NIH Toolbox

Technical Manual

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NIH Toolbox Technical Manual

Domain:

COGNITION

Subdomain:

PROCESSING SPEED

Measure:

NIH Toolbox Pattern Comparison Processing Speed Test

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This Technical Manual contains the following informational sections:

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Section 1: Introduction to NIH Toolbox

NIH Toolbox is a multidimensional set of brief measures assessing cognitive, emotional, motor, and sensory function from ages 3-85. This suite of on-line and royalty-free measures can be administered to study participants 3 to 85 years of age in two hours or less, across diverse study designs and settings.

What is the NIH Toolbox?

The NIH Toolbox provides a standard set of royalty-free, brief, and comprehensive assessment tools that can be used by researchers and clinicians in a variety of settings, with a particular emphasis on measuring outcomes in longitudinal epidemiologic studies and prevention or intervention trials across the lifespan (ages 3-85). The battery ensures that assessment methods and results can be used for comparisons across existing and future studies and provides a "common currency" for the study of neurological research that promotes economies of scale and enhanced efficiency in measurement. The NIH Toolbox can be used to monitor neurological and behavioral function over time and measure key constructs across developmental stages. This facilitates the study of functional changes across the lifespan, including evaluating intervention and treatment effectiveness.

The NIH Toolbox Batteries

The basic NIH Toolbox can be administered within two hours and divides tests into four domain batteries: Cognition, Emotion, Motor, and Sensation. In addition, within some domains, there are supplemental measures that are available to be administered.

Selection of the NIH Toolbox Domains and Subdomains

Four domains were selected for the NIH Toolbox: Cognition, Emotion, Motor, and Sensation. Subdomain selection was based upon literature reviews, expert interviews, and multiple formal Requests for Information (RFI) of NIH-funded researchers. Initial literature and database reviews and an RFI identified the subdomains for inclusion in the NIH Toolbox, existing measures relevant to the project goals, and criteria for instrument selection. NIH Project Team members, external content experts, and contract scientists met at a follow-up consensus meeting to discuss potential subdomains along with the criteria affecting instrument selection, creation, and norming. Additional expert interviews were undertaken to gather more detailed information from clinical and scientific experts to help further refine the list of possible subdomains. A second consensus group meeting was held and results directed the decision for the final NIH Toolbox to assess four core domain areas (cognitive, emotional, motor, and sensory health and function).

Selection of Measures for the NIH Toolbox

More than 1,400 existing measures were identified and evaluated for potential inclusion in the NIH Toolbox. The selection criteria included a measure's applicability across the life span,

psychometric soundness, brevity, ease of use, applicability in diverse settings and with different groups, and lack of intellectual property constraints. There was also a preference for instruments that were already validated and normed for use with individuals between 3 and 85 years old. Results of the instrument selection process yielded draft development plans established for the NIH Toolbox measures.

Early Childhood Use

NIH Toolbox measure development focused special attention on assessing young children, to ensure that all tests given are developmentally appropriate for ages 3-7. A special team of early childhood assessment consultants was engaged to provide testing guidelines for the very young, to offer input on measure development, and to review all NIH Toolbox measures to ensure they fit the needs of young children. Advanced statistical methods were used to emphasize continuity of measurement, allowing Toolbox users to confidently conduct longitudinal measurement from age 3 through the life span while assessing the same domain constructs.

Section 2: Validation

Validation studies were conducted for all NIH Toolbox Cognition domain measures, to assure that these important tools for research met rigorous psychometric standards. Studies were

conducted across the entire age range and were statistically compared against "gold standard" measures wherever available.

For specifics regarding Cognition domain measure validation, see Weintraub et al., Cognition Assessment Using the NIH Toolbox, *Neurology*, in press. This manuscript describes measure development studies undertaken (e.g., expert panels for content development and validation; cognitive interviews; small and large-scale pilot testing) and psychometric characteristics (e.g., internal consistency and test-retest reliability; convergent and divergent validity).

