

Supplemental Materials for

Comparison of computerised and pencil-and-paper neuropsychological assessments in older culturally and linguistically diverse Australians

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Materials and Methods

Computerised Neuropsychological Assessment (SENSUS) Test Domains and Descriptions

Processing Speed

Simple Reaction Time: Participants were presented with a yellow square against a grey background on screen and instructed to tap the square as quickly as possible. Participants completed a total of 4 practice trials and 36 test trials with an interstimulus interval of 1, 2, or 4 seconds. The score was calculated as the hit reaction time in milliseconds across all trials.

Complex Reaction Time: Participants were presented with two vertically organised squares on the screen in the following configurations: Red-Red, Yellow-Yellow, Red-Yellow, or Yellow-Red (10 of each type were randomly presented). Participants were required to press the upper square if the squares were the same colour, or to press the lower square if the squares were different colours. Brief instructions were repeated after each error to increase accuracy. Prior to test trials, participants completed a practice trial requiring 4 correct responses to progress. A total of 40 trials (interstimulus interval 3-seconds) were completed. The score was calculated as the hit reaction time in milliseconds across all trials.

Executive Function

Stroop Test: Participants completed four conditions. (1) Colour Naming; participants named colour patches presented on the screen. (2) Word Reading; participants read colour names presented in black ink. (3) Colour-Word; participants named the ink colour while ignoring the word, which was displayed in incongruent ink (Mitrushina, Boone, Razani, & D'Elia, 2005). (4) Switching; participants responded based on two rules, if the word appeared without a surrounding box, they said the colour the word was printed in (as per Colour-Word), or if the word was surrounded by a box, they read the word while ignoring ink colour. The score was calculated for each condition as time to complete (seconds) with minimum 75% accuracy.

Visual Memory

Picture Location Memory: Participants were required to remember various common objects (Snodgrass & Vanderwart, 1980) and their paired location as presented on the screen. Pictures were presented sequentially in one location on a grid. The order of pairing presentation was randomised for each trial. Three levels of difficulty were administered based on the number of object-location pairings (i.e., 2, 4, and 6). Test trials commenced after all items had been presented. Participants were presented with one picture at the bottom of the screen and touched the square where the item was presented. Feedback on accuracy was provided at the end of each trial. When participants reached criterion (all correct) they moved to the next level. There was a maximum of 6 learning trials, the test was terminated if the participant failed the level. The score was calculated as the total number of trials to criterion.

Table S1*Model 1 Hierarchical Regression Global cognition PnPA*

Variable	Step 1			Step 2			Step 3		
	B	β	<i>p</i>	B	β	<i>p</i>	B	β	<i>p</i>
Age	-0.049	-0.232	.030*	-0.072	-0.340	.003*	-	-	-
Sex	0.547	0.270	.012*	0.311	0.154	.135	-	-	-
Education	0.128	0.426	<.001*	0.123	0.412	<.001*	-	-	-
Computer use	0.064	0.032	.777	-0.013	-0.006	.951	-	-	-
AoA				-0.011	-0.096	.468	-	-	-
Preference				-0.536	-0.245	.052	-	-	-
% English				-0.007	-0.165	.231	-	-	-
Non-English use				-0.474	-0.214	.057	-	-	-
Residency				-0.032	-0.281	.037*	-	-	-
English Edu.				0.004	0.017	.870	-	-	-
Comm. Assoc.				-0.058	-0.026	.812	-	-	-
<i>R</i> ²			0.311			0.502			-
ΔR^2			0.311			0.191			-
<i>p</i> ΔF^2			< .001*			.005*			-
Model <i>p</i>			< .001*			< .001*			-

Note. *N* = 72 due to reduced sample size for variables collected at Wave 4 and missing data.

AoA: Age-of-acquisition, Preference: Preferred language as English or Non-English, % English:

Percentage of day English spoken, Non-English use: frequency of non-English language spoken, Comm.

