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MEDICINE

Judging the evidence for bilingualism and cognitive reserve: A commentary on Mukadam, Sommerlad, & Livingston

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Recent evidence suggests that bilingualism leads to domain-general cognitive outcomes. Impressively, some research has suggested that bilinguals have delayed onset of symptoms of dementia compared to monolinguals. Mukadam, Sommerlad, and Livingston (in press) recently conducted a meta-analysis to examine the strength of the protective effect of bilingualism on dementia. We review their findings in the following commentary.

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INTRODUCTION

Recent evidence suggests that lifelong bilingualism reshapes the brain and helps to prevent cognitive decline in older age (review in Bialystok, 2017). For example, Klein et al. (2016) showed that at the population level, predominantly bilingual countries show lower incidence rates of dementia than monolingual countries. Mukadam, Sommerlad, and Livingston (in press) recently conducted a meta-analysis to examine the strength of the protective effect of bilingualism on dementia. The authors claim that retrospective studies are often confounded by extraneous variables, whereas prospective studies are less susceptible. They conducted a meta-analysis on available literature and concluded that bilingualism does not protect from dementia or cognitive decline given that only retrospective studies showed positive effects of bilingualism. However, three factors undermine their analysis and challenge their conclusions.

STATISTICAL ISSUES

Although the authors state that 13 articles were included in their meta-analysis, it appears that the analysis included only four studies, all of which were prospective. Thus, any conclusions comparing retrospective and prospective studies are not supported by statistical evidence. Nonetheless, of the four prospective studies included in the analysis, three included information regarding age at onset, the same measure as the retrospective studies. However, the authors did not analyze these data, arguing that "[t]hese outcomes were too heterogeneous to be combined in a meta-analysis". We respectfully disagree given that meta-analyses are used precisely for the purpose of combining heterogeneous data and examining overall patterns. A more direct comparison of prospective and retrospective studies would be to include both types of studies within the same model using age at onset of dementia. It would have also been possible to include age at onset and incidence rate in a single analysis. One of the key features of a meta-analysis is that the individual studies included do not need to have the same dependent variables (Field, 2010). The dependent variables are converted to effect sizes (e.g. Cohen's d), and it allows comparison of disparate outcomes (i.e. incidence/age of onset). Thus, including retrospective and prospective studies in a single meta-analysis would have allowed for

the examination of whether the type of study (retrospective vs. prospective) moderated the overall effect. It is possible that such an analysis based on both study types would favour bilinguals and that the moderator analysis would not reveal a difference between the sources, but the analyses that are presented simply allow no conclusions.

CONCEPTUAL ISSUES

Retrospective and prospective studies do not measure the same thing. Retrospective studies measure age at onset of dementia symptoms, whereas prospective studies examine dementia incidence rate. Given that prospective and retrospective studies are not measuring the same outcome variable, this likely contributes to bilingualism being protective in one case and not the other. Retrospective dementia studies often interpret their data according to a cognitive reserve perspective - the individual can cope with more neural degeneration (e.g. Perani et al., 2017). From this standpoint, one should not necessarily expect incidence rates of dementia to differ between monolinguals and bilinguals. Both groups will get the disease (eventually), but bilinguals should be able to withstand more disease pathology than monolinguals before reaching a critical drop-off point (hence the later age of onset for bilinguals). In other words, what is critical is not whether the individual gets the disease, but how quickly he or she accrues symptoms.

METHODOLOGICAL ISSUES

The authors' claim that retrospective studies are often confounded by extraneous variables to which prospective studies are less susceptible. While this is generally true, methodological flaws are pervasive in the prospective studies included in the analysis outweighing the benefits of the within-subject design. For example, Sanders, Hall, Katz, and Lipton (2012) failed to ask their "monolinguals" if they spoke or understood other languages. Relatedly, Zahodne, Schofield, Farrell, Stern, and Manly (2014) failed to report second language proficiency and use and included "bilinguals" that reported speaking their second language "not well". These limitations alone make it difficult to rule out the possibility that some of the monolinguals in these studies were, in fact, receptive bilinguals, and that some bilinguals were not very proficient in their second languages. It is therefore not entirely surprising that there were no significant differences in these cases. In contrast, many of the retrospective studies carefully controlled for multiple confounding variables, and these studies generally reported positive effects for bilingualism. For example, Craik et al. (2010) controlled for education and gender, as well as cognitive and occupational levels and found that bilinguals showed symptoms of dementia 5.1 years later than monolinguals. Alladi et al. (2013) examined a sample of individuals from an Indian population and revealed a delay of 4.5 years for bilinguals, independent of immigration status and the aforementioned controls.

CONCLUSIONS

We agree that well-controlled prospective studies would be informative and help uncover the differences between bilingual and monolingual individuals as they progress into Alzheimer's disease. Ultimately, these studies could also help to reveal the mechanisms allowing bilinguals to stave off symptoms for longer. However, such studies are still lacking. Of the studies that exist and provide adequate control for confounds, bilingualism is generally found to be protective and delays symptoms for about 4.5 years. The overall picture is still clearly in favour of bilingualism protecting against symptoms of dementia. Thus, we suggest that the authors' recommendation that bilingualism be removed from consideration as a protective factor by policy makers is premature.

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