Section 3: Norming

NIH Toolbox conducted a large national standardization study in both English and Spanish languages to allow for normative comparisons on each assessment. A sample of 4,859 participants, ages 3-85 – representative of the U.S. population based on gender, ethnicity, race, and socioeconomic status – was administered all of the NIH Toolbox measures at sites around the country (n = 2,917 English-speaking children, ages 3-17; n = 496 Spanish-speaking children, ages 3-7; n = 1,038 English-speaking adults, ages 18-85; n = 408 Spanish-speaking adults, ages 18-85). NIH Toolbox normative scores are now available for each year of age from 3 through 17, as well as for age ranges 18-29, 30-39, 40-49, 50-59, 60-69, and 70-85, allowing for targeted and accurate comparisons to the U.S. population.

Specifics regarding NIH Toolbox norming sampling methods (e.g., stratification by age, gender, and language preference; sampling a minimum of 25-100 individuals per targeted demographic and language subgroup) and norming analytic methods (e.g., post-stratification adjustment using iterative proportional fitting, i.e., "raking") can be found in the following publication: Beaumont et al., Norming Plans for the NIH Toolbox, *Neurology*, in press.

Section 4: NIH Toolbox and the National Children's Study (NCS)

In collaboration with NIH Toolbox scientists, NCS investigators selected measures from PROMIS and NIH Toolbox for a Maternal Health Profile, the Maternal Self-Reported Health Battery. This profile assesses Physical Health (Physical function, Fatigue, Sleep disturbance, Sleep-related impairment), Mental Health (Anger, Anxiety, Depression, Positive affect, Perceived stress, Self-efficacy), and Social Health (Social support and companionship, Social isolation). The Maternal Self-Reported Health Battery was field tested in fall 2011, using an online sample of 1000 women (200 pre-conception, 150 pregnant women (50 per trimester), and 650 mothers with a child between 0-36 months of age). In addition, NIH Toolbox norming was jointly sponsored by the NCS and included: 3,413 children in single-year age bands (from 3-17 years); 1,446 adults in seven age bands, including the mothers of children also being tested; and 105 pregnant women. The NIH Toolbox sampling plan matched distributions of race/ethnicity and level of education for each age band.

Section 5: Domain Definition

Domain: COGNITION

Cognition refers to the mental processes involved in gaining knowledge and comprehension. It includes processes such as thinking, knowing, remembering, judging, and problem-solving. These higher-level functions of the brain encompass language, imagination, perception, and the planning and execution of complex behaviors. Measurement of cognition is essential to any study of health and well-being and should be included in large-scale epidemiologic studies and experimental studies of health and development, even when the target of the study is not cognition itself. The Cognition domain includes measures of:

EXECUTIVE FUNCTION

Measured by:

NIH Toolbox Flanker Inhibitory Control and Attention Test

NIH Toolbox Dimensional Change Card Sort Test

ATTENTION

Measured by:

NIH Toolbox Flanker Inhibitory Control and Attention Test

EPISODIC MEMORY

Measured by:

NIH Toolbox Picture Sequence Memory Test

NIH Toolbox Auditory Verbal Learning Test (Rey) (Supplemental Measure)

LANGUAGE

Measured by:

NIH Toolbox Picture Vocabulary Test

NIH Toolbox Oral Reading Recognition Test

PROCESSING SPEED

Measured by:

NIH Toolbox Pattern Comparison Processing Speed Test

NIH Toolbox Oral Symbol Digit Test (Supplemental Measure)

WORKING MEMORY

Measured by:

NIH Toolbox List Sorting Working Memory Test

Section 6: Subdomain Definition

Subdomain: PROCESSING SPEED

Processing Speed is defined as either the amount of time it takes to process a set amount of information, or, conversely, the amount of information that can be processed within a certain amount of time. It is a measure that reflects mental efficiency. Processing Speed is central for many cognitive functions and domains and is sensitive to change and/or disease. In NIH Toolbox, Processing Speed is measured by:

NIH Toolbox Pattern Comparison Processing Speed Test

NIH Toolbox Oral Symbol Digit Test (Supplemental Measure)

Section 7: Measure Description

COGNITION Core Measure

The NIH Toolbox Pattern Comparison Processing Speed Test (Pattern Comparison) measures speed of processing by asking participants to discern whether two side-by-side pictures are the same or not. The items are presented one pair at a time on the computer screen, and the participant is given 90 seconds to respond to as many items as possible (up to a maximum of 130). The items are designed to be simple so as to most purely measure processing speed. The

test overall takes approximately three minutes to administer. This test is recommended for ages 7-85, but is available for use as young as age 3, if desired.

