

Appendix 1. NIH Toolbox Cognition Battery in Spanish Raw to Scaled Score Conversions.

Appendix 1. Illustrated below are look up tables converting raw Spanish NIH Toolbox Cognition Battery scores into normalized scaled scores (M=10, SD=3). The normalized scaled scores are for application in the age- and fully demographically-corrected formulas presented in Appendix 2. To use, select the scaled score table appropriate for the correction desired (age- or fully-corrected) and demographics (i.e., adult or child) of the given individual. The scaled score is then entered into the appropriate Appendix 2 formula in order to derive the desired corrected score.

Raw Score indicates:

DCCS – computed score

Picture Sequence Memory – computed score

Pattern Comparison – raw score

Picture Vocabulary – theta score

Flanker – computed score

List Sort – raw score

Oral Reading – theta score

Appendix 1. NIH Toolbox Cognition Battery in Spanish Raw to Scaled Score Conversions.

Raw to Scaled Score for use in Age- and Fully-corrected Formulas

Spanish Adults (18-85 years old)

SS	DCCS	Flanker	List Sort	Picture Sequence Memory	Pattern Comparison	Oral Reading	Picture Vocabulary	SS
1	0.0-2.0054	0.0-2.2167	0-2	200.0-240.57	0-19	-15.0- -12.27	-15.0- -3.29	1
2	2.0055-2.0450	2.2168-3.5511	3-5	240.58-302.92	20-24	-12.26- -8.55	-3.28- -2.53	2
3	2.0451-2.0846	3.5512-3.8782	6	302.93-314.85	25-27	-8.54- -4.25	-2.52- -1.91	3
4	2.0847-2.1242	3.8783-4.2561	7	314.86-328.02	28-32	-4.24- -2.24	-1.90- -0.78	4
5	2.1243-2.2337	4.2562-4.8558	8	328.03-347.98	33-34	-2.23- -0.99	-0.77- -0.08	5
6	2.2338-2.9854	4.8559-5.8047	9-10	347.99-382.29	35-38	-0.98-0.19	-0.07-0.62	6
7	2.9855-5.1967	5.8048-6.6628	11	382.30-415.60	39-42	0.20-1.17	0.63-1.44	7
8	5.1968-6.6663	6.6629-7.2813	12-13	415.61-447.02	43-46	1.18-2.20	1.45-2.15	8
9	6.6664-7.1996	7.2814-7.8747	14	447.03-486.02	47-49	2.21-2.84	2.16-3.02	9
10	7.1997-7.7081	7.8748-8.2511	---	486.03-524.13	50-53	2.85-3.45	3.03-3.72	10
11	7.7082-8.0149	8.2512-8.6100	15-16	524.14-553.85	54-56	3.46-3.92	3.73-4.28	11
12	8.0150-8.3414	8.6101-8.8794	17	553.86-581.33	57-60	3.93-4.52	4.29-5.01	12
13	8.3415-8.6681	8.8795-9.2239	18	581.34-614.50	61-63	4.53-5.21	5.02-5.59	13
14	8.6682-8.9667	9.2240-9.4928	19	614.51-647.19	64-66	5.22-5.84	5.60-5.91	14
15	8.9668-9.2697	9.4929-9.6015	20-21	647.20-679.22	67-70	5.85-6.68	5.92-6.32	15
16	9.2698-9.5231	9.6016-9.7463	22	679.23-700.22	71-72	6.69-7.60	6.33-6.95	16
17	9.5232-9.7529	9.7464-9.9189	23-24	700.23-727.13	73-75	7.61-10.26	6.96-7.80	17
18	9.7530-9.8465	9.9190-10.0	25	727.14-777.13	76-80	10.27-12.97	7.81-10.38	18
19	9.8466-10.0	---	26	777.14-800.0	81-130	12.98-15.0	10.39-15.0	19

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Appendix 1. NIH Toolbox Cognition Battery in Spanish Raw to Scaled Score Conversions.