Assoc.: Community association, Residency: years lived in Australia, English Edu.: Years of education in

English. Only cases with complete data were included in analyses.

* *p* < .05.

Table S2*Model 2 Hierarchical Regression Global cognition PnPA*

Variable	Step 1			Step 2			Step 3		
	B	β	<i>p</i>	B	β	<i>p</i>	B	β	<i>p</i>
Age	-0.049	-0.232	.030	-0.046	-0.218	.027*	-0.072	-0.340	.003*
Sex	0.547	0.270	.012	0.415	0.205	.042*	0.311	0.154	.135
Education	0.128	0.426	<.001*	0.107	0.358	.001*	0.123	0.412	<.001*
Computer use	0.064	0.032	.777	0.043	0.021	.837	-0.013	-0.006	.951
AoA				-0.026	-0.231	.030*	-0.011	-0.096	.468
Preference				-0.539	-0.246	.048*	-0.536	-0.245	.052
% English				-0.005	-0.124	.366	-0.007	-0.165	.231
Non-English use				-0.404	-0.182	.103	-0.474	-0.214	.057
Residency							-0.032	-0.281	.037*
English Edu.							0.004	0.017	.870
Comm. Assoc.							-0.058	-0.026	.812
R^2			0.311			0.463			0.502
ΔR^2			0.311			0.152			0.039
$p\Delta F^2$			<.001*			.003*			.207
Model <i>p</i>			<.001*			<.001*			<.001*

Note. *N* = 72 due to reduced sample size for variables collected at Wave 4 and missing data.

AoA: Age-of-acquisition, Preference: Preferred language as English or Non-English, % English:

Percentage of day English spoken, Non-English use: frequency of non-English language spoken, Comm.

Assoc.: Community association, Residency: years lived in Australia, English Edu.: Years of education in

English. Only cases with complete data were included in analyses.

* *p* <.05.

Table S3*Model 3 Hierarchical Regression Global cognition PnPA*

Variable	Step 1			Step 2			Step 3		
	B	β	<i>p</i>	B	β	<i>p</i>	B	β	<i>p</i>
Age	-0.049	-0.232	.030*	-0.079	-0.371	.002*	-0.072	-0.340	.003*
Sex	0.547	0.270	.012*	0.405	0.200	.063	0.311	0.154	.135
Education	0.128	0.426	<.001*	0.141	0.470	<.001*	0.123	0.412	<.001*
Computer use	0.064	0.032	.777	0.005	0.002	.982	-0.013	-0.006	.951
Residency				-0.036	-0.319	.008*	-0.032	-0.281	.037*
English Edu.				0.000	-0.002	.988	0.004	0.017	.870
Comm. Assoc.				-0.304	-0.135	.185	-0.058	-0.026	.812
AoA							-0.011	-0.096	.468
Preference							-0.536	-0.245	.052
% English							-0.007	-0.165	.231
Non-English use							-0.474	-0.214	.057
R^2			0.311			0.399			0.502
ΔR^2			0.311			0.088			0.103
$p\Delta F^2$			<.001*			.031*			.022*
Model <i>p</i>			<.001*			<.001*			<.001*

Note. *N* = 72 due to reduced sample size for variables collected at Wave 4 and missing data.

AoA: Age-of-acquisition, Preference: Preferred language as English or Non-English, % English:

Percentage of day English spoken, Non-English use: frequency of non-English language spoken, Comm.

Assoc.: Community association, Residency: years lived in Australia, English Edu.: Years of education in

English. Only cases with complete data were included in analyses.

* *p* <.05.

