

# NIH Toolbox



## Technical Manual

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# **NIH Toolbox Technical Manual**

**Domain:**

**COGNITION**

**Subdomain:**

**EPISODIC MEMORY**

**Measure:**

**NIH Toolbox Picture Sequence Memory Test**

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This Technical Manual contains the following informational sections:

**Section 1: Introduction to NIH Toolbox**

**Section 2: Validation**

**Section 3: Norming**

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

**Section 5: Domain Definition**

**Section 6: Subdomain Definition**

**Section 7: Measure Description**

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

**Section 9: The Measure's Scoring Model**

**Section 10: Measure Norms**

## **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: EPISODIC MEMORY**

Episodic Memory refers to cognitive processes involved in the acquisition, storage, and retrieval of new information. It involves conscious recollection of information learned within a context. The term "learning" refers to the acquisition of skills and knowledge, while the term "memory" refers to the persistence of this learning over time and/or the facility with which one is able to spontaneously recall the information following a delay. Episodic Memory can be verbal, as in remembering a conversation or a list of grocery items, or nonverbal, as in imagining a place one visited or a picture one saw a week ago. In NIH Toolbox, Episodic Memory is measured by:

NIH Toolbox Picture Sequence Memory Test

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

## **Section 7: Measure Description**

### **COGNITION Core Measure**

The NIH Toolbox Picture Sequence Memory Test (PSMT) was developed to assess Episodic Memory for ages 3-85 years. Respondents recalling increasingly lengthy series of illustrated objects and activities that are presented in a particular order on the computer screen, while corresponding audio-recorded phrases are played. The participants are asked to recall the

sequence of pictures presented over two learning trials. Sequence length varies from 6-18 pictures, depending on age. Participants are given credit for each adjacent pair of pictures they correctly place (i.e., if pictures in locations 7 and 8 are placed in that order and adjacent to each other anywhere – such as slots 1 and 2 – one point is awarded), up to the maximum value for the sequence, which is one less than the sequence length (if there are 18 pictures in the sequence, the maximum score is 17, because that is the number of adjacent pairs of pictures that exist). The test takes approximately seven minutes to administer. This test is recommended for ages 3-85.

## **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: Testing was reduced to two trials instead of three; sequence lengths were changed so that ages 3-4 get a 6-item sequence for Trials 1 and 2, ages 5-6 get a 9-item sequence for Trials 1 and 2, and ages 7-85 get a 15-item sequence for Trial 1 and an 18-item sequence for Trial 2.

Test scoring changes: An IRT scoring model was implemented based on the norming study results instead of the summed score of adjacent pairs previously employed.

## **Section 9: The Measure's Scoring Model**

Measurement theory applied for scoring:

Item Response Theory (IRT)

Rasch/IRT model employed:

Graded Response Model

Measure length:

Fixed, based on age

Response data:

Continuous (number of adjacent pairs placed correctly for each of trials 1 and 2)



Scores computed/available\*:

Rasch/IRT Theta Score

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)

Computed Score (converted from Theta score; range from 200 to 700)