Section 8: Post-Validation/Post-Norming Changes to the Measure

In addition to those changes previously reported on during the measure's development and validation phases (Weintraub et al., Cognition Assessment Using the NIH Toolbox, *Neurology*, in press), the following changes have been made to this measure:

Test administration changes: The test is recommended for ages 7+, but it can successfully be administered to younger ages (i.e., ages 3-6).

Section 9: The Measure's Scoring Model

Measurement theory applied for scoring:

Classical Test Theory (CTT)

CTT scoring approach employed:

Sum (the number of items answered correctly in a 90-second period)

Measure length:

Timed (90-second response period)

Response data:

Dichotomous

Scores computed/available*:

Sum (range 0 to 130)

Age-Adjusted Scale Score (mean=100, standard deviation=15)

Fully Adjusted Scale Score (mean=100, standard deviation=15)

Unadjusted Scale Score (mean=100, standard deviation=15)

National Percentile Rank (corresponds to the Age-Adjusted Scale Score)

*Details on these scores and their interpretations are available in the NIH Toolbox Scoring and Interpretation Guide.

Section 10: Measure Norms

The following Tables and Figure present NIH Toolbox normative data associated with this measure:

Table 1. **Measure Raw/Computed Score, Unadjusted Scale Score, and Fully Adjusted Scale Score Summary (N, Mean, Standard Deviation) by Age Group (3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18-29, 30-39, 40-49, 50-59, 60-69, 70-85, All)**

Table 2. **Measure Raw/Computed Score Statistics (N, Mean, Standard Deviation, Minimum/Maximum Observed, $25^{th}/50^{th}/75^{th}$ Percentile) per Age Group (3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18-29, 30-39, 40-49, 50-59, 60-69, 70-85, All)**

Figure 1. **Measure Mean Unadjusted Scale Scores across All Age Groups (3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18-29, 30-39, 40-49, 50-59, 60-69, 70-85)**

Table 1. NIH Toolbox Pattern Comparison Processing Speed Test by Age Group	Pattern Comparison Processing Speed Test (number correct)			Pattern Comparison Unadjusted Scale Score			Pattern Comparison Fully Adjusted Scale Score		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Age Group									
3	134	13.79	6.13	134	73.86	6.77	121	98.42	9.26
4	220	17.97	4.54	220	78.36	4.54	204	99.38	7.80
5	206	23.50	3.77	206	83.69	3.54	186	99.47	6.50
6	217	28.31	4.91	217	88.33	4.86	195	99.13	7.84
7	254	31.03	3.63	254	90.80	3.48	229	99.30	6.59
8	212	33.61	4.34	212	93.36	4.25	203	99.11	7.34
9	223	36.68	4.47	223	96.43	4.59	209	99.39	7.35
10	236	37.87	4.74	236	97.79	4.83	218	99.39	7.73
11	223	41.91	4.61	223	101.97	4.94	210	99.46	7.63
12	220	44.08	4.93	220	104.34	5.31	210	99.37	8.32
13	222	47.17	5.17	222	107.78	5.75	214	99.48	8.67
14	234	49.25	5.04	234	110.14	5.67	226	99.36	8.27
15	224	50.40	5.39	224	111.47	6.19	217	99.17	8.75
16	215	53.18	5.96	215	114.89	7.19	205	99.49	9.83
17	224	53.42	5.96	224	115.13	7.03	216	99.65	9.52
18 - 29	266	53.60	19.83	266	115.49	23.67	257	99.24	31.68
30 - 39	310	49.80	15.69	310	110.90	17.89	294	99.39	25.03
40 - 49	254	46.84	16.47	254	107.45	18.13	238	99.12	25.93
50 - 59	191	41.53	19.42	191	101.71	20.40	175	99.51	30.21
60 - 69	164	39.44	16.39	164	99.47	16.90	151	99.38	25.79
70 - 85	241	33.06	11.48	241	92.90	11.28	212	98.98	17.91
All	4690	44.14	13.11	4690	104.83	14.31	4390	99.30	16.03

