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

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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 al¹ 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 al² 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 al⁴ 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 al¹) 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 al⁴) 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

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-sec.	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.

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
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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