\*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<sup>th</sup>/50<sup>th</sup>/75<sup>th</sup> 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 Picture Sequence Memory Test by Age Group	Picture Sequence Memory Test (theta)			Picture Sequence Memory Unadjusted Scale Score			Picture Sequence Memory Fully Adjusted Scale Score		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
<b>Age Group</b>									
<b>3</b>	132	-2.37	0.28	132	73.16	4.54	119	100.17	6.07
<b>4</b>	196	-1.90	0.36	196	79.97	5.24	182	100.54	7.35
<b>5</b>	146	-1.37	0.36	146	87.53	4.80	133	100.65	7.44
<b>6</b>	152	-1.07	0.36	152	91.55	4.80	135	99.98	7.36
<b>7</b>	191	-0.92	0.29	191	93.59	3.78	171	100.38	6.12
<b>8</b>	185	-0.50	0.44	185	99.24	5.93	178	100.26	9.02
<b>9</b>	187	-0.38	0.43	187	100.96	6.02	174	100.28	8.09
<b>10</b>	204	-0.26	0.39	204	102.51	5.38	191	100.18	7.46
<b>11</b>	193	-0.16	0.46	193	104.15	6.61	183	100.69	8.92
<b>12</b>	194	0.14	0.41	194	108.44	6.08	185	100.38	7.98
<b>13</b>	197	0.05	0.45	197	107.17	6.55	189	100.33	8.37
<b>14</b>	191	0.13	0.41	191	108.44	6.18	184	100.46	8.21
<b>15</b>	192	0.15	0.44	192	108.80	6.76	186	100.19	8.51
<b>16</b>	180	0.31	0.45	180	111.16	7.15	171	100.40	9.03
<b>17</b>	187	0.23	0.47	187	109.97	7.09	180	100.20	8.93
<b>18 - 29</b>	245	0.18	1.59	245	109.72	25.10	236	100.13	30.85
<b>30 - 39</b>	279	0.05	1.28	279	107.39	19.07	267	100.34	23.80
<b>40 - 49</b>	229	-0.17	1.60	229	104.32	23.23	218	100.31	29.93
<b>50 - 59</b>	169	-0.69	1.64	169	96.91	22.88	157	100.78	32.17
<b>60 - 69</b>	130	-0.93	1.17	130	93.56	15.01	123	100.28	23.25
<b>70 - 85</b>	167	-1.25	1.00	167	89.28	13.30	154	100.16	18.95
<b>All</b>	3946	-0.35	1.03	3946	101.76	14.92	3716	100.34	16.54

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 3		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	38	33	71	31	30	61	69	63	132
	Mean	-2.41	-2.28	-2.36	-2.30	-2.62	-2.43	-2.39	-2.35	-2.37
	Standard Deviation	0.42	0.24	0.35	0.18	0.14	0.17	0.34	0.21	0.28
	Minimum Observed	-3.28	-3.01	-3.28	-3.28	-3.28	-3.28	-3.28	-3.28	-3.28
	25th Percentile	-2.94	-2.54	-2.68	-2.68	-3.05	-2.72	-2.93	-2.62	-2.71
	50th Percentile (Median)	-2.53	-2.33	-2.41	-2.24	-2.62	-2.42	-2.42	-2.41	-2.41
	75th Percentile	-2.15	-1.94	-2.01	-1.97	-2.30	-2.07	-2.02	-2.08	-2.07
	Maximum Observed	-0.82	-1.62	-0.82	-1.59	-1.90	-1.59	-0.82	-1.62	-0.82

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 4		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	54	57	111	37	48	85	91	105	196
	Mean	-1.82	-1.93	-1.86	-2.07	-2.16	-2.11	-1.86	-1.97	-1.90
	Standard Deviation	0.48	0.41	0.45	0.20	0.18	0.19	0.40	0.33	0.36
	Minimum Observed	-3.00	-3.28	-3.28	-3.28	-3.28	-3.28	-3.28	-3.28	-3.28
	25th Percentile	-2.38	-2.65	-2.42	-2.49	-2.63	-2.55	-2.38	-2.63	-2.42
	50th Percentile (Median)	-1.90	-1.83	-1.90	-1.94	-2.22	-2.08	-1.90	-1.90	-1.90
	75th Percentile	-1.38	-1.62	-1.46	-1.77	-1.77	-1.77	-1.42	-1.62	-1.59
	Maximum Observed	-0.78	-0.78	-0.78	-0.82	-0.82	-0.82	-0.78	-0.78	-0.78