Raw to Scaled Score for use in Age- and Fully-corrected Formulas

Spanish Children (3-7 years old)

SS	DCCS	Flanker	List Sort	Picture Sequence Memory	Pattern Comparison	Oral Reading	Picture Vocabulary	SS
1	0.0-0.0450	0.0-0.1431	---	200.0-203.78	0-9	-15.0- -14.38	-15.0- -8.09	1
2	0.0451-0.1006	0.1432-0.3668	---	203.79-209.85	10-17	-14.37- -12.25	-8.08- -7.32	2
3	0.1007-0.1699	0.3669-0.5851	---	209.86-222.41	18-19	-12.24- -10.74	-7.31- -6.74	3
4	0.1700-0.2501	0.5852-0.7633	0	222.42-234.92	20	-10.73- -10.06	-6.73- -6.00	4
5	0.2502-0.3711	0.7634-1.0106	1	234.93-265.17	21-22	-10.05- -9.42	-5.99- -5.57	5
6	0.3712-0.5848	1.0107-1.2479	2-3	265.18-278.30	23	-9.41- -9.38	-5.56- -5.05	6
7	0.5849-0.7446	1.2480-1.4969	4	278.31-299.61	24-27	-9.37- -8.63	-5.04- -4.31	7
8	0.7447-0.9366	1.4970-1.8443	5	299.62-331.60	28-30	-8.62- -8.05	-4.30- -3.69	8
9	0.9367-2.1315	1.8444-2.1975	6	331.61-349.97	31-35	-8.04- -6.67	-3.68- -2.89	9
10	2.1316-3.4622	2.1976-4.9949	7-8	349.98-385.62	36-38	-6.66- -5.25	-2.88- -2.19	10
11	3.4623-4.9085	4.9950-5.8689	9	385.63-416.84	39-41	-5.24- -4.46	-2.18- -1.69	11
12	4.9086-6.1072	5.8690-6.6244	10	416.85-454.97	42-44	-4.45- -3.48	-1.68- -1.22	12
13	6.1073-6.4982	6.6245-7.1510	11-12	454.98-470.93	45-47	-3.47- -2.40	-1.21- -0.71	13
14	6.4983-6.8405	7.1511-7.5392	13	470.94-480.85	48-51	-2.39- -1.12	-0.70- -0.09	14
15	6.8406-7.2028	7.5393-7.8889	14	480.86-489.49	52-53	-1.11- -0.37	-0.08-0.42	15
16	7.2029-7.6234	7.8890-8.3210	15-16	489.50-518.13	54-55	-0.36-0.53	0.43-1.04	16
17	7.6235-8.7665	8.3211-8.5352	17	518.14-538.41	56-59	0.54-1.81	1.05-1.24	17
18	8.7666-9.5623	8.5353-9.3765	18-23	538.42-567.40	60-72	1.82-10.17	1.25-2.32	18
19	9.5624-10.0	9.3766-10.0	24-26	567.41-800.0	73-130	10.18-15.0	2.33-15.0	19

Raw Score indicates:

DCCS – computed score

Picture Sequence Memory – computed score

Pattern Comparison – raw score

Picture Vocabulary – theta score

Flanker – computed score

List Sort – raw score

Oral Reading – theta score

Appendix 2. NIH Toolbox Cognition Battery in Spanish Normative Formulas.

Appendix 2.1 Formula Converting Raw scores to Uncorrected Normally-distributed Standard Scores.

Test	Formula
DCCS	$\{[(\text{DCCS raw score}) - (4.89)] / 2.93\} * 15 + 100$
Flanker	$\{[(\text{Flanker raw score}) - (5.81)] / 2.77\} * 15 + 100$
List Sort	$\{[(\text{List Sort raw score}) - (11.37)] / 5.09\} * 15 + 100$
Picture Sequence Memory	$\{[(\text{Picture Sequence Memory raw score}) - (432.24)] / 107.60\} * 15 + 100$
Pattern Comparison	$\{[(\text{Pattern Comparison raw score}) - (43.55)] / 12.56\} * 15 + 100$
Oral Reading	$\{[(\text{Oral Reading raw score}) - (-2.97)] / 6.27\} * 15 + 100$
Picture Vocabulary	$\{[(\text{Picture Vocabulary raw score}) - (-0.06)] / 3.52\} * 15 + 100$
Fluid Composite	$[(\text{Mean of DCC, Flanker, List Sort, Pic Seq Mem, \& Pattern Comparison Uncorrected Standard Scores}) - 100.47] / (13.34)] * 15 + 100$
Crystallized Composite	$[(\text{Mean of Oral Reading \& Picture Vocabulary Uncorrected Standard Scores}) - 100.50] / (14.48)] * 15 + 100$
Total Composite	$[(\text{Mean of Uncorrected Fluid \& Crystallized Composite Standard Scores}) - 103.86] / (12.81)] * 15 + 100$

