

The bilingual advantage: *acta est fabula?*

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In their article, Paap, Johnson and Sawi (2015) present a comprehensive analysis of the results on the so-called advantage of bilinguals in executive functions. They raise several critical aspects of the studies published on this topic that could be summarized as follows: (1) methodological concerns related to sample size, the characteristics of participants and how the bilingual and monolingual groups were matched on socio-demographic factors, (2) statistical concerns related to the analyses reported and (3) theoretical issues related to the inconsistency of the results across tasks and groups of participants. Their conclusion is straightforward and consistent with the empirical characterization of the bilingual advantage by de Bruin, Treccani and Della Sala (2015): most likely, generalized and generalizable bilingual advantages in executive function do not exist. Borrowing the Latin expression used by Paap et al., their study offers a compelling (and explanatory) review showing that, as far as the universality of the so-called bilingual advantage is concerned, *acta est fabula*.

While we agree with most of Paap et al.'s (2015) arguments, there are two issues that may be worth considering to guide future studies. Firstly, it has been claimed that differences between monolinguals and bilinguals in some components of the multifaceted construct of executive functions could be mediated by the age of second-language acquisition. However, how this factor could modulate potential differences between bilinguals and monolinguals in executive functions is far from clear, yet suggestive. While some studies have reported an advantage in inhibitory control for early bilinguals over both late bilinguals and monolinguals (e.g., Luk, De Sa, & Bialystok, 2011), others have not been able to replicate these findings and it has been suggested that some of the effects may be clearer in late bilinguals (e.g., Tao, Marzecova, Taft, Asanowicz, & Wodniecka, 2011; see Vega-Mendoza, West, Sorace, & Bak, 2015, for review). In particular, a series of large sample-size studies from our

group showed no differences between native bilinguals and monolinguals (see Antón et al., 2014; Duñabeitia et al., 2014), thus undermining the stability of the hypothesis favoring a bilingual advantage for early bilinguals.

It was initially argued that acquiring (and using) a second language during infancy might necessarily imply an enhancement of additional non-linguistic cognitive abilities, given the additional executive control demands imposed by the use of two languages. However, as seen, crib bilingualism does not necessarily give rise to a benefit with respect to monolinguals. A newborn can easily incorporate one or two languages into his repertoire with no need for a cognitive reconfiguration. A different scenario may arise for bilinguals who have acquired a second language late in life. Late bilinguals may undergo a reconfiguration of their cognitive skills to deal with the newly learned linguistic ability and to accommodate the existing system, yielding collateral cognitive improvements. Training and cross-sectional studies demonstrate that specific cognitively demanding acquired skills have a causal effect in the enhancement of attention skills (e.g., Dye, Green, & Bavelier, 2009). Moreover, the transfer effects to specific cognitive abilities (including executive control) derived from different forms of training may be more salient when the training takes place later in life (e.g., Hillman, Erickson, & Kramer, 2008). Hence, becoming bilingual late in life may well yield significant improvement of executive functions (see Antoniou, Gunasekera, & Wong, 2013). Nonetheless, given the absence of direct evidence in support of this hypothesis, it should be taken *cum grano salis*.

Secondly, while Paap et al.'s (2015) argument regarding misalignment problems when considering how neural and behavioral data fit together is legitimate, the potential impact of bilingualism on the structure and anatomical connectivity of the human brain should not be dismissed (e.g., García-Pentón et al., 2014; Pliatsikas, Moschopoulou, &

Saddy, 2015). It is true that differences between bilinguals and monolinguals do not always generalize across studies, are scarce and mostly inconsistent given current evidence (see Li, Legault, & Litcofsky, 2014; García-Pentón et al., 2015). Nevertheless, investigating structural changes invoked by native or lately acquired bilingualism represents a promising avenue to better understand the impact of multilingualism at the cognitive level. In any case, two important caveats must be made. Firstly, the inconsistency of behavioral findings cannot and will not be settled by structural or functional brain differences, and simply changing the arena of the debate from cognition to the brain is not going to be helpful. This is related to the second difficulty in reconciling behavioral and neuroimaging data: there is no direct mapping between brain structure and cognitive function, and we are far from understanding how increases or decreases in the density or volume of a particular region (e.g., anterior cingulate) or a particular network for a specific group of participants is linked to a putative cognitive function. A difference in the structural configuration of the brain or in the anatomical connectome does not necessarily come *pari passu* with an understanding of how cognitive processes are operating in monolinguals and bilinguals.

Finally, we want to highlight the importance of self-criticism among researchers as well as the need for a good scientific practice and an unbiased peer-reviewing system around this topic motivated only by what the data show. As long as experiments are performed properly, data showing no advantage should have the same publishing possibilities as data showing an advantage. Anything else would be damaging for science. We need to understand when, how, and why some experiments showed significant differences while others showed no difference between bilinguals and monolinguals. The use of large samples of participants to overcome power issues and well matched groups controlling for demographic factors is a critical avenue to improve

this understanding, but a thorough revision of the postulates and hypotheses guiding the research agenda is also needed. The Earth was thought to be flat until the opposite was shown.

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