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 5		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	45	47	92	26	28	54	71	75	146
	Mean	-1.32	-1.38	-1.35	-1.49	-1.57	-1.52	-1.35	-1.41	-1.37
	Standard Deviation	0.43	0.42	0.42	0.25	0.17	0.21	0.37	0.35	0.36
	Minimum Observed	-2.52	-2.52	-2.52	-2.52	-2.40	-2.52	-2.52	-2.52	-2.52
	25th Percentile	-1.91	-1.91	-1.91	-1.91	-1.95	-1.91	-1.91	-1.91	-1.91
	50th Percentile (Median)	-1.23	-1.48	-1.23	-1.48	-1.57	-1.48	-1.23	-1.48	-1.33
	75th Percentile	-0.88	-0.80	-0.88	-1.21	-1.23	-1.23	-0.88	-0.88	-0.88
	Maximum Observed	0.12	0.12	0.12	-0.11	-0.11	-0.11	0.12	0.12	0.12

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 6		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	41	49	90	29	33	62	70	82	152
	Mean	-0.96	-1.13	-1.04	-1.28	-1.13	-1.22	-1.02	-1.13	-1.07
	Standard Deviation	0.42	0.43	0.43	0.25	0.19	0.22	0.37	0.36	0.36
	Minimum Observed	-2.40	-2.52	-2.52	-2.52	-2.52	-2.52	-2.52	-2.52	-2.52
	25th Percentile	-1.33	-1.84	-1.57	-1.57	-1.57	-1.57	-1.42	-1.83	-1.57
	50th Percentile (Median)	-0.80	-1.23	-0.98	-1.15	-1.23	-1.15	-0.94	-1.23	-0.98
	75th Percentile	-0.68	-0.68	-0.68	-0.80	-0.68	-0.71	-0.68	-0.68	-0.68
	Maximum Observed	0.12	0.12	0.12	-0.48	-0.11	-0.11	0.12	0.12	0.12

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 7		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	53	52	105	43	43	86	96	95	191
	Mean	-0.89	-0.90	-0.89	-0.98	-1.15	-1.05	-0.90	-0.95	-0.92
	Standard Deviation	0.41	0.29	0.35	0.18	0.16	0.17	0.32	0.24	0.29
	Minimum Observed	-2.40	-2.52	-2.52	-1.91	-2.40	-2.40	-2.40	-2.52	-2.52
	25th Percentile	-1.33	-1.23	-1.23	-1.27	-1.48	-1.33	-1.33	-1.23	-1.23
	50th Percentile (Median)	-0.71	-0.71	-0.71	-0.80	-1.23	-0.92	-0.80	-0.80	-0.80
	75th Percentile	-0.55	-0.55	-0.55	-0.68	-0.68	-0.68	-0.55	-0.55	-0.55
	Maximum Observed	0.12	0.12	0.12	0.12	-0.35	0.12	0.12	0.12	0.12

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 8		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	92	93	185	0	0	0	92	93	185
	Mean	-0.46	-0.56	-0.50				-0.46	-0.56	-0.50
	Standard Deviation	0.45	0.42	0.44				0.45	0.42	0.44
	Minimum Observed	-2.00	-2.32	-2.32				-2.00	-2.32	-2.32
	25th Percentile	-1.03	-0.98	-1.03				-1.03	-0.98	-1.03
	50th Percentile (Median)	-0.47	-0.49	-0.48				-0.47	-0.49	-0.48
	75th Percentile	0.08	0.07	0.08				0.08	0.07	0.08
	Maximum Observed	1.27	1.10	1.27				1.27	1.10	1.27

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 9		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	88	99	187	0	0	0	88	99	187
	Mean	-0.40	-0.36	-0.38				-0.40	-0.36	-0.38
	Standard Deviation	0.49	0.38	0.43				0.49	0.38	0.43
	Minimum Observed	-2.30	-2.13	-2.30				-2.30	-2.13	-2.30
	25th Percentile	-0.96	-0.91	-0.95				-0.96	-0.91	-0.95
	50th Percentile (Median)	-0.42	-0.38	-0.42				-0.42	-0.38	-0.42
	75th Percentile	0.22	0.13	0.21				0.22	0.13	0.21
	Maximum Observed	1.46	1.37	1.46				1.46	1.37	1.46