Appendix 2.2 Formulas Converting Scaled Scores to Age-Corrected Standard Scores

Test	Formula
Spanish Adults	
DCCS	$100 + 15 * \{[(\text{DCCS scaled score}) - (13.48 - 7.84*(\text{age}/100))] / [2.52 - 1.11*(\text{age}/100)]\} / 1.30$
Flanker	$100 + 15 * \{[(\text{Flanker scaled score}) - (13.91 - 8.89*(\text{age}/100))] / [1.87 + 0.52*(\text{age}/100)]\} / 1.25$
List Sort	$100 + 15 * \{[(\text{List Sort scaled score}) - (13.37 - 7.97*(\text{age}/100))] / [2.78 - 1.31*(\text{age}/100)]\} / 1.26$
Picture Sequence	$100 + 15 * \{[(\text{Picture Sequence Memory scaled score}) - (13.40 - 8.57*(\text{age}/100))] /$

Appendix 2. NIH Toolbox Cognition Battery in Spanish Normative Formulas.

Memory	$[2.66 - 1.27 * (\text{age}/100)] / 1.27$
Pattern Comparison	$100 + 15 * \{[(\text{Pattern comp scaled score}) - (13.97 - 9.07 * (\text{age}/100))] / [2.44 - 0.78 * (\text{age}/100)]\} / 1.26$
Oral Reading	$100 + 15 * \{[(\text{Reading scaled score}) - (11.95 - 4.43 * (\text{age}/100))] / [1.96 + 0.81 * (\text{age}/100)]\} / 1.26$
Picture Vocabulary	$100 + 15 * \{[(\text{Vocabulary scaled score}) - (3.90 + 32.00 * (\text{age}/100) - 36.02 * (\text{age}/100)^2)] / [1.45 + 1.78 * (\text{age}/100)]\} / 1.25$
Fluid Composite	$100 + 15 * \{[(\text{Mean of DCC, Flanker, List Sort, Pic Seq Mem, \& Pattern Comparison Scaled Scores}) - (13.36 - 7.41 * (\text{age}/100))] / [1.64 - 0.31 * (\text{age}/100)]\} / 1.26$
Crystallized Composite	$100 + 15 * \{[(\text{Mean of Oral Reading \& Picture Vocabulary Scaled Scores}) - (3.02 + 16.27 * (\text{age}/100)^{0.5} - 16.23 * (\text{age}/100)^2)] / [1.70 + 0.74 * (\text{age}/100)]\} / 1.24$
Total Cognition Composite	$100 + 15 * \{[(\text{Mean of Fluid \& Crystallized Composite Scaled Scores}) - (12.04 - 4.30 * (\text{age}/100))] / [1.11 + 0.84 * (\text{age}/100)]\} / 1.28$
Spanish Children	
DCCS	$100 + 15 * \{[(\text{DCCS scaled score}) - (4.04 + 11.68 * (\text{age}/10))] / [1.86 + 0.32 * (\text{age}/10)]\} / 1.25$
Flanker	$100 + 15 * \{[(\text{Flanker scaled score}) - (2.76 + 14.10 * (\text{age}/10))] / [1.83 - 0.12 * (\text{age}/10)]\} / 1.30$
List Sort	$100 + 15 * \{[(\text{List Sort scaled score}) - (3.04 + 12.79 * (\text{age}/10))] / [2.03 - 0.18 * (\text{age}/10)]\} / 1.26$
Picture Sequence Memory	$100 + 15 * \{[(\text{Picture Sequence Memory scaled score}) - (14.93 + 6.86 * \log(\text{age}/10))] / [1.49 + 0.63 * (\text{age}/10)]\} / 1.23$
Pattern Comparison	$100 + 15 * \{[(\text{Pattern Comp scaled score}) - (3.36 + 12.88 * (\text{age}/10))] / [2.87 - 2.07 * (\text{age}/10)]\} / 1.32$
Oral Reading	$100 + 15 * \{[(\text{Reading scaled score}) - (3.69 + 10.95 * (\text{age}/10))] / [1.51 + 1.13 * (\text{age}/10)]\} / 1.23$
Picture Vocabulary	$100 + 15 * \{[(\text{Vocabulary scaled score}) - (3.84 + 12.48 * (\text{age}/10))] / [2.16 -$

Appendix 2. NIH Toolbox Cognition Battery in Spanish Normative Formulas.