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 3		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	34	35	69	33	32	65	67	67	134
	Mean	13.74	14.52	14.05	14.08	11.05	12.90	13.82	13.76	13.79
	Standard Deviation	8.77	6.71	7.74	4.74	2.33	3.77	7.03	5.13	6.13
	Minimum Observed	1.00	0.00	0.00	2.00	4.00	2.00	1.00	0.00	0.00
	25th Percentile	5.00	8.00	7.00	6.00	5.00	5.00	5.00	7.00	7.00
	50th Percentile (Median)	13.00	13.00	13.00	10.00	10.00	10.00	11.00	12.00	12.00
	75th Percentile	17.00	17.00	17.00	20.00	13.00	17.00	17.00	17.00	17.00
	Maximum Observed	50.00	65.00	65.00	52.00	33.00	52.00	52.00	65.00	65.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 4		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	60	66	126	42	52	94	102	118	220
	Mean	18.37	18.34	18.36	17.27	14.52	16.04	18.19	17.67	17.97
	Standard Deviation	5.26	5.55	5.39	3.56	2.39	2.99	4.62	4.48	4.54
	Minimum Observed	3.00	3.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00
	25th Percentile	14.00	11.00	12.00	11.00	10.00	11.00	13.00	11.00	12.00
	50th Percentile (Median)	19.00	18.00	18.00	16.00	13.00	14.00	19.00	17.00	18.00
	75th Percentile	24.00	23.00	24.00	22.00	17.00	21.00	23.00	22.00	23.00
	Maximum Observed	37.00	49.00	49.00	42.00	40.00	42.00	42.00	49.00	49.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 5		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	55	64	119	42	45	87	97	109	206
	Mean	23.52	24.16	23.79	21.45	23.27	22.19	23.14	24.00	23.50
	Standard Deviation	4.86	3.78	4.30	3.23	2.47	2.87	4.24	3.30	3.77
	Minimum Observed	9.00	2.00	2.00	4.00	4.00	4.00	4.00	2.00	2.00
	25th Percentile	19.00	20.00	19.00	19.00	18.00	18.00	19.00	20.00	19.00
	50th Percentile (Median)	24.00	23.00	24.00	23.00	25.00	24.00	24.00	24.00	24.00
	75th Percentile	28.00	28.00	28.00	27.00	28.00	27.00	28.00	28.00	28.00
	Maximum Observed	37.00	43.00	43.00	36.00	45.00	45.00	37.00	45.00	45.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 6		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	62	61	123	41	53	94	103	114	217
	Mean	28.36	28.43	28.39	27.63	28.34	27.95	28.24	28.41	28.31
	Standard Deviation	6.35	5.94	6.12	2.57	2.63	2.59	5.17	4.68	4.91
	Minimum Observed	12.00	8.00	8.00	10.00	6.00	6.00	10.00	6.00	6.00
	25th Percentile	22.00	23.00	22.00	22.00	23.00	22.00	22.00	23.00	22.00
	50th Percentile (Median)	27.00	27.00	27.00	28.00	28.00	28.00	27.00	27.00	27.00
	75th Percentile	34.00	33.00	34.00	32.00	33.00	32.00	34.00	33.00	34.00
	Maximum Observed	54.00	71.00	71.00	39.00	56.00	56.00	54.00	71.00	71.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 7		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	83	80	163	45	46	91	128	126	254
	Mean	30.69	30.81	30.74	33.96	30.92	32.74	31.15	30.82	31.03
	Standard Deviation	5.05	3.23	4.24	2.20	1.81	2.06	4.30	2.79	3.63
	Minimum Observed	6.00	12.00	6.00	16.00	13.00	13.00	6.00	12.00	6.00
	25th Percentile	26.00	27.00	26.00	30.00	27.00	28.00	26.00	27.00	26.00
	50th Percentile (Median)	32.00	31.00	31.00	35.00	32.00	33.00	32.00	31.00	32.00
	75th Percentile	35.00	35.00	35.00	39.00	34.00	37.00	36.00	35.00	35.00
	Maximum Observed	46.00	45.00	46.00	45.00	43.00	45.00	46.00	45.00	46.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 8		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	110	102	212	0	0	0	110	102	212