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 10		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	97	107	204	0	0	0	97	107	204
	Mean	-0.31	-0.21	-0.26				-0.31	-0.21	-0.26
	Standard Deviation	0.42	0.35	0.39				0.42	0.35	0.39
	Minimum Observed	-1.99	-1.73	-1.99				-1.99	-1.73	-1.99
	25th Percentile	-0.83	-0.68	-0.73				-0.83	-0.68	-0.73
	50th Percentile (Median)	-0.28	-0.26	-0.26				-0.28	-0.26	-0.26
	75th Percentile	0.23	0.30	0.27				0.23	0.30	0.27
	Maximum Observed	1.38	1.38	1.38				1.38	1.38	1.38

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 11		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	98	95	193	0	0	0	98	95	193
	Mean	-0.23	-0.07	-0.16				-0.23	-0.07	-0.16
	Standard Deviation	0.50	0.41	0.46				0.50	0.41	0.46
	Minimum Observed	-2.20	-1.99	-2.20				-2.20	-1.99	-2.20
	25th Percentile	-0.85	-0.62	-0.68				-0.85	-0.62	-0.68
	50th Percentile (Median)	-0.19	-0.12	-0.17				-0.19	-0.12	-0.17
	75th Percentile	0.36	0.65	0.43				0.36	0.65	0.43
	Maximum Observed	1.55	1.37	1.55				1.55	1.37	1.55

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 12		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	93	101	194	0	0	0	93	101	194
	Mean	0.08	0.22	0.14				0.08	0.22	0.14
	Standard Deviation	0.46	0.36	0.41				0.46	0.36	0.41
	Minimum Observed	-1.83	-1.71	-1.83				-1.83	-1.71	-1.83
	25th Percentile	-0.51	-0.21	-0.41				-0.51	-0.21	-0.41
	50th Percentile (Median)	0.20	0.22	0.22				0.20	0.22	0.22
	75th Percentile	0.59	0.65	0.65				0.59	0.65	0.65
	Maximum Observed	1.38	1.67	1.67				1.38	1.67	1.67



Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 13		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	109	88	197	0	0	0	109	88	197
	Mean	0.03	0.09	0.05				0.03	0.09	0.05
	Standard Deviation	0.50	0.37	0.45				0.50	0.37	0.45
	Minimum Observed	-1.95	-1.95	-1.95				-1.95	-1.95	-1.95
	25th Percentile	-0.61	-0.43	-0.56				-0.61	-0.43	-0.56
	50th Percentile (Median)	0.08	0.17	0.13				0.08	0.17	0.13
	75th Percentile	0.64	0.62	0.64				0.64	0.62	0.64
	Maximum Observed	1.46	1.67	1.67				1.46	1.67	1.67

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 14		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	99	92	191	0	0	0	99	92	191
	Mean	0.13	0.14	0.13				0.13	0.14	0.13
	Standard Deviation	0.46	0.34	0.41				0.46	0.34	0.41
	Minimum Observed	-1.66	-2.20	-2.20				-1.66	-2.20	-2.20
	25th Percentile	-0.44	-0.29	-0.43				-0.44	-0.29	-0.43
	50th Percentile (Median)	0.05	0.24	0.18				0.05	0.24	0.18
	75th Percentile	0.78	0.65	0.74				0.78	0.65	0.74
	Maximum Observed	1.55	1.67	1.67				1.55	1.67	1.67

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 15		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	95	97	192	0	0	0	95	97	192
	Mean	0.13	0.19	0.15				0.13	0.19	0.15
	Standard Deviation	0.44	0.44	0.44				0.44	0.44	0.44
	Minimum Observed	-1.80	-2.07	-2.07				-1.80	-2.07	-2.07
	25th Percentile	-0.34	-0.42	-0.38				-0.34	-0.42	-0.38
	50th Percentile (Median)	0.20	0.41	0.23				0.20	0.41	0.23
	75th Percentile	0.52	0.78	0.73				0.52	0.78	0.73
	Maximum Observed	1.67	1.55	1.67				1.67	1.55	1.67

