11-2018

# An integrative approach to investigating bilingual advantages in cognitive decline: The Australian longitudinal study of ageing

Wei Xing TOH
*Singapore Management University*, wxtoh@smu.edu.sg

Andree HARTANTO
*Singapore Management University*, andreeh@smu.edu.sg

Joanne Qin Ying TAN
*Singapore Management University*, joanne.tan.2017@phdps.smu.edu.sg

Hwajin YANG
*Singapore Management University*, hjyang@smu.edu.sg



## Citation

TOH, Wei Xing, HARTANTO, Andree, TAN, Joanne Qin Ying, & YANG, Hwajin.(2018). An integrative approach to investigating bilingual advantages in cognitive decline: The Australian longitudinal study of ageing. *International Journal of Geriatric Psychiatry, 33(10)*, 1412-1414.

**Available at:** https://ink.library.smu.edu.sg/soss_research/2752

# An Integrative Approach to Investigating Bilingual Advantages in Cognitive Decline: The Australian Longitudinal Study of Ageing

Wei Xing Toh, Andree Hartanto, Qin Ying Joanne Tan, Hwajin Yang
Singapore Management University

Word Count: 694

A commentary on

The relationship of bilingualism to cognitive decline: The Australian Longitudinal Study of Ageing

*by Mukadam, N., Jichi, F., Green, D., & Livingston, G (2018). International Journal of Geriatric Psychiatry, 33(2), e249-e256, DOI: 10.1002/gps. 4778.*

Mukadam et al[1] analysed a large-scale, prospective dataset from the Australian Longitudinal Study of Ageing (ALSA)—which tracked a sample of 2,087 elderly participants (65 years or older) across 20 years—and found that bilinguals and monolinguals did not significantly differ in executive functioning and cognitive decline. The authors conclude that bilingualism "does not protect from cognitive decline or enhance cognitive function" (p. 7).[1] Despite the authors' laudable intentions, we would caution that their conclusions are premature.

The first issue concerns the use of verbal measures of executive functions (EF), which tap verbal skills more than nonverbal measures do. This could have unfairly disadvantaged bilinguals who were not as linguistically proficient as monolinguals, as evidenced by bilinguals' poorer performance on the National Adult Reading Test. Bilingual advantages have been reported for studies that employed nonverbal, and not verbal, measures of EF (see Table 1). For instance, Luo et al[2] found that bilinguals (aged 60–80) outperformed their monolingual counterparts on nonverbal spatial working memory tasks—assessed by Corsi forward and backward tests—but performed worse than monolinguals on verbal working memory tasks (i.e., word span and alpha span). Therefore, Mukadam et al's use of verbal measures of EF could have suppressed possible enhancements conferred by bilingualism.

A second concern is that the MMSE has been shown to be biased against individuals with lower education and socioeconomic status (i.e., false positives), and less sensitive in detecting mild cognitive impairments or early stages of dementia among those with higher education and socioeconomic status (i.e., false negatives).[3] Given that bilinguals in the ALSA have lower socioeconomic status than monolinguals, this could account for Mukadam et al's finding of bilinguals' lower MMSE scores than monolinguals' and the lack of potential group differences in cognitive decline rate. Further, the MMSE, as a generic measure of cognitive decline, is unable to adequately discriminate between different types of cognitive decline and insensitive to cognitive impairments that involve EF; this may further mask bilingualism-related cognitive advantages. Crucially, bilingualism—owing to its associated advantages in nonverbal EF—privileges specific, but not all, types of cognitive functions. For instance, Alladi et al[4] found that bilingualism delayed the onset of Alzheimer's disease, frontotemporal dementia, and vascular dementia, but not the aphasic forms. These findings highlight the nuanced and complex nature of bilingual advantages in cognitive decline. Therefore, Mukadam et al's null findings may reflect instrumental biases inherent in the MMSE and its insensitivity for detection of specific types of cognitive decline that could be protected by bilingualism.

Third, the ALSA dataset is limited due to its coarse-grained conceptualization of bilingualism as a categorical variable; previous research has shown that more fine-grained indices of bilingual experiences better capture relevant cognitive advantages.[5] As Mukadam et al noted, findings in favor of bilingual advantages in cognitive decline were primarily demonstrated in multilingual contexts (e.g., Alladi et al).[4] This speaks to the importance of bilinguals' interactional contexts of conversational exchanges, which impose varying levels of control demands on bilinguals.[5] Specifically, bilinguals who reside in a predominantly English-speaking society (e.g., Australia; Mukadam et al[1]) would resemble single-language context bilinguals (e.g., speaking English at work and non-English/native language at home). In contrast, bilinguals who reside in a linguistically diverse environment (e.g., Hyderabad; Alladi et al[4]) would resemble dual-language context bilinguals who speak multiple languages interchangeably within the same contexts. Given that dual-language context bilinguals would more frequently exercise higher levels of cognitive control, it is difficult to reach definitive conclusions about the effect of bilingualism on cognitive decline without a comprehensive language profile of participants.

In closing, we contend that the use of inadequate measures for tapping EF and cognitive decline, coupled with an imprecise conceptualization of bilingualism, severely limit Mukadam et al's claims that bilingualism offers no advantages on executive functions and cognitive decline. Of particular importance for future studies examining bilingual advantages among aging populations is the use of more rigorous indices of bilingualism that have been shown to modulate cognitive advantages: onset age, language dominance, and frequency and proficiency of language switching.