	$0.59*(age/10)] / 1.30$
Fluid Composite	$100 + 15 * \{[(Mean\ of\ DCC,\ Flanker,\ List\ Sort,\ Pic\ Seq\ Mem,\ \&\ Pattern\ Comparison\ Scaled\ Scores) - (3.53 + 12.82*(age/10))] / [1.11 + 0.11*(age/10)]\} / 1.23$
Crystallized Composite	$100 + 15 * \{[(Mean\ of\ Oral\ Reading\ \&\ Picture\ Vocabulary\ Scaled\ Scores) - (4.35 + 10.99*(age/10))] / [2.12 - 0.75*(age/10)]\} / 1.26$
Total Cognition Composite	$100 + 15 * \{[(Mean\ of\ Fluid\ \&\ Crystallized\ Composite\ Scaled\ Scores) - (5.27 + 9.91*(age/10))] / [1.51 - 0.55*(age/10)]\} / 1.22$

Appendix 2.3 Formulas Converting Scaled Scores to Fully-Corrected T-Scores.

Test	Formula
Spanish Adults	
DCCS	$50 + 10 * \{[(DCCS\ scaled\ score) - (11.00 - 7.24*(age/100) + 1.27*((edu+1)/10)^2 + 0.61*male)] / [1.56 - 0.18*(age/100) + 0.16*((edu+1)/10) + 0.34*male]\} / 1.30$
Flanker	$50 + 10 * \{[(Flanker\ scaled\ score) - (10.16 - 7.95*(age/100) + 2.64*((edu+1)/10) + 0.70*male)] / [1.25 + 0.63*(age/100) + 0.14*((edu+1)/10) + 0.46*male]\} / 1.26$
List Sort	$50 + 10 * \{[(List\ Sort\ scaled\ score) - (10.68 - 7.14*(age/100) + 1.95*((edu+1)/10) + 0.05*male)] / [2.55 - 1.20*(age/100) + 0.08*((edu+1)/10) - 0.03*male]\} / 1.26$
Picture Sequence Memory	$50 + 10 * \{[(Picture\ Sequence\ Memory\ scaled\ score) - (9.95 - 7.34*(age/100) + 2.51*((edu+1)/10) - 0.45*male)] / [2.68 - 0.89*(age/100) - 0.29*((edu+1)/10) + 0.16*male]\} / 1.28$
Pattern Comparison	$50 + 10 * \{[(Pattern\ Comp\ scaled\ score) - (11.98 - 8.68*(age/100) + 1.41*((edu+1)/10) + 0.46*male)] / [1.34 - 0.35*(age/100) + 0.67*((edu+1)/10) + 0.15*male]\} / 1.25$
Oral Reading	$50 + 10 * \{[(Reading\ scaled\ score) - (9.37 - 3.65*(age/100) + 1.86*((edu+1)/10) + 0.09*male)] / [3.21 + 0.46*(age/100) + 0.04*((edu+1)/10)^{-2} - 1.49*((edu+1)/10)^{-0.5} + 0.54*male]\} / 1.23$
Picture Vocabulary	$50 + 10 * \{[(Vocabulary\ scaled\ score) - (1.71 + 28.94*(age/100) - 31.60*(age/100)^2 + 2.23*((edu+1)/10) - 0.20*male)] / [0.64 + 1.74*(age/100) + 0.49*((edu+1)/10) +$

Appendix 2. NIH Toolbox Cognition Battery in Spanish Normative Formulas.

