism (Luk & Bialystok, 2013). Age in particular would lend itself to a continuous measurement if one investigated samples with greater age ranges in a larger follow-up study.

In a similar vein, the categorisation of children into “monolinguals” and “bilinguals” could be operationalised as a continuum, especially in view of recent findings showing that exposure to linguistically diverse environments alone has the potential to shape processing even in monolinguals (Bice & Kroll, 2019). Given the presence of both English and Spanish in the context of Grote et al.'s (2021) study, it is likely that all children in this study were exposed to linguistic diversity to some extent. The very notion of pure “monolingualism” could thus be challenged on the grounds that (a) processing in monolinguals is affected by the contextual presence of linguistic diversity (Bice & Kroll, 2019), and (b) children officially categorised as “monolinguals” may still have knowledge of several registers and varieties, which may shape EFs (Antoniou et al., 2016). A continuous measurement of bilingualism would have allowed Grote et al. (2021) to get around the formation of pure monolingual control groups. The notion of a Spanish monolingual group needs to be questioned. The fact that the two monolingual groups were not equally “monolingual” is acknowledged by Grote et al., who defined different cut-off points for the proficiency measure used for categorisation (page 13, footnote 1). It is feasible that the monolingual group speaking the majority language English was fully monolingual. However, it is highly unlikely that one can find fully monolingual children of the minority language Spanish in the investigated context. How could these children possibly have avoided exposure to the majority language in the media, at playgrounds etc. for the duration of three to four years? Research shows that even minimal exposure to language materials in audio-visual format automatically triggers implicit learning processes in both adults (Gullberg et al., 2010) and children (Roseberry et al., 2009), and it is unlikely that the Spanish monolinguals have not been exposed to such input, e.g., by watching TV in the majority language.

Regardless of whether the monolingual-bilingual variable is operationalised on a categorical or continuous basis, future research may re-consider the basis of its assessment. If bilingualism effects arise from active usage of the two languages (De Bruin & Della Sala, 2016), then it makes sense to define the language background of participants as “functionally monolingual” or “functionally bilingual”, rather than to apply proficiency-based criteria. Measurements of degree of bilingualism could be based on the relative usage of the involved languages by creating entropy scores à la Gullifer and Titone (2020). The bilingualism entropy formula generates a score assessing the linguistic diversity of participants' language usage patterns indicative of degree of bilingualism, based on bilinguals' self-reports of their usage of each respective language in different contexts. The self-reports used to generate the entropy score are collected using standardised questionnaires, such as the Language History Questionnaire (Li et al., 2014), in which participants provide details on the frequency with which they use their languages in different contexts and with different interlocutors.

² Source: <https://datacenter.kidscount.org/updates/show/184-the-number-of-bilingual-kids-in-america-continues-to-rise>

To investigate the influence of language entropy on EFs in the context of child bilingualism, these tools would need to be converted into parental questionnaires, and the questions would need to be adapted to capture the reality of bilingual children, incorporating assessments of the linguistic input they receive by caregivers, which shapes children's own language use and knowledge (De Houwer, 2011).

To shed further light on the relationship between bilingualism and EFs in children, a closer investigation is needed of the specific bilingualism variables affecting EFs. In terms of the EF tasks used, Grote et al.'s study (2021) provides a promising methodological framework for assessing EFs in bilingual children, which, if combined with measurements of language usage patterns, could reveal insights into the causes of bilingualism effects on EF development. The Adaptive Control Hypothesis suggests that one of the key factors influencing EFs in bilinguals is code-switching, i.e., the common bilingual practice of switching between languages within the same utterance or conversation to optimise communication in bilingual contexts (Beatty-Martínez et al., 2020; Green & Abutalebi, 2013). Indeed, there is growing evidence that code-switching in adult bilinguals modulates EFs (Lai & O'Brien, 2020; Hofweber et al., 2020; Verreyt et al., 2016; Yang et al., 2016) and divergent thinking (Kharkhurin & Wei, 2015), although counter-examples and null-results co-exist (Paap et al., 2017). However, to date few studies explore how code-switching affects the early stages of EF development in bilingual children. Exploring the effects of code-switching on EFs is a particularly impactful research question because parents of bilingual children frequently ask themselves whether code-switching is beneficial, neutral or detrimental for the linguistic and cognitive development of their children. It is therefore of crucial importance to investigate the nature and effects of childhood code-switching on EFs, to address any potential misconceptions about code-switching.

