

Neuropsychological Performance in Cognitively Normal Native & Non-Native English Speakers: A Pilot Study

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Introduction

- There is inconclusive research about differences in cognitive abilities on English-administered neuropsychological tests between English as a second language speakers (ESLS) and Native English speakers (NES).
- Research has shown that NES groups significantly outperform ESLS and bilingual groups on confrontation naming¹⁻³, whereas findings have been mixed regarding performance on lexical fluency tasks^{3,4}.
- Literature on memory measures in NES compared to ESLS is also limited, and findings are inconclusive^{3,5}.
- In contrast, a growing body of research has found ESLS perform better than NES on executive function measures, which is called "executive advantage."⁶
- The purpose of this study is to compare neuropsychological test performance of NES and ESLS, and further investigate the effect of native language writing systems.

Method

- The dataset was retrieved from the National Alzheimer's Coordinating Center (NACC).
- Participants were either coded as a NES or ESLS. NES is defined as an individual who identifies his or her first language as English. ESLS is defined as an individual who identifies his or her first language as any language other than English, and later learned English.
- All participants were required to be coded as being a healthy control in the dataset. All subjects were age- and education matched.
- Using Shirk's⁷ normative calculator, raw scores from neuropsychological tests were converted to percentiles and normed based on the subject's age, education, and gender.

Table 1. Demographics

	ESLS(n = 25)	NES (n = 25)	T, χ^2	p-value
Mean Age (SD)	69.80 (9.75)	69.84 (9.44)	.02	.99
Mean Edu (SD)	15.44 (3.72)	15.68 (3.53)	.23	.82
Gender				
Male	11 (44%)	10 (40%)	.08	.77
Female	14 (56%)	15 (60%)		
Ethnicity			4.02	.13
White	21 (84%)	22 (88%)		
Black/AA	1 (4%)	3 (12%)		
Asian American	3 (12%)	0 (0%)		

Note. LM = Logical Memory; DSF = Digit Span Forward; DSB = Digit Span Backward; SD = standard deviation; NS = Not significant. b Tests of homogeneity assumption violated; ^a Significant differences observed using Hochberg's GT2 Post Hoc Test (alpha = *p < .05, **p < .01, ***p < .001)

Main Measures

Table 2. Independent t-tests for cognitive tests (percentiles)

	ESLS (n=25)		NES (n=25)		t	p	CI	d
	Mean	SD	Mean	SD				
Logical Memory Immediate	54.15	33.28	58.49	23.66	.53	.69	-12.08, 20.76	NS
Logical Memory Delay	54.66	32.64	52.60	26.39	-.245	.81	-18.96, 14.84	NS
Digit Span Forward	30.69	27.73	48.54	29.97	1.26	.21	-6.61, 28.71	NS
Digit Span Forward length	32.97	29.63	50.05	24.28	2.19	.03	1.46, 34.24	.62
Digit Span Backward	32.46	30.13	53.42	27.24	2.58	.01	4.62, 37.29	.73
Digit Span Backward length	32.97	29.63	50.05	24.28	2.23	.03	1.67, 32.49	.63
Animal Fluency	32.71	27.60	50.26	27.29	2.26	.03	1.95, 33.17	.64
Vegetable Fluency	57.79	31.80	68.25	31.32	1.17	.25	-7.48, 28.41	NS
Trail Making Test Part A	36.84	22.86	51.56	26.44	2.11	.04	.66, 28.77	.60
Trail Making Test Part B	35.95	22.48	53.04	21.22	2.77	.01	4.67, 29.53	.78
WAIS-R Digit Symbol	38.88	25.73	46.19	29.24	2.61	.01	4.90, 37.57	.74
Boston Naming Test	20.53	22.20	38.88	25.73	2.70	.01	4.68, 32.01	.76

Note. WAIS-R = Wechsler Adult Intelligence Scale-Revised CI = confidence interval