Table S4*Model 4 Hierarchical Regression Global cognition CNA*

Variable	Step 1			Step 2			Step 3		
	B	β	<i>p</i>	B	β	<i>p</i>	B	β	<i>p</i>
Age	-0.020	-0.091	.481	-0.039	-0.175	.193	-	-	-
Sex	0.398	0.188	.154	0.192	0.091	.496	-	-	-
Education	0.070	0.217	.124	0.084	0.261	.063	-	-	-
Computer use	0.316	0.149	.285	0.323	0.153	.239	-	-	-
AoA				-0.038	-0.308	.058	-	-	-
Preference				-0.204	-0.090	.567	-	-	-
% English				-0.008	-0.188	.265	-	-	-
Non-English use				-0.723	-0.302	.049*	-	-	-
Residency				-0.025	-0.201	.217	-	-	-
English Edu.				0.086	0.342	.013*	-	-	-
Comm. Assoc.				-0.031	-0.013	.921	-	-	-
R^2			0.137			0.383			-
ΔR^2			0.137			0.247			-
$p\Delta F^2$.084			.018*			-
Model <i>p</i>			.084			.008*			-

Note. $N = 72$ due to reduced sample size for variables collected at Wave 4 and missing data.

AoA: Age-of-acquisition, Preference: Preferred language as English or Non-English, % English:

Percentage of day English spoken, Non-English use: frequency of non-English language spoken, Comm.

Assoc.: Community association, Residency: years lived in Australia, English Edu.: Years of education in

English. Only cases with complete data were included in analyses.

* $p < .05$.

Table S5

Model 5 Hierarchical Regression Global cognition CNA

Variable	Step 1			Step 2			Step 3		
	B	β	<i>p</i>	B	β	<i>p</i>	B	β	<i>p</i>
Age	-0.020	-0.091	.481	-0.021	-0.093	.476	-0.039	-0.175	.193
Sex	0.398	0.188	.154	0.378	0.179	.193	0.192	0.091	.496
Education	0.070	0.217	.124	0.048	0.148	.294	0.084	0.261	.063
Computer use	0.316	0.149	.285	0.285	0.135	.318	0.323	0.153	.239
AoA				-0.034	-0.275	.041*	-0.038	-0.308	.058
Preference				-0.284	-0.125	.439	-0.204	-0.090	.567
% English				-0.007	-0.149	.394	-0.008	-0.188	.265
Non-English use				-0.650	-0.272	.082	-0.723	-0.302	.049*
Residency							-0.025	-0.201	.217
English Edu.							0.086	0.342	.013*
Comm. Assoc.							-0.031	-0.013	.921
R^2			0.137			0.265			0.383
ΔR^2			0.137			0.128			0.119
$p\Delta F^2$.084			.080			.036*
Model <i>p</i>			.084			.035*			.008*

Note. *N* = 72 due to reduced sample size for variables collected at Wave 4 and missing data.

AoA: Age-of-acquisition, Preference: Preferred language as English or Non-English, % English:

Percentage of day English spoken, Non-English use: frequency of non-English language spoken, Comm.

Assoc.: Community association, Residency: years lived in Australia, English Edu.: Years of education in

English. Only cases with complete data were included in analyses.

* *p* < .05.

Table S6

Model 6 Hierarchical Regression Global cognition CNA

Variable	Step 1			Step 2			Step 3		
	B	β	<i>p</i>	B	β	<i>p</i>	B	β	<i>p</i>
Age	-0.020	-0.091	.481	-0.049	-0.221	.104	-0.039	-0.175	.193
Sex	0.398	0.188	.154	0.178	0.084	.519	0.192	0.091	.496
Education	0.070	0.217	.124	0.110	0.340	.019*	0.084	0.261	.063
Computer use	0.316	0.149	.285	0.331	0.157	.251	0.323	0.153	.239
Residency				-0.039	-0.306	.032*	-0.025	-0.201	.217
English Edu.				0.066	0.263	.048*	0.086	0.342	.013*
Comm. Assoc.				-0.236	-0.097	.435	-0.031	-0.013	.921
AoA							-0.038	-0.308	.058
Preference							-0.204	-0.090	.567
% English							-0.008	-0.188	.265
Non-English use							-0.723	-0.302	.049*
R^2			0.137			0.253			0.383
ΔR^2			0.137			0.116			0.131
$p\Delta F^2$.084			.055			.052
Model <i>p</i>			.084			.026*			.008*

Note. *N* = 72 due to reduced sample size for variables collected at Wave 4 and missing data.

