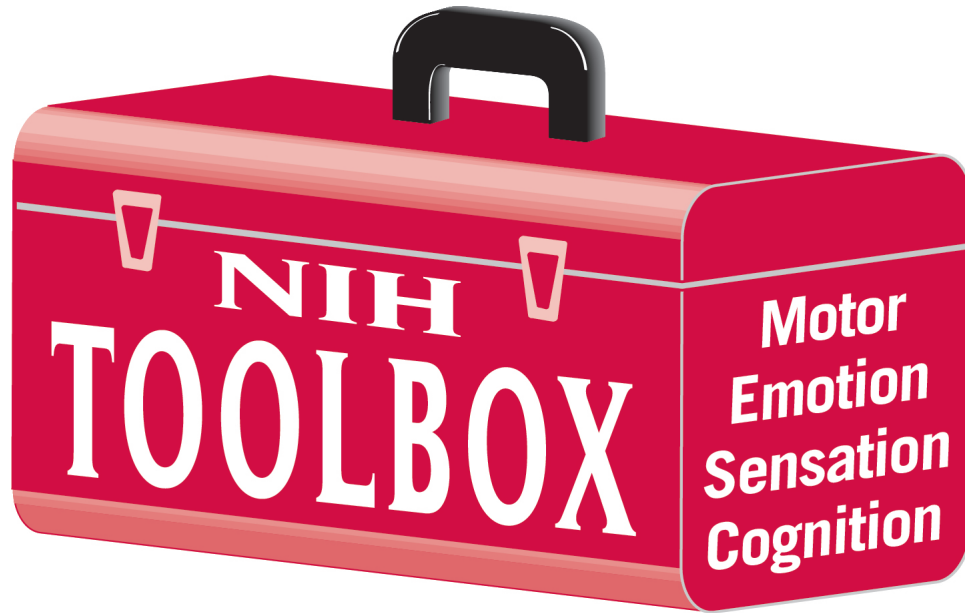# NIH Toolbox

Technical Manual

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NIH Toolbox Technical Manual

Domain:

COGNITION

Subdomain:

EXECUTIVE FUNCTION

Measure:

NIH Toolbox Dimensional Change Card Sort Test

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National Institute on Deafness and Other Communication Disorders (NIDCD)

National Institute on Drug Abuse (NIDA)

Office of Behavioral and Social Sciences Research (OBSSR)

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

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

the Measure

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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: EXECUTIVE FUNCTION

Executive Function is the capacity to plan, organize, and monitor the execution of behaviors

that are strategically directed in a goal-oriented manner. NIH Toolbox focuses on set shifting

(i.e., the capacity for switching among multiple aspects of a strategy or task) and the inhibition

of automatic response tendencies that may interfere with achieving a goal. In NIH Toolbox,

Executive Function is measured by:

NIH Toolbox Flanker Inhibitory Control and Attention Test

NIH Toolbox Dimensional Change Card Sort Test

Section 7:   Measure Description

COGNITION Core Measure

The NIH Toolbox Dimensional Change Card Sort Test (DCCS) is a measure of cognitive flexibility.

Two target pictures are presented that vary along two dimensions (e.g., shape and color).

Participants are asked to match a series of bivalent test pictures (e.g., yellow balls and blue

trucks) to the target pictures, first according to one dimension (e.g., color) and then, after a

number of trials, according to the other dimension (e.g., shape). "Switch" trials are also

employed, in which the participant must change the dimension being matched. For example,

after four straight trials matching on shape, the participant may be asked to match on color on the next trial and then go back to shape, thus requiring the cognitive flexibility to quickly choose the correct stimulus. This test takes approximately four minutes to administer and is recommended for ages 3-85.

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

No notable Post-Validation/Post-Norming changes were made to the measure subsequent 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).

Section 9:   The Measure's Scoring Model

Measurement theory applied for scoring:

　　Classical Test Theory (CTT)

CTT scoring approach employed:

　　Sum (Accuracy Score + Reaction Time Score)

Accuracy Score = 0.125 * Number of Correct Responses

40 possible accuracy points (Pre-Switch (before changing to the other dimension): 5 Points, Post-Switch: 5 Points, Mixed Trials: 30 Points). Individuals age 8 and up automatically receive 10 accuracy points for the Pre-Switch and Post-Switch trials (i.e., age 8 and up typically score at the ceiling on these trials).