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 16		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	93	87	180	0	0	0	93	87	180
	Mean	0.37	0.21	0.31				0.37	0.21	0.31
	Standard Deviation	0.50	0.40	0.45				0.50	0.40	0.45
	Minimum Observed	-1.99	-1.80	-1.99				-1.99	-1.80	-1.99
	25th Percentile	-0.20	-0.19	-0.20				-0.20	-0.19	-0.20
	50th Percentile (Median)	0.48	0.30	0.35				0.48	0.30	0.35
	75th Percentile	1.07	0.65	0.88				1.07	0.65	0.88
	Maximum Observed	1.67	1.67	1.67				1.67	1.67	1.67

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 17		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	96	91	187	0	0	0	96	91	187
	Mean	0.23	0.24	0.23				0.23	0.24	0.23
	Standard Deviation	0.51	0.41	0.47				0.51	0.41	0.47
	Minimum Observed	-1.99	-2.13	-2.13				-1.99	-2.13	-2.13
	25th Percentile	-0.25	-0.34	-0.25				-0.25	-0.34	-0.25
	50th Percentile (Median)	0.41	0.39	0.41				0.41	0.39	0.41
	75th Percentile	0.78	0.87	0.78				0.78	0.87	0.78
	Maximum Observed	1.46	1.67	1.67				1.46	1.67	1.67

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 18-29		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	54	110	164	14	67	81	68	177	245
	Mean	0.08	0.30	0.20	0.23	-0.01	0.05	0.09	0.25	0.18
	Standard Deviation	2.24	1.54	1.81	0.84	1.06	1.03	2.02	1.39	1.59
	Minimum Observed	-2.06	-1.62	-2.06	-1.57	-2.23	-2.23	-2.06	-2.23	-2.23
	25th Percentile	-0.56	-0.20	-0.37	-0.12	-0.58	-0.43	-0.56	-0.24	-0.37
	50th Percentile (Median)	0.02	0.38	0.23	0.47	0.08	0.08	0.02	0.30	0.23
	75th Percentile	0.83	0.99	0.95	0.57	0.65	0.64	0.83	0.97	0.83
	Maximum Observed	1.67	1.67	1.67	1.37	1.67	1.67	1.67	1.67	1.67

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 30-39		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	49	147	196	19	64	83	68	211	279
	Mean	-0.18	0.18	0.06	-0.18	-0.04	-0.08	-0.18	0.16	0.05
	Standard Deviation	1.65	1.29	1.42	1.20	0.75	0.87	1.53	1.16	1.28
	Minimum Observed	-2.07	-2.07	-2.07	-2.12	-2.06	-2.12	-2.12	-2.07	-2.12
	25th Percentile	-0.76	-0.41	-0.48	-1.07	-0.66	-0.70	-0.76	-0.41	-0.48
	50th Percentile (Median)	-0.16	0.21	0.13	-0.09	0.02	-0.06	-0.16	0.18	0.11
	75th Percentile	0.54	0.78	0.74	0.44	0.65	0.65	0.54	0.78	0.74
	Maximum Observed	1.38	1.67	1.67	1.55	1.55	1.55	1.55	1.67	1.67

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 40-49		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	59	109	168	23	38	61	82	147	229
	Mean	-0.25	-0.01	-0.12	-0.97	-0.34	-0.64	-0.32	-0.04	-0.17
	Standard Deviation	1.97	1.64	1.77	0.93	0.79	0.90	1.78	1.47	1.60
	Minimum Observed	-2.12	-2.07	-2.12	-2.13	-2.23	-2.23	-2.13	-2.23	-2.23
	25th Percentile	-0.84	-0.70	-0.75	-1.83	-1.12	-1.29	-1.15	-0.72	-0.84
	50th Percentile (Median)	-0.30	0.08	-0.02	-0.93	-0.24	-0.56	-0.40	0.07	-0.16
	75th Percentile	0.54	0.78	0.65	-0.37	0.30	0.01	0.47	0.76	0.65
	Maximum Observed	1.67	1.55	1.67	0.57	1.10	1.10	1.67	1.55	1.67