AoA: Age-of-acquisition, Preference: Preferred language as English or Non-English, % English:

Percentage of day English spoken, Non-English use: frequency of non-English language spoken, Comm.

Assoc.: Community association, Residency: years lived in Australia, English Edu.: Years of education in

English. Only cases with complete data were included in analyses.

* *p* < .05.

Table S7

Comparison of ESB and CALD participant's raw pencil-and-paper and computerised assessment scores

Test PnPA	ESB (n = 873)		CALD (n = 164)		U or t value (df)	p
	M (range)	SD	M (range)	SD		
DSC	48.45 (14-105)	12.16	44.11 (13-78)	11.82	t(1020) = 4.19	< .001*
TMT A	45.70 (20-128)	15.37	53.61 (24-159)	20.95	U = 52255	< .001*
LMSA Immediate Recall	11.12 (0-23)	4.01	10.04 (2-21)	3.63	t(1032) = 3.19	.001*
LMSA Delayed Recall	9.42 (0-22)	4.05	8.41 (0-19)	3.91	t(1032) = 2.92	.004
RAVLT						
Trial 1	4.78 (0-12)	1.48	4.05 (0-8)	1.67	t(1030) = 5.59	< .001*
Trial 5	10.69 (2-15)	2.48	9.49 (4-15)	2.70	t(1026) = 5.57	< .001*
Delayed Recall	7.63 (0-15)	3.47	6.57 (0-14)	3.51	t(1024) = 3.56	< .001*
Recognition	89.55 (50-100)	9.16	86.35 (20-100)	11.35	U = 57000	.001*
<i>Derived Scores</i>						
Learning over trials ^a	17.39 (-8-43)	7.13	15.66 (-9-34)	6.66	t(1026) = 2.86	.004
Total Learning ^b	41.26 (17-68)	9.19	35.91 (12-65)	10.38	t(1026) = 6.64	< .001*
BVRT	11.85 (5-15)	1.80	11.17 (5-15)	2.00	t(1025) = 4.36	< .001*
BNT	24.97 (8-30)	3.49	20.26 (6-29)	4.84	U = 29523	< .001*
Semantic Fluency	15.94 (1-35)	4.33	13.73 (4-25)	4.07	t(1030) = 6.01	< .001*
Block Design	21.60 (0-44)	8.12	19.90 (0-47)	8.63	t(1032) = 2.44	.015
FAS	37.83 (8-87)	12.27	29.76 (8-67)	12.52	t(1029) = 7.65	< .001*
Test CNA						
Simple RT	621.65 (335-2016)	186.07	683.73 (341-1828)	216.32	U = 54484	< .001*
Complex RT	950.59 (580-2207)	195.00	1005.39 (669-2369)	247.48	U = 59954	.009
Stroop						
Colour Naming	30.39 (18-90)	6.92	33.03 (20-58)	7.40	U = 52098	< .001*
Word Reading	21.14 (12-42)	4.13	22.03 (14-42)	4.57	U = 60079	.039
Colour Word	63.03 (31-172)	20.20	61.65 (33-154)	20.69	U = 58530	.261
Switching	82.91 (33-280)	31.21	86.19 (26-243)	31.62	U = 42729	.171
<i>Derived Scores</i>						
Interference ^c	32.72 (1-132)	17.99	28.79 (-1-104)	17.40	U = 51236	.001*
Switching – Colour Word	21.16 (-89-166)	23.79	25.84 (-53-124)	26.00	U = 39625	.049
Picture Location 2	1.72 (1-7)	1.10	2.04 (1-7)	1.21	U = 54749	< .001*
Picture Location 3	3.63 (1-7)	1.94	3.98 (1-7)	1.98	t(1001) = -2.07	.039