	$0.39 * \text{male}] / 1.25$
Fluid Composite	$50 + 10 * \{[(\text{Mean of DCC, Flanker, List Sort, Pic Seq Mem, \& Pattern Comparison Scaled Scores}) - (9.79 - 6.58 * (\text{age}/100) + 2.55 * ((\text{edu}+1)/10) + 0.33 * \text{male})] / [1.57 - 0.33 * (\text{age}/100) - 0.14 * ((\text{edu}+1)/10) + 0.12 * \text{male}]\} / 1.25$
Crystallized Composite	$50 + 10 * \{[(\text{Mean of Oral Reading \& Picture Vocabulary Scaled Scores}) - (5.09 + 15.77 * (\text{age}/100) - 19.13 * (\text{age}/100)^2 + 1.90 * ((\text{edu}+1)/10) - 0.03 * \text{male})] / [2.66 + 0.73 * (\text{age}/100) + 0.04 * ((\text{edu}+1)/10)^{-2} - 1.32 * ((\text{edu}+1)/10)^{-0.5} + 0.44 * \text{male}]\} / 1.23$
Total Cognition Composite	$50 + 10 * \{[(\text{Mean of Fluid \& Crystallized Composite Scaled Scores}) - (8.46 - 3.30 * (\text{age}/100) + 2.55 * ((\text{edu}+1)/10) + 0.08 * \text{male})] / [1.09 + 0.49 * (\text{age}/100) - 0.10 * ((\text{edu}+1)/10) + 0.20 * \text{male}]\} / 1.26$
Spanish Children	
DCCS	$50 + 10 * \{[(\text{DCCS scaled score}) - (2.91 + 11.80 * (\text{age}/10) + 1.13 * ((\text{edu}+1)/10) - 0.28 * \text{male})] / [1.68 + 0.31 * (\text{age}/10) + 0.11 * ((\text{edu}+1)/10) + 0.03 * \text{male}]\} / 1.26$
Flanker	$50 + 10 * \{[(\text{Flanker scaled score}) - (1.97 + 14.23 * (\text{age}/10) + 0.61 * ((\text{edu}+1)/10) + 0.14 * \text{male})] / [1.73 - 0.06 * (\text{age}/10) + 0.03 * ((\text{edu}+1)/10) + 0.08 * \text{male}]\} / 1.29$
List Sort	$50 + 10 * \{[(\text{List Sort scaled score}) - (2.10 + 13.09 * (\text{age}/10) + 0.97 * ((\text{edu}+1)/10) - 0.55 * \text{male})] / [1.72 - 0.07 * (\text{age}/10) + 0.06 * ((\text{edu}+1)/10) + 0.34 * \text{male}]\} / 1.26$
Picture Sequence Memory	$50 + 10 * \{[(\text{Picture Sequence Memory scaled score}) - (2.07 + 14.20 * (\text{age}/10) + 0.50 * ((\text{edu}+1)/10) + 0.33 * \text{male})] / [1.14 + 0.78 * (\text{age}/10) + 0.30 * ((\text{edu}+1)/10) - 0.17 * \text{male}]\} / 1.25$
Pattern Comparison	$50 + 10 * \{[(\text{Pattern Comp scaled score}) - (2.90 + 12.94 * (\text{age}/10) + 0.32 * ((\text{edu}+1)/10) + 0.21 * \text{male})] / [3.45 - 2.20 * (\text{age}/10) - 0.58 * ((\text{edu}+1)/10) + 0.21 * \text{male}]\} / 1.33$
Oral Reading	$50 + 10 * \{[(\text{Reading scaled score}) - (3.33 + 11.10 * (\text{age}/10) + 0.35 * ((\text{edu}+1)/10) - 0.24 * \text{male})] / [1.48 + 1.02 * (\text{age}/10) + 0.13 * ((\text{edu}+1)/10) - 0.11 * \text{male}]\} / 1.22$
Picture Vocabulary	$50 + 10 * \{[(\text{Vocabulary scaled score}) - (3.74 + 12.51 * (\text{age}/10) + 0.43 * ((\text{edu}+1)/10) - 0.78 * \text{male})] / [1.96 - 0.41 * (\text{age}/10) + 0.09 * ((\text{edu}+1)/10) - 0.04 * \text{male}]\} / 1.31$
Fluid Composite	$50 + 10 * \{[(\text{Mean of DCC, Flanker, List Sort, Pic Seq Mem, \& Pattern Comparison$

Appendix 2. NIH Toolbox Cognition Battery in Spanish Normative Formulas.

	$\text{Scaled Scores} - (2.51 + 13.03 \cdot (\text{age}/10) + 0.89 \cdot ((\text{edu}+1)/10) - 0.12 \cdot \text{male}) / [1.11 + 0.24 \cdot (\text{age}/10) - 0.07 \cdot ((\text{edu}+1)/10) - 0.04 \cdot \text{male}] / 1.22$
Crystallized Composite	$50 + 10 \cdot \{[(\text{Mean of Oral Reading \& Picture Vocabulary Scaled Scores}) - (3.81 + 11.22 \cdot (\text{age}/10) + 0.56 \cdot ((\text{edu}+1)/10) - 0.48 \cdot \text{male})] / [1.72 - 0.55 \cdot (\text{age}/10) + 0.24 \cdot ((\text{edu}+1)/10) + 0.06 \cdot \text{male}]\} / 1.24$
Total Cognition Composite	$50 + 10 \cdot \{[(\text{Mean of Fluid \& Crystallized Composite Scaled Scores}) - (4.66 + 10.23 \cdot (\text{age}/10) + 0.50 \cdot ((\text{edu}+1)/10) - 0.28 \cdot \text{male})] / [1.58 - 0.64 \cdot (\text{age}/10) - 0.03 \cdot ((\text{edu}+1)/10) + 0.03 \cdot \text{male}]\} / 1.22$