Existing research already dispels widespread beliefs that code-switching has detrimental effects on language development, showing, on the contrary, that it plays a scaffolding role for learning (Yow et al., 2018). Moreover, code-switching in children is systematic and resembles adults' bilingual speech, suggesting that it is not a sign of deficiency, but rather a sign that children are emerging bilinguals acquiring the language usage patterns of their speech communities (Cantone, 2007; Meisel, 1994; Treffers-Daller, in press). This would suggest that child code-switching should enhance EFs in a similar way as adult code-switching has been proposed to do (Green & Abutalebi, 2013). However, whether code-switching affects the general cognitive development of bilingual children remains an unexplored research question. This current lack of investigations is perhaps due to the complexities associated with assessing code-switching in children, in whom both the language systems and the EFs are still under construction (Treffers-Daller, in press).

The challenge for future research will be to develop age-appropriate ecologically valid measures of child code-switching because self-reports and parent-reports will be confounded by attitudes towards code-switching (Dewaele & Wei, 2014), and frequency judgement tasks as used by Hofweber et al. (2020) are not a realistic alternative due to children's likely lack of metalinguistic awareness. The most feasible alternative probably involves the recording of short conversations or role plays between children and caretakers, following the approach of Yim and Bialystok (2012) and Lai and O'Brien (2020). This would allow not only for the measurement of code-switching frequency, but also for the assessment of qualitatively different code-switching types that affect EFs differentially (Treffers-Daller, 1998; Muysken, 2000; Green & Wei, 2014; Hofweber et al., 2020). Given that the language systems in children are still in development, it is important to differentiate between communicatively purposeful code-switching with other bilinguals, and code-switching used to compensate for initial gaps in bilingual children's competence. To tease apart these two phenomena, researchers could manipulate the conversational context, comparing children's code-switching in the presence of monolingual and bilingual interlocutors. Whilst code-switching with other bilinguals is a communicative strategy, code-switching in the presence of monolinguals could be interpreted as a sign of cross-linguistic interference and transfer (Grosjean, 2012).

Some bilingualism-related predictors of EFs, such as code-switching, have been argued to be best captured as continuous, rather than categorical variables, to account for individual differences (Luk &

Bialystok, 2013). However, code-switching also differs as a function of community practices, suggesting that group comparisons may also provide useful insights (Muysken, 2000; Deuchar, Muysken & Wang, 2007; Hofweber et al., 2016). An extension of Grote et al.'s (2021) study investigating code-switching could in fact use mixed models, which allow for a promising integrated approach incorporating both categorical and continuous predictors (Kremin & Byers-Heinlein, 2020). This would allow for a comparison of children from different speech communities with various language combinations, as well as for an investigation of individual variability in code-switching usage. An important factor shaping code-switching and language mixing in bilingual children is language dominance (Cantone et al., 2008). Future research on code-switching and EFs in bilingual children should thus consider the phenomenon in light of children's language dominance. Dominance is a complex construct, and its assessment is challenging (Treffers-Daller, 2016). Although proficiency is a valid measure of dominance in bilingual children (Kupisch & Van de Weijer, 2016), a multi-method approach involving parental questionnaires and ecologically valid performance measures may reflect the complexity of the phenomenon more adequately (Unsworth et al., 2018).

3. Conclusion

To conclude, this commentary recommends a close reading of Grote et al.'s study (2021), which provides convincing evidence for the occurrence of EF modulations in bilingual children from low-SES backgrounds. Thus, the study serves as an inspiration for further research investigating the reasons underlying the observed patterns. To do this, future research with bilingual children should attempt a more detailed assessment of usage patterns, such as code-switching, and background measures, such as dominance. Crucially, research should incorporate both group comparisons and individual difference measurements, to account for the complexity of bilingualism.