	Mean	32.53	35.24	33.61				32.53	35.24	33.61
	Standard Deviation	4.90	3.50	4.34				4.90	3.50	4.34
	Minimum Observed	9.00	16.00	9.00				9.00	16.00	9.00
	25th Percentile	27.00	31.00	29.00				27.00	31.00	29.00
	50th Percentile (Median)	34.00	36.00	34.00				34.00	36.00	34.00
	75th Percentile	39.00	40.00	40.00				39.00	40.00	40.00
	Maximum Observed	49.00	48.00	49.00				49.00	48.00	49.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 9		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	111	112	223	0	0	0	111	112	223
	Mean	36.00	37.71	36.68				36.00	37.71	36.68
	Standard Deviation	5.11	3.70	4.47				5.11	3.70	4.47
	Minimum Observed	9.00	1.00	1.00				9.00	1.00	1.00
	25th Percentile	31.00	34.00	33.00				31.00	34.00	33.00
	50th Percentile (Median)	37.00	39.00	38.00				37.00	39.00	38.00
	75th Percentile	42.00	42.00	42.00				42.00	42.00	42.00
	Maximum Observed	53.00	53.00	53.00				53.00	53.00	53.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 10		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	119	117	236	0	0	0	119	117	236
	Mean	36.88	39.44	37.87				36.88	39.44	37.87
	Standard Deviation	5.11	4.24	4.74				5.11	4.24	4.74
	Minimum Observed	10.00	11.00	10.00				10.00	11.00	10.00
	25th Percentile	30.00	34.00	32.00				30.00	34.00	32.00
	50th Percentile (Median)	38.00	41.00	38.00				38.00	41.00	38.00
	75th Percentile	43.00	46.00	44.00				43.00	46.00	44.00
	Maximum Observed	57.00	58.00	58.00				57.00	58.00	58.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 11		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	114	109	223	0	0	0	114	109	223
	Mean	40.23	44.44	41.91				40.23	44.44	41.91
	Standard Deviation	4.63	4.30	4.61				4.63	4.30	4.61
	Minimum Observed	23.00	24.00	23.00				23.00	24.00	23.00
	25th Percentile	35.00	39.00	37.00				35.00	39.00	37.00
	50th Percentile (Median)	40.00	44.00	42.00				40.00	44.00	42.00
	75th Percentile	46.00	50.00	47.00				46.00	50.00	47.00
	Maximum Observed	59.00	67.00	67.00				59.00	67.00	67.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 12		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	103	117	220	0	0	0	103	117	220
	Mean	42.58	46.06	44.08				42.58	46.06	44.08
	Standard Deviation	5.27	4.45	4.93				5.27	4.45	4.93
	Minimum Observed	15.00	21.00	15.00				15.00	21.00	15.00
	25th Percentile	38.00	40.00	38.00				38.00	40.00	38.00
	50th Percentile (Median)	43.00	46.00	44.00				43.00	46.00	44.00
	75th Percentile	48.00	52.00	51.00				48.00	52.00	51.00
	Maximum Observed	65.00	63.00	65.00				65.00	63.00	65.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 13		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	117	105	222	0	0	0	117	105	222
	Mean	47.07	47.37	47.17				47.07	47.37	47.17
	Standard Deviation	5.81	4.37	5.17				5.81	4.37	5.17
	Minimum Observed	19.00	20.00	19.00				19.00	20.00	19.00
	25th Percentile	41.00	43.00	42.00				41.00	43.00	42.00
	50th Percentile (Median)	47.00	47.00	47.00				47.00	47.00	47.00
	75th Percentile	54.00	53.00	54.00				54.00	53.00	54.00
	Maximum Observed	72.00	64.00	72.00				72.00	64.00	72.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 14		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	113	121	234	0	0	0	113	121	234
	Mean	48.86	49.82	49.25				48.86	49.82	49.25
	Standard Deviation	5.68	4.36	5.04				5.68	4.36	5.04
