Foreign language learning as potential treatment for mild cognitive impairment

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KEY MESSAGES

1. Improvement in cognitive abilities can be achieved in older adults with mild cognitive impairment.
2. Cognitively stimulating activities, including foreign language learning, is a potentially effective intervention.

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Introduction

As the number of older adults increases, age-related health issues (both physical and cognitive) and associated costs are expected to increase, placing emotional and financial stress on family members and the health system. Dementia is one of the most devastating and costly diseases that older adults face. The present study aimed to determine whether foreign language learning can improve cognitive outcomes of older adults with mild cognitive impairment (MCI). The objectives are to determine whether foreign language learning is (1) effective in boosting cognitive reserve and promoting healthy cognitive function and (2) superior to other established cognitively stimulating activities such as crossword and logic puzzles.

Methods

All participants gave written informed consent in accordance with the protocol approved by the Joint Chinese University of Hong Kong – New Territories East Cluster Clinical Research Ethics Committee. Participants were Cantonese speakers with minimal exposure to English. Of 137 participants with MCI enrolled, 86 (mean age, 71.8±6.3 years) completed all phases of the study. MCI was defined as a score of 0.5 on the Clinical Dementia Rating (CDR) or a score of 0 on the CDR plus 1.5 standard deviations below the age-typical mean on the Chinese version of the Alzheimer's Disease Assessment Scale—Cognitive subscale (ADAS-Cog) or the Category Verbal Fluency Test (CVFT). The latter criterion was designed to capture older adults who may score normal on the CDR but show subtle deficits in neuropsychological measures.

Participants were randomly assigned to one of three groups: experimental group (n=29) who completed levels 1-5 of the Rosetta Stone English language training software (that uses a combination of images, text, and sounds to teach vocabulary and grammar in a way designed to simulate immersion learning), active control group (n=29) who completed computer-delivered crossword and logic puzzles, and passive control group (n=28) who listened to and read about the background of Chinese music through a computer. Participants in the three groups were closely matched in age ($F(2, 85)=0.41$, P=0.67) and years of education ($F(2, 85)=1.29$, P=0.28).

Participants were familiarised with the computer software interface at the onset of training. The training was up to 5 hours per week for 6 months. In addition, each group met for occasional social activities led by the research assistant or social group leader: the experimental group practised English skills with an English speaker; the active control group played games in a group setting (eg Pictionary); and the passive control group discussed music or sang.

Cognitive outcome was measured at the start of training (pretest), at the end of training at 12 months (posttest), and at 3 months after the end of training (follow-up) using the Auditory Reading Span, the Simon Task, Wechsler Digit Span, the Boston

TABLE. Cognitive outcome by group across three time points*

Cognitive outcome	Experimental group (n=29)			Active control group (n=29)			Passive control group (n=28)		
	Pretest	Posttest	Follow-up	Pretest	Posttest	Follow-up	Pretest	Posttest	Follow-up
Clinical Dementia Rating (total score range, 0-3)	0.39±0.21	0.28±0.25	0.31±0.25	0.39± 0.21	0.29±0.25	0.29±0.25	0.37±0.22	0.25±0.25	0.28±0.25
Alzheimer's Disease Assessment Scale–Cognitive subscale (total score range, 0-70)	11.53±3.55	7.43±4.08	6.91±2.79	12.45±4.85	8.70±4.74	9.01±4.85	12.55±4.88	10.66±6.03	9.62±5.76
Category Verbal Fluency Test (total score range, 0-66)	40.48±10.66	41.38±10.36	42.31±9.87	37.72±9.20	39.72± 9.90	40.24±12.33	36.57±7.24	36.75±8.73	36.96±7.78