Note. Raw scores are presented unadjusted for covariates, t-test (*t*) or Mann-Whitney U (*U*) test statistics for group comparisons are presented. ESB: English-speaking background. CALD: Culturally and Linguistically Diverse. PnPA: Pencil-and-paper neuropsychological assessment. CNA: Computerised neuropsychological assessment. Please refer to manuscript for full test names, descriptions, and corresponding cognitive domains. ^a RAVLT Learning over trials was calculated as Total learning – 5 x Trial 1 score. ^b RAVLT Total Learning was calculated as cumulative total score for Trials 1-5. ^c Stroop Interference was calculated as Stroop Colour Word – Colour Naming. All *p* values are according to Bonferroni correction for multiple comparisons * *p* < .003

CALD Predictor Variable Correlations

Table S8

Pearson correlation matrix for CALD Predictor Variables PnPA Global Composite

		English age-of-acquisition	Preferred language	Percentage of day English spoken	Frequency of non-English languages spoken	Years of residency Australia	Years of Education in English	Community Association
English age-of-acquisition	Pearson Correlation	1	.113	.309	-.289	.502	.349	.252
	<i>p</i>		.317	.005	.009	.000	.001	.023
	<i>N</i>		79	79	79	79	79	79
Preferred language	Pearson Correlation		1	.645	-.441	.081	-.054	.296
	<i>p</i>			.000	.000	.472	.629	.007
	<i>N</i>			79	79	79	79	79
Percentage of day English spoken [#]	Pearson Correlation			1	-.484	0.091	.155	.346
	<i>p</i>				.000	.420	.166	.002
	<i>N</i>				79	79	79	79
Frequency of non-English languages spoken	Pearson Correlation				1	-.202	-.057	-.263
	<i>p</i>					.071	.614	.018
	<i>N</i>					79	79	79
Years of residency Australia [#]	Pearson Correlation					1	.043	.012
	<i>p</i>						.703	.917
	<i>N</i>						79	79
Years of Education in English [#]	Pearson Correlation						1	.205
	<i>p</i>							.066
	<i>N</i>							79
Community Association	Pearson Correlation							1
	<i>p</i>							
	<i>N</i>							

Note. Partial Pearson correlations for CALD predictor variables, controlling for PnPA global composite score for CALD sample are presented. Please refer to Table 2 in the manuscript for more detail on CALD predictor variables. [#] Variables were reverse coded so that higher scores = more CALD.

Table S9

Pearson correlation matrix for CALD Predictor Variables CNA Global Composite

		English age-of-acquisition	Preferred language	Percentage of day English spoken	Frequency of non-English languages spoken	Years of residency Australia	Years of Education in English	Community Association
English age-of-acquisition	Pearson Correlation	1	.050	.171	-.336	.437	.404	.213
	<i>p</i>		.690	.174	.006	.000	.001	.089
	<i>N</i>		63	63	63	63	63	63
Preferred language	Pearson Correlation		1	.638	-.420	.072	-.024	.299
	<i>p</i>			.000	.001	.569	.852	.030
	<i>N</i>			63	63	63	63	63
Percentage of day English spoken [#]	Pearson Correlation			1	-.481	.033	.155	.248
	<i>p</i>				.000	.795	.218	.046
	<i>N</i>				63	63	63	63
Frequency of non-English languages spoken	Pearson Correlation				1	-.332	-.038	-.188
	<i>p</i>					.007	.762	.134
	<i>N</i>					63	63	63
Years of residency Australia [#]	Pearson Correlation					1	.019	-.019
	<i>p</i>						.881	.878
	<i>N</i>						63	63
Years of Education in English [#]	Pearson Correlation						1	.153
	<i>p</i>							.223
	<i>N</i>							63
Community Association	Pearson Correlation							1
	<i>p</i>							
	<i>N</i>							

Note. Partial Pearson correlations for CALD predictor variables, controlling for CNA global composite score for CALD sample are presented. Please refer to Table 2 in the manuscript for more detail on CALD predictor variables. [#] Variables were reverse coded so that higher scores = more CALD.