	Minimum Observed	21.00	27.00	21.00				21.00	27.00	21.00
	25th Percentile	42.00	44.00	43.00				42.00	44.00	43.00
	50th Percentile (Median)	48.00	50.00	50.00				48.00	50.00	50.00
	75th Percentile	56.00	56.00	56.00				56.00	56.00	56.00
	Maximum Observed	68.00	67.00	68.00				68.00	67.00	68.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 15		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	111	113	224	0	0	0	111	113	224
	Mean	50.22	50.66	50.40				50.22	50.66	50.40
	Standard Deviation	6.02	4.73	5.39				6.02	4.73	5.39
	Minimum Observed	19.00	17.00	17.00				19.00	17.00	17.00
	25th Percentile	44.00	45.00	44.00				44.00	45.00	44.00
	50th Percentile (Median)	50.00	52.00	51.00				50.00	52.00	51.00
	75th Percentile	56.00	56.00	56.00				56.00	56.00	56.00
	Maximum Observed	76.00	71.00	76.00				76.00	71.00	76.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 16		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	107	108	215	0	0	0	107	108	215
	Mean	52.43	54.27	53.18				52.43	54.27	53.18
	Standard Deviation	6.81	4.96	5.96				6.81	4.96	5.96
	Minimum Observed	22.00	27.00	22.00				22.00	27.00	22.00
	25th Percentile	44.00	48.00	45.00				44.00	48.00	45.00
	50th Percentile (Median)	51.00	56.00	55.00				51.00	56.00	55.00
	75th Percentile	60.00	61.00	60.00				60.00	61.00	60.00
	Maximum Observed	80.00	72.00	80.00				80.00	72.00	80.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 17		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	110	114	224	0	0	0	110	114	224
	Mean	54.30	51.98	53.42				54.30	51.98	53.42
	Standard Deviation	6.53	5.32	5.96				6.53	5.32	5.96
	Minimum Observed	28.00	4.00	4.00				28.00	4.00	4.00
	25th Percentile	47.00	48.00	47.00				47.00	48.00	47.00
	50th Percentile (Median)	55.00	53.00	54.00				55.00	53.00	54.00
	75th Percentile	61.00	59.00	60.00				61.00	59.00	60.00
	Maximum Observed	79.00	75.00	79.00				79.00	75.00	79.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 18-29		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	60	113	173	21	72	93	81	185	266
	Mean	55.71	53.80	54.70	49.38	45.28	46.57	55.11	52.36	53.60
	Standard Deviation	27.09	18.89	22.09	15.98	10.70	12.19	24.93	16.95	19.83
	Minimum Observed	27.00	28.00	27.00	23.00	22.00	22.00	23.00	22.00	22.00
	25th Percentile	47.00	46.00	46.00	41.00	40.00	41.00	47.00	44.00	45.00
	50th Percentile (Median)	57.00	55.00	55.00	49.00	44.00	47.00	55.00	53.00	54.00
	75th Percentile	66.00	61.00	63.00	60.00	52.00	53.00	65.00	59.00	62.00
	Maximum Observed	77.00	72.00	77.00	67.00	73.00	73.00	77.00	73.00	77.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 30-39		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	55	157	212	21	77	98	76	234	310
	Mean	49.56	50.89	50.44	48.26	43.69	45.08	49.42	49.99	49.80
	Standard Deviation	25.09	14.57	17.86	9.22	7.82	8.32	21.82	13.15	15.69
	Minimum Observed	16.00	20.00	16.00	33.00	21.00	21.00	16.00	20.00	16.00
	25th Percentile	41.00	44.00	43.00	42.00	36.00	38.00	41.00	43.00	42.00
	50th Percentile (Median)	52.00	52.00	52.00	46.00	43.00	44.00	52.00	51.00	51.00
	75th Percentile	59.00	57.00	58.00	57.00	50.00	51.00	59.00	57.00	57.00
	Maximum Observed	77.00	75.00	77.00	63.00	63.00	63.00	77.00	75.00	77.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 40-49		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	62	120	182	30	42	72	92	162	254