* Data are presented as mean ± standard deviation

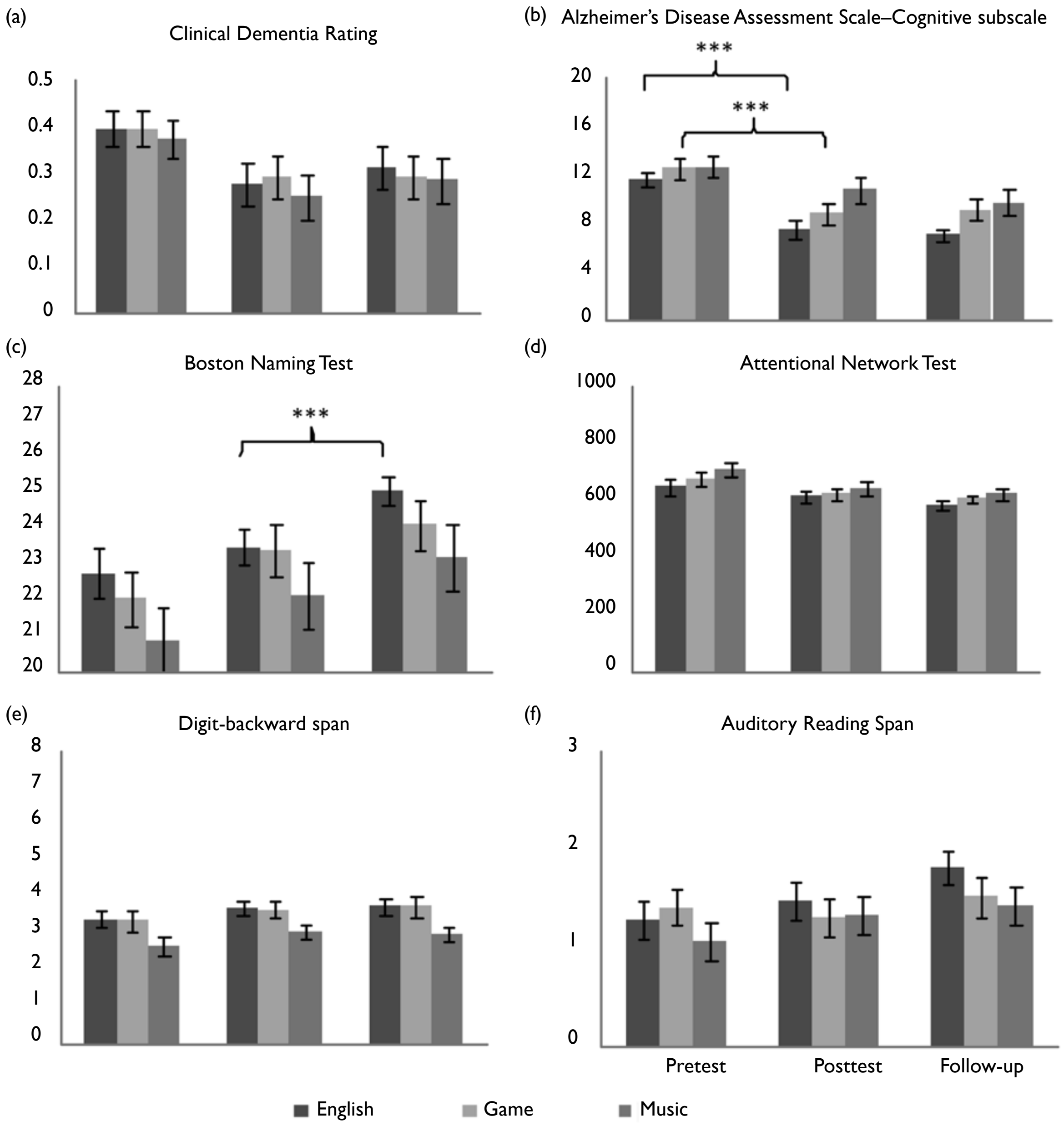

FIG. Cognitive outcome measures at three time points: (a) Clinical Dementia Rating, (b) Alzheimer's Disease Assessment Scale–Cognitive subscale, (c) Boston Naming Test, (d) Attentional Network Test, (e) digit-backward span, and (f) Auditory Reading Span.

Naming Test, and the Attention Network Test. Cognitive function, attention, and working memory are sensitive to age-related cognitive decline.

A 3x3 repeated measures ANOVA of the three groups and three time points was used. Planned comparisons were made using t-tests.

Results

The three groups were comparable at pre-test (Table). Across groups, significant main effects of time were found for CDR [$F(2, 166)=8.1$, $P<0.0001$, $\eta^2=0.089$], ADAS-Cog [$F(2, 166)=38.3$, $P<0.0001$, $\eta^2=0.316$], Boston Naming Test [$F(2, 166)=31.5$, $P<0.0001$, $\eta^2=0.275$], Attention Network Test [$F(2, 166)=9.4$, $P<0.0001$, $\eta2=0.102$], digit-backward span [$F(2, 83)=6.3$, $P=0.002$, $\eta^2=0.070$], and Auditory Reading Span [$F(2, 166)=4.2$, $P=0.016$, $\eta^2=0.049$] (Fig). However, Auditory Reading Span did not pass the correction for multiple comparisons (at $P<0.005$). CDR, ADAS-Cog, Attention Network Test, and digit-backward span improved significantly from pretest to posttest ($P<0.013$), but scores remaining stable from posttest to follow-up ($P>0.05$). Only the Boston Naming Test score improved significantly at both posttest ($P<0.001$) and follow-up ($P<0.001$).

There were no significant effects of group ($P>0.09$) or group-by-time interactions ($P>0.11$). However, foreign language learning produced significant improvement in ADAS-Cog and Boston Naming Test scores after Bonferroni correction for family-wise type 1 error at $P<0.005$. Specifically, the experimental group achieved significant improvement in ADAS-Cog from pretest to posttest [$t(28)= -6.02$, $P<0.0001$, Cohen's $d= -1.07$] and in Boston Naming Test from pretest to follow-up [$t(28)=4.59$, $P<0.0001$, Cohen's $d=0.639$]. Compared with the experimental group, the passive control group only achieved improvements in CDR ($P=0.02$) and Attention Network Test ($P=0.01$) from pretest to posttest, but these effects did not pass Bonferroni correction. Thus, foreign language training was more effective than music listening in boosting cognitive reserve and promoting healthy cognitive function. Compared with the experimental group, the active control group only achieved improvement in ADAS-Cog [$t(28)= -4.58$, $P<0.0001$, Cohen's $d= -0.778$] from pretest to posttest. Thus, foreign language training was more effective than crossword and puzzles in reducing the risk of cognitive deficits and in improving a broader range of cognitive functions. Attention Network Test and digit-backward span was not significant in any of the three groups ($P>0.07$).

Discussion

As far as we are aware, this is the first prospective, randomised control study to evaluate foreign language learning on cognitive improvement in older adults with MCI. The protective effect of bilingualism on cognitive decline in older adults has been reported.[4] However, those studies were retrospective in nature and lifelong bilingualism was the focus. In the present study, we demonstrated that both short-term learning of a new language and other active cognitively stimulating activities could enhance cognitive functions. Nonetheless, the effect of foreign language learning was larger on ADAS-Cog. In addition, the training-induced benefit in the cognitive measure of linguistic function was only observed in the experimental group.

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