Reaction Time (RT) Score = $5 - \left(5 * \left[\dfrac{\log RT - \log(500)}{\log(3000) - \log(500)} \right] \right)$

Task-specific reaction time scores = individual's non-dominant dimension median reaction time (using only correct trials with reaction times >= 100ms and <= three standard deviations from the individual's mean per respective trial type). A log (Base 10) transformation is applied to the median reaction time score to create a more normal score distribution. Minimum reaction time is 500ms; maximum reaction time is 3,000ms. Individuals whose median reaction times fall outside of this range but within the allowable range of 100ms – 10,000ms are truncated (i.e., reaction times between 3,000ms and 10,000ms are set equal to 3,000ms).

If accuracy levels are <= 80%, the final "total" computed score = the accuracy score. If accuracy levels are > 80%, reaction time score and accuracy score are combined.

Measure length:

Fixed

Response data:

Dichotomous (accuracy); Continuous (reaction time)

Scores computed/available*:

Computed Accuracy + Reaction Time Score (range 0 to 10)

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, 25th/50th/75th 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 Dimensional Change Card Sort Test by Age Group	Dimensional Change Card Sort Test (0-10)			DCCS Unadjusted Scale Score			DCCS Fully Adjusted Scale Score		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Age Group									
3	122	1.53	0.90	122	73.31	5.19	108	97.16	11.09
4	211	2.22	0.97	211	77.83	4.15	196	99.20	10.96
5	218	3.53	1.26	218	82.30	4.39	195	101.77	12.71
6	218	4.83	1.27	218	86.61	4.34	196	102.50	11.53
7	253	4.84	1.28	253	87.33	4.33	228	103.39	12.12
8	213	6.67	0.59	213	93.92	3.09	204	98.50	6.65
9	222	7.08	0.52	222	96.94	3.77	208	97.99	5.96
10	235	7.18	0.62	235	98.47	4.20	217	98.74	6.52
11	223	7.65	0.57	223	102.90	5.24	210	98.45	6.44
12	220	7.77	0.68	220	104.80	5.48	210	98.89	7.01
13	223	8.04	0.63	223	107.80	5.68	215	98.55	6.93
14	235	8.24	0.50	235	109.75	5.38	227	97.62	5.74
15	224	8.36	0.62	224	111.99	6.46	217	97.92	6.85
16	216	8.61	0.52	216	115.00	6.58	206	97.90	6.19
17	224	8.69	0.51	224	116.16	6.77	216	97.87	6.39
18 - 29	266	8.59	1.86	266	115.10	21.59	257	97.86	19.42
30 - 39	309	8.32	1.49	309	111.19	15.92	294	97.79	15.82
40 - 49	254	8.06	2.24	254	108.83	18.63	238	98.78	19.99
50 - 59	190	7.71	2.14	190	103.83	17.81	174	98.11	20.42
60 - 69	165	7.38	2.42	165	101.14	16.62	153	98.77	21.47
70 - 85	246	6.43	2.08	246	94.42	10.46	215	100.20	19.05
All	4687	7.63	1.81	4687	105.57	13.66	4384	98.56	12.69

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 3	English			Spanish			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	All
N	26	34	60	36	26	62	62	60	122
Mean	1.50	1.72	1.61	1.30	1.28	1.29	1.43	1.64	1.53
Standard Deviation	1.08	1.20	1.14	0.66	0.43	0.57	0.85	0.95	0.90
Minimum Observed	0.00	0.00	0.00	0.13	0.13	0.13	0.00	0.00	0.00
25th Percentile	0.50	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
50th Percentile (Median)	1.00	0.75	1.00	0.63	0.75	0.75	0.88	0.75	0.75
75th Percentile	2.50	3.50	2.75	1.00	1.75	1.25	2.13	2.88	2.50
Maximum Observed	4.63	6.38	6.38	6.11	4.50	6.11	6.11	6.38	6.38

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 4	English			Spanish			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	All
N	59	61	120	42	49	91	101	110	211
Mean	2.19	2.37	2.27	1.83	2.23	2.01	2.13	2.35	2.22
Standard Deviation	1.22	1.15	1.18	0.59	0.55	0.57	1.01	0.93	0.97
Minimum Observed	0.25	0.00	0.00	0.13	0.13	0.13	0.13	0.00	0.00
25th Percentile	0.75	0.75	0.75	0.63	0.75	0.63	0.75	0.75	0.75
50th Percentile (Median)	1.00	1.00	1.00	1.00	2.13	1.00	1.00	1.00	1.00
75th Percentile	4.00	4.25	4.00	2.75	3.25	3.13	3.63	3.88	3.75
Maximum Observed	5.57	7.08	7.08	7.51	9.13	9.13	7.51	9.13	9.13