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 50-59		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	56	76	132	15	22	37	71	98	169
	Mean	-0.93	-0.42	-0.70	-0.43	-0.76	-0.59	-0.89	-0.44	-0.69
	Standard Deviation	1.70	1.75	1.81	0.76	0.80	0.80	1.57	1.59	1.64
	Minimum Observed	-2.30	-2.20	-2.30	-1.14	-1.92	-1.92	-2.30	-2.20	-2.30
	25th Percentile	-1.40	-1.12	-1.30	-1.01	-1.31	-1.05	-1.38	-1.12	-1.30
	50th Percentile (Median)	-1.12	-0.42	-0.87	-0.51	-0.73	-0.61	-1.11	-0.43	-0.86
	75th Percentile	-0.52	0.13	-0.13	0.14	-0.47	-0.12	-0.48	0.13	-0.12
	Maximum Observed	0.67	1.55	1.55	0.76	0.74	0.76	0.76	1.55	1.55

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 60-69		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	45	64	109	8	13	21	53	77	130
	Mean	-1.00	-0.82	-0.92	-1.54	-0.91	-1.24	-1.03	-0.83	-0.93
	Standard Deviation	1.35	1.12	1.23	0.81	0.67	0.78	1.30	1.06	1.17
	Minimum Observed	-1.91	-2.07	-2.07	-2.37	-2.79	-2.79	-2.37	-2.79	-2.79
	25th Percentile	-1.54	-1.22	-1.54	-2.13	-1.38	-1.87	-1.54	-1.22	-1.54
	50th Percentile (Median)	-1.22	-0.88	-0.97	-1.54	-0.82	-1.22	-1.22	-0.88	-0.97
	75th Percentile	-0.56	-0.36	-0.56	-1.22	-0.30	-0.73	-0.56	-0.36	-0.56
	Maximum Observed	0.09	0.60	0.60	-0.14	0.06	0.06	0.09	0.60	0.60

Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – Age 70-85		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	73	80	153	6	8	14	79	88	167
	Mean	-1.40	-1.04	-1.25	-1.28	-1.09	-1.18	-1.40	-1.04	-1.25
	Standard Deviation	1.08	0.96	1.04	0.33	0.47	0.41	1.04	0.93	1.00
	Minimum Observed	-2.79	-3.12	-3.12	-2.12	-2.34	-2.34	-2.79	-3.12	-3.12
	25th Percentile	-1.87	-1.71	-1.87	-1.54	-1.52	-1.52	-1.87	-1.71	-1.87
	50th Percentile (Median)	-1.22	-1.05	-1.22	-1.23	-1.22	-1.22	-1.22	-1.05	-1.22
	75th Percentile	-0.72	-0.41	-0.68	-0.97	-0.68	-0.82	-0.72	-0.41	-0.68
	Maximum Observed	0.00	0.09	0.09	-0.73	0.09	0.09	0.00	0.09	0.09

<b>Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – NCS Sample of Mothers</b>		<b>English</b>	<b>Spanish</b>	<b>All</b>
	N	77	34	111
	Mean	0.12	-0.15	0.04
	Standard Deviation	0.87	0.89	0.88
	Minimum Observed	-1.82	-2.23	-2.23
	25th Percentile	-0.48	-0.70	-0.65
	50th Percentile (Median)	0.15	-0.12	0.00
	75th Percentile	0.78	0.54	0.76
	Maximum Observed	1.55	1.46	1.55

<b>Table 2. NIH Toolbox Picture Sequence Memory Test (theta) – NCS Sample of Pregnant Women</b>		<b>English</b>	<b>Spanish</b>	<b>All</b>
	N	80	40	120
	Mean	0.23	0.05	0.17
	Standard Deviation	0.80	0.90	0.84
	Minimum Observed	-1.80	-1.95	-1.95
	25th Percentile	-0.28	-0.44	-0.40
	50th Percentile (Median)	0.41	0.14	0.21
	75th Percentile	0.77	0.65	0.74
	Maximum Observed	1.67	1.67	1.67

Figure 1  
Least Squares Means