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*Table 1*. Summary of studies comparing monolinguals and bilinguals on executive functions and cognitive decline measures.

| Study | Participants | Country | *N* | Type of study | Bilinguals | Tasks used | Control variables | Outcomes (Monolinguals vs. Bilinguals) |
|---|---|---|---|---|---|---|---|---|
| Mukadam et al. (2018) | ≥ 65 years in 1992 | Australia | 2,087 | Prospect. (ALSA) | Speak language other than English at home | MMSE, Boston Naming, describing similarities, verbal fluency | Demographics, health, social characteristics, EF scores differences | No difference in MMSE decline |
| Bak et al. (2014) | Healthy adults aged 11 in 1947 | Scotland | 853 | Prospect. (SMS) | Learned L2 well enough to communicate | Logical memory, spatial span, verbal paired associates, digit span backward, letter-number sequencing, composite of symbol search, digit symbol, visual inspection time, simple and choice RTs; Moray House Test; NART; VFT | Childhood intelligence, age, sex, participant & father's social class | Increased scores on g-factor in passive/active bilinguals |
| Lawton et al. (2014) | Hispanics identified from census | US | 1,789 | Prospect. | Speak L2 at least "very often" | Modified MMSE; delayed free recall; neuropsychological assessment scale; questionnaire on cognitive decline | Immigration status | No difference in mean age of dementia diagnosis |
| Sanders et al. (2012) | Medicare recipients | US | 1,779 | Prospect. | Speak language other than English | BIMC; achievement test; vocabulary & information subtests of WAIS-III; cognitive tests of attention, episodic memory, EF, visuospatial ability, & language | Sex, race, years of education, immigration marital status, hypertension, diabetes, myocardial infarction, and stroke | No association with incident dementia |
| Yeung et al. (2014) | Elders selected from health care register | Canada | 1,468 | Prospect. ; Cross-sect. | Speak L2 | 3MSE | Age, sex, education, subjective memory loss at baseline | No association between language status and dementia |
| Zahodne et al. (2014) | Adults without baseline cognitive impairment | US | 1,067 | Prospect. | Speak L2 well or very well | SRT; Boston Naming; Boston diagnostic aphasia exam; repetition and comprehension tests; similarities subtest of WAIS-R; Identities and Oddities subtest of MDRS; Color Trails | Age, sex, education, proportion of life spent in the US, country of origin, and recruitment wave | No difference in adjusted rate of dementia conversion |
| Alladi et al. (2013) | Diagnosed with dementia | India | 648 | Retro. | Communicate in more than one language | MMSE, ACE-R | Literacy, years of education, sex, family history, vascular risk | B's onset of symptoms 4.5 years later than Ms |

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|---|---|---|---|---|---|---|---|---|
| Bialystok et al. (2007) | Diagnosed with dementia | Canada | 184 | Retro. | Speak 2 languages during most adult life | MMSE | Age, education, and occupation | B's onset of symptoms 4 years later than Ms; no difference in rate of cognitive decline. |
| Bialystok et al. (2014) | Diagnosed with dementia or MCI | Canada | 149 | Retro. | Speak 2 languages during majority of adult life | Delis-Kaplan EF System; Trail making, color-word interference, VFT | Education and immigration | B's onset of MCI symptoms 4.7 years later than M, and 7.2 years later for Alzheimer's dementia |
| Alladi et al. (2017) | Diagnosed with FTD | India | 193 | Retro. | Communicate in more than one language | MMSE, ACE-R | Education, literacy, occupation, gender, rural/urban dwelling and family history of dementia | B's delayed age at onset of dementia in behavioral variant FTD |
| Bialystok et al. (2008) | College students and older adults | Canada | 96 | Cross-sec. | Speak L1 and L2 daily | Forward/backward Corsi block span; self-ordered pointing; PPVT; Boston Naming; letter & category fluency; Simon & Stroop; Sustained attention to response task | Education and immigration | No difference in working memory; M performed better on lexical retrieval tasks; B performed better on EF tasks |
| Gold et al. (2013) | Younger and old adults | USA | 110 | Cross-sec. | Speak L1 & L2 daily since ≤10 | PPVT; CCF; Digits Span; a color-shape task-switching | Sex, age, education, SES, intelligence, digit span performance | B outperformed M in perceptual switching while displaying decreased activation in brain regions; B's attenuation in age-related over-recruitment associated with better task-switching |
| Luo et al. (2013) | Participants ages 18–35 & ages 60-80 | Canada | 278 | Cross-sect. | Speak L1 & L2 fluently & daily | Shipley Vocab. Test; CCF; word span and alpha span tasks; Corsi blocks test | Education | Aging associated with a greater decline in spatial WM than verbal WM. B outperformed M in spatial WM; M outperformed B in verbal WM. |

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| Ramakrishnan et al. (2017) | Patients ≥45 years diagnosed with MCI | India | 115 | Retro. | Communicate in L2 | ACE-R or ACE-III, Rey auditory verbal learning test | Age at presentation & onset of symptoms, gender, residence, education, occupation, history of stroke, vascular risk factors | B's clinical onset of cognitive complaints 7.4 years later than M |

*Note*. ACE-R=Addenbrooke's Cognitive Examination–Revised; ALSA=Australian Longitudinal Study of Ageing; BIMC=Blessed Information-Memory-Concentration test; CCF=Cattell Culture Fair Test; EF=Executive Functions; FTD=Frontotemporal Dementia; MCI=Mild Cognitive Impairment; MDRS=Mattis Dementia Rating Scale; 3MSE=Modified Mini-mental State Examination; SMS=Scottish Mental Survey; SRT= Selective Reminding Test; PPVT=Peabody Picture Vocabulary Test; WAIS=Wechsler Adult Intelligence Scale