	Mean	46.71	48.16	47.55	39.67	42.02	40.80	45.82	47.61	46.84
	Standard Deviation	20.71	16.11	17.81	11.92	9.76	10.70	18.75	14.97	16.47
	Minimum Observed	23.00	25.00	23.00	12.00	14.00	12.00	12.00	14.00	12.00
	25th Percentile	41.00	42.00	42.00	34.00	35.00	34.00	39.00	42.00	41.00
	50th Percentile (Median)	47.00	48.00	48.00	41.00	44.00	42.00	47.00	48.00	47.00
	75th Percentile	54.00	55.00	54.00	48.00	49.00	49.00	53.00	54.00	54.00
	Maximum Observed	66.00	71.00	71.00	56.00	62.00	62.00	66.00	71.00	71.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 50-59		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	56	85	141	24	26	50	80	111	191
	Mean	41.33	42.36	41.82	39.12	38.33	38.79	41.09	42.03	41.53
	Standard Deviation	26.77	17.23	21.47	13.59	9.61	11.58	23.55	15.86	19.42
	Minimum Observed	14.00	11.00	11.00	19.00	19.00	19.00	14.00	11.00	11.00
	25th Percentile	34.00	36.00	35.00	35.00	31.00	32.00	34.00	35.00	35.00
	50th Percentile (Median)	42.00	43.00	42.00	38.00	39.00	39.00	42.00	42.00	42.00
	75th Percentile	48.00	48.00	48.00	48.00	45.00	46.00	48.00	48.00	48.00
	Maximum Observed	63.00	65.00	65.00	57.00	58.00	58.00	63.00	65.00	65.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 60-69		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	48	71	119	19	26	45	67	97	164
	Mean	40.20	39.94	40.07	33.95	31.72	32.94	39.62	39.26	39.44
	Standard Deviation	19.55	16.19	17.54	13.01	9.74	11.15	18.19	15.11	16.39
	Minimum Observed	11.00	14.00	11.00	8.00	7.00	7.00	8.00	7.00	7.00
	25th Percentile	35.00	34.00	34.00	24.00	25.00	24.00	34.00	33.00	33.00
	50th Percentile (Median)	42.00	41.00	42.00	36.00	31.00	35.00	42.00	41.00	41.00
	75th Percentile	46.00	47.00	46.00	43.00	38.00	42.00	46.00	47.00	46.00
	Maximum Observed	64.00	57.00	64.00	50.00	55.00	55.00	64.00	57.00	64.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – Age 70-85		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	93	105	198	25	18	43	118	123	241
	Mean	32.95	33.87	33.35	27.96	27.03	27.65	32.66	33.59	33.06
	Standard Deviation	14.48	9.86	12.23	5.98	6.43	6.10	13.22	9.54	11.48
	Minimum Observed	8.00	15.00	8.00	4.00	4.00	4.00	4.00	4.00	4.00
	25th Percentile	27.00	29.00	28.00	23.00	22.00	22.00	26.00	29.00	28.00
	50th Percentile (Median)	33.00	35.00	34.00	29.00	26.00	27.00	33.00	35.00	33.00
	75th Percentile	40.00	40.00	40.00	33.00	33.00	33.00	39.00	40.00	40.00
	Maximum Observed	52.00	54.00	54.00	45.00	48.00	48.00	52.00	54.00	54.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – NCS Sample of Mothers		English	Spanish	All
	N	80	35	115
	Mean	51.00	44.54	49.03
	Standard Deviation	10.72	8.91	10.59
	Minimum Observed	28.00	27.00	27.00
	25th Percentile	42.50	37.00	41.00
	50th Percentile (Median)	50.00	45.00	49.00
	75th Percentile	58.00	51.00	57.00
	Maximum Observed	75.00	63.00	75.00

Table 2. NIH Toolbox Pattern Comparison Processing Speed Test (number correct) – NCS Sample of Pregnant Women		English	Spanish	All
	N	82	44	126
	Mean	51.59	44.93	49.26
	Standard Deviation	7.72	10.94	9.48
	Minimum Observed	34.00	14.00	14.00
	25th Percentile	46.00	38.00	44.00
	50th Percentile (Median)	52.00	44.00	49.00
	75th Percentile	57.00	52.00	56.00
	Maximum Observed	72.00	73.00	73.00

Figure 1
Least Squares Means