References

- Antoniou, K., Grohmann, K.K., Kambanaros, M., Katsos, N. (2016). The effect of childhood bilingualism and multilingualism on executive control. *Cognition*, 149, 18-30.
- Bak, T. H. (2016). Cooking pasta in La Paz: Bilingualism, bias and the replication crisis. *Linguistic Approaches to Bilingualism*, 6(5), 699-717.
- Beatty-Martínez, A. L., Navarro-Torres, C. A., & Dussias, P. E. (2020). Codeswitching: a bilingual toolkit for opportunistic speech planning. *Frontiers in Psychology*, 11, 1699.
- Bice, K., & Kroll, J. F. (2019). English only? Monolinguals in linguistically diverse contexts have an edge in language learning. *Brain and Language*, 196, 104644.
- Blom, E., Küntay, A. C., Messer, M., Verhagen, J., & Leseman, P. (2014). The benefits of being bilingual: Working memory in bilingual Turkish–Dutch children. *Journal of Experimental Child Psychology*, 128, 105-119.
- Calvo, A., & Bialystok, E. (2014). Independent effects of bilingualism and socioeconomic status on language ability and executive functioning. *Cognition*, 130(3), 278-288.
- Cantone, K. F. (2007). *Code-switching in bilingual children* (Vol. 296). Springer.
- Cantone, K., Kupisch, T., Müller, N., & Schmitz, K. (2008). Rethinking language dominance in bilingual children. *Linguistische Berichte*, 2008(215), 307-343.
- Carlson, S. M., & Meltzoff, A. N. (2008). Bilingual experience and executive functioning in young children. *Developmental Science*, 11(2), 282-298.

- De Bruin, A., & Della Sala, S. (2016). The importance of language use when studying the neuroanatomical basis of bilingualism. *Language, Cognition and Neuroscience*, 31(3), 335–339.
- De Houwer, A. (2011). Language input environments and language development in bilingual acquisition. *Applied Linguistics Review*, 2, 221-240.
- Deuchar, M., Muysken, P., & Wang, S. L. (2007). Structured variation in codeswitching: towards an empirically based typology of bilingual speech patterns. *International Journal of Bilingual Education and Bilingualism*, 10(3), 298-340.
- Dewaele, J. M., & Wei, L. (2014). Attitudes towards code-switching among adult mono- and multilingual language users. *Journal of Multilingual and Multicultural Development*, 35(3), 235-251.
- Green, D. W., & Abutalebi, J. (2013). Language control in bilinguals: The adaptive control hypothesis. *Journal of Cognitive Psychology*, 25(5), 515-530.
- Green, D. W., & Wei, L. (2014). A control process model of code-switching. *Language, Cognition and Neuroscience*, 29(4), 499-511.
- Grote, K., Scott, R., & Gilger, J. (2021). Bilingual advantages in executive functioning: Evidence from a low-income sample. *First Language*. Tbc
- Grosjean, F. (2012). An attempt to isolate, and then differentiate, transfer and interference. *International Journal of Bilingualism*. 16(10), 11-21.
- Gullberg, M., Roberts, L., Dimroth, C., Veroude, K., & Indefrey, P. (2010). Adult language learning after minimal exposure to an unknown natural language. *Language Learning*, 60, 5-24.
<https://doi.org/10.1111/j.1467-9922.2010.00598>.
- Gullifer, J. W., & Titone, D. (2020). Characterizing the social diversity of bilingualism using language entropy. *Bilingualism: Language and Cognition*, 23(2), 283-294.
- Hofweber, J., Marinis, T., & Treffers-Daller, J. (2016). Effects of dense code-switching on executive control. *Linguistic Approaches to Bilingualism*, 6(5), 648-668.
- Hofweber, J., Marinis, T., & Treffers-Daller, J. (2020). How different code-switching types modulate bilinguals' executive functions: A dual control mode perspective. *Bilingualism: Language and Cognition*, 23(4), 909-925.
- Hofweber, J., Marinis, T. & Treffers-Daller, J. (2019). Predicting executive functions in bilinguals using ecologically valid measures of code-switching behaviour. In: I. A. Sekerina, L. Spradlin, and V. Valian (Eds.). *Bilingualism, Executive Functions, and Beyond. Questions and Insights*, Studies in Bilingualism, Benjamins Publishing.
- Kharkhurin, A. V., & Wei, L. (2015). The role of code-switching in bilingual creativity. *International Journal of Bilingual Education and Bilingualism*, 18(2), 153-169.
- Kremin, L. V., & Byers-Heinlein, K. (2020). Why not both? Rethinking categorical and continuous approaches to bilingualism. <https://psyarxiv.com/nkvap/>
- Kupisch, T., & Van de Weijer, J. (2016). The role of the childhood environment for language dominance: A study adult simultaneous bilingual speakers of German and French. In C. Silva-Corvalan, J. and Treffers-Daller (eds.), *Language Dominance in Bilinguals. Issues of Measurement and Operationalization*. Cambridge University Press, pp. 174-195.
- Li, P., Zhang, F. A. N., Tsai, E., & Puls, B. (2014). Language history questionnaire (LHQ 2.0): A new dynamic web-based research tool. *Bilingualism: Language and Cognition*, 17(3), 673.