Table 3. Cognitive test performance percentiles between three groups

	NES-O Mean (SD)	ESLS-LO Mean (SD)	ESLS-SO Mean (SD)	F	η^2	d
LM Immediate Recall ^b	58.49 (23.66)	52.71 (34.00)	57.23 (33.74)	.204	.01	NS
LM Delayed Recall	52.60 (26.39)	54.98 (33.58)	53.98 (32.77)	.033	.01	NS
DSF	44.84 (29.58)	33.78 (34.47)	33.79 (29.93)	.775	.03	NS
DSF Length	48.54 (29.87)	28.16 (29.17)	36.08 (25.37)	2.57	.10	NS
DSB	53.42 ^a (27.24)	26.31 ^a (25.53)	45.53 (36.56)	4.69*	.17	1.03
DSB Length	50.05 ^a (24.28)	24.98 ^a (23.70)	49.93 (35.25)	5.19*	.18	1.04
Animal Fluency	50.26 (27.29)	33.47 (27.07)	31.08 (30.54)	2.53	.10	NS
Vegetable Fluency	68.25 (31.32)	59.77 (28.74)	53.58 (39.37)	.78	.03	NS
Trails A	51.56 (26.44)	33.90 (22.74)	43.09 (23.33)	2.58	.10	NS
Trails B	53.04 ^a (21.22)	34.18 ^a (25.62)	39.71 (14.43)	3.94*	.14	.80
WAIS-Digit Symbol	67.42 ^a (28.18)	43.32 ^a (28.34)	52.29 (32.16)	3.64*	.13	.85
Boston Naming Test	38.88 ^a (25.73)	23.32 (24.01)	14.60 ^a (17.70)	3.98*	.15	1.10

Note. LM = Logical Memory; DSF = Digit Span Forward; DSB = Digit Span Backward; SD = standard deviation; NS = Not significant. b Tests of homogeneity assumption violated; ^a Significant differences observed using Hochberg's GT2 Post Hoc Test (alpha = *p < .05, **p < .01, ***p < .001)

Results

- Twenty-five ESLS and 25 NES met inclusion criteria. ESLS group primary languages included Spanish (n = 11), Russian (n = 2), Chinese (n = 1), Croatian (n = 1), Ukrainian (n = 1), Farsi (n = 1), French (n = 1), German (n = 1), Greek (n = 1), Hindi (n = 1), Polish (n = 1), Portuguese (n = 1), Roman (n = 1), and Urdu (n = 1).
- Independent samples t-test revealed statistically significant group differences at p < .05 for: Digit Span Forward length, Digit Span Backward, Digit Span Backward length, Animal Fluency, Trail Making Test A, Trail Making Test B, WAIS-R Digit Symbol, and Boston Naming Test. Results showed medium effect sizes that ranged from .60 – .78. See Table 2.
- For the next analysis, we were interested in assessing cognitive performance of individuals whose primary language was derived from a Latin-based writing system, or primary language derived that use characters /symbolic dialect. Participants were assigned to one of three groups: Native English speaker only (NES-O), English as a Second Language speaker with Latin-based language origin (ESLS-LO), and English as a Second Language Speaker with symbolic language origin (ESLS-SO). Twenty-five individuals comprised the NES-O group, 14 individuals comprised the ESLS-LO group, and eight individuals comprised the ESLS-SO group.
- The One-way ANOVA was significant for: Digit Span Backward, Digit Span Backward length, Trails B, WAIS-R Digit Symbol, and Boston Naming Test. The strength of the relationship between NES-O, ESLS-LO, and ESLS-SO, assessed by η^2 ranged from medium to large, accounting for 13% to 18% of the variance in the DV. Table 3

Conclusions

- Post-hoc tests showed ESLS-LO and NES-O group significantly differed on DSB, TMT-B, and WAIS- Symbol Digit. Additionally, performance of the ESLS-SO and NES-O groups significantly differed on BNT
- Taken together, our findings suggest that NES outperform ESLS on measures of language, working memory, attention, executive functioning (set-shifting), and psychomotor processing speed. Furthermore, post-hoc tests showed that NES-O generally perform better than ESLS-LO and ESLS-SO on all measures. However, as expected in a cognitively healthy sample, group means remained in the average range on most measures, except for BNT. While group means were in the average range, our findings are likely still clinically meaningful, as ESLS performance consistently remained in the lower end of the average range. These finding suggests that, although still considered "cognitively healthy" regardless of cultural background, there is greater need for neuropsychological measures that utilize normative samples that better represent all cultures, including ones with different linguistic backgrounds.

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