- Lai, G., & O'Brien, B. A. (2020). Examining language switching and cognitive control through the adaptive control hypothesis. *Frontiers in Psychology, 11*, 1171.
- Luk, G., & Bialystok, E. (2013). Bilingualism is not a categorical variable: Interaction between language proficiency and usage. *Journal of Cognitive Psychology, 25*(5), 605-621.
- Meisel, J. M. (1994). Code-switching in young bilingual children: The acquisition of grammatical constraints. *Studies in Second Language Acquisition, 16*, 413-439.
- Muysken, P. (2000). *Bilingual speech: A typology of code-mixing*. Cambridge University Press.
- Paap, K. R., Johnson, H. A., & Sawi, O. (2015). Bilingual advantages in executive functioning either do not exist or are restricted to very specific and undetermined circumstances. *Cortex, 69*, 265-278.
- Paap, K. R., Myuz, H. A., Anders, R. T., Bockelman, M. F., Mikulinsky, R., & Sawi, O. M. (2017). No compelling evidence for a bilingual advantage in switching or that frequent language switching reduces switch cost. *Journal of Cognitive Psychology, 29*(2), 89-112.
- Roseberry, S., Hirsh-Pasek, K., Parish-Morris, J., & Golinkoff, R. M. (2009). Live action: Can young children learn verbs from video?. *Child Development, 80*(5), 1360-1375.
- Treffers-Daller, J. (1998). The inhibitory control model and code-switching. *Bilingualism: Language and Cognition, 1*, 98-99.
- Treffers-Daller, J. (in press). Code-switching in bilingual and trilingual children. In: Stavans, E. & Jessner, U. (Eds). *The Cambridge Handbook of Child Multilingualism*. Cambridge University Press.
- Treffers-Daller, J. (2016). Language Dominance: The construct, its measurement and operationalisation. In C. Silva-Corvalan, and J. Treffers-Daller (eds.), *Language Dominance in Bilinguals. Issues of Measurement and Operationalization*. Cambridge University Press, pp. 174-195.
- Unsworth, S., Chondrogianni, V., & Skarabela, B. (2018). Experiential measures can be used as a proxy for language dominance in bilingual language acquisition research. *Frontiers in Psychology, 9*, 1809.
- Verreyt, N., Woumans, E. V. Y., Vandelanotte, D., Szmalec, A., & Duyck, W. (2016). The influence of language switching experience on the bilingual executive control advantage. *Bilingualism: Language and Cognition, 19*(1), 181-190.
- Yang, H., Hartanto, A., & Yang, S. (2016). The complex nature of bilinguals' language usage modulates task-switching outcomes. *Frontiers in Psychology, 7*, 560.
- Yim, O., & Bialystok, E. (2012). Degree of conversational code-switching enhances verbal task switching in Cantonese-English bilinguals. *Bilingualism: Language and Cognition, 15*(4), 873-883.
- Yow, W. Q., Tan, J. S., & Flynn, S. (2018). Code-switching as a marker of linguistic competence in bilingual children. *Bilingualism: Language and Cognition, 21*(5), 1075-1090.