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 5		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	63	64	127	44	47	91	107	111	218
	Mean	3.36	3.95	3.60	3.35	2.98	3.20	3.36	3.78	3.53
	Standard Deviation	1.65	1.29	1.48	0.96	0.77	0.87	1.40	1.11	1.26
	Minimum Observed	0.25	0.13	0.13	0.38	0.25	0.25	0.25	0.13	0.13
	25th Percentile	1.00	2.13	1.00	1.00	0.88	0.88	1.00	1.00	1.00
	50th Percentile (Median)	3.88	4.00	3.88	3.50	2.13	3.38	3.88	4.00	3.88
	75th Percentile	5.39	5.92	5.73	5.46	5.00	5.00	5.39	5.92	5.66
	Maximum Observed	6.65	7.28	7.28	9.13	9.13	9.13	9.13	9.13	9.13

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 6		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	63	61	124	42	52	94	105	113	218
	Mean	4.82	5.27	5.00	3.94	4.28	4.09	4.67	5.07	4.83
	Standard Deviation	1.68	1.29	1.50	0.92	0.78	0.84	1.43	1.10	1.27
	Minimum Observed	0.38	0.00	0.00	0.63	0.63	0.63	0.38	0.00	0.00
	25th Percentile	3.13	4.94	4.00	2.00	1.00	1.00	3.00	4.00	3.38
	50th Percentile (Median)	5.77	6.02	5.83	3.63	5.57	3.88	5.59	5.86	5.79
	75th Percentile	6.56	6.49	6.51	6.29	6.25	6.27	6.49	6.49	6.49
	Maximum Observed	7.76	9.13	9.13	7.38	7.21	7.38	7.76	9.13	9.13

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 7	English			Spanish			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	All
N	83	79	162	45	46	91	128	125	253
Mean	4.46	5.39	4.81	4.98	5.12	5.04	4.53	5.35	4.84
Standard Deviation	1.76	1.09	1.49	0.90	0.67	0.78	1.51	0.95	1.28
Minimum Observed	0.38	0.88	0.38	0.38	0.25	0.25	0.38	0.25	0.25
25th Percentile	1.00	4.75	2.13	3.13	4.00	3.63	1.00	4.75	2.13
50th Percentile (Median)	5.76	6.00	5.86	6.27	6.07	6.11	5.82	6.00	5.92
75th Percentile	6.72	6.88	6.75	6.73	6.81	6.73	6.72	6.82	6.75
Maximum Observed	8.50	8.18	8.50	7.76	7.69	7.76	8.50	8.18	8.50

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 8	English			Spanish			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	All
N	109	104	213	0	0	0	109	104	213
Mean	6.57	6.81	6.67				6.57	6.81	6.67
Standard Deviation	0.67	0.48	0.59				0.67	0.48	0.59
Minimum Observed	2.13	2.13	2.13				2.13	2.13	2.13
25th Percentile	6.29	6.46	6.37				6.29	6.46	6.37
50th Percentile (Median)	6.79	6.96	6.87				6.79	6.96	6.87
75th Percentile	7.20	7.41	7.35				7.20	7.41	7.35
Maximum Observed	8.35	8.37	8.37				8.35	8.37	8.37

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 9	English			Spanish			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	All
N	110	112	222	0	0	0	110	112	222
Mean	7.08	7.08	7.08				7.08	7.08	7.08
Standard Deviation	0.59	0.43	0.52				0.59	0.43	0.52
Minimum Observed	2.63	3.50	2.63				2.63	3.50	2.63
25th Percentile	6.71	6.60	6.65				6.71	6.60	6.65
50th Percentile (Median)	7.22	7.16	7.20				7.22	7.16	7.20
75th Percentile	7.66	7.62	7.66				7.66	7.62	7.66
Maximum Observed	9.35	8.82	9.35				9.35	8.82	9.35

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 10	English			Spanish			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	All
N	118	117	235	0	0	0	118	117	235
Mean	7.04	7.41	7.18				7.04	7.41	7.18
Standard Deviation	0.76	0.40	0.62				0.76	0.40	0.62
Minimum Observed	2.13	4.00	2.13				2.13	4.00	2.13
25th Percentile	6.79	7.05	6.85				6.79	7.05	6.85
50th Percentile (Median)	7.36	7.35	7.36				7.36	7.35	7.36
75th Percentile	7.82	7.92	7.85				7.82	7.92	7.85
Maximum Observed	8.86	9.46	9.46				8.86	9.46	9.46

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – 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	7.60	7.72	7.65				7.60	7.72	7.65
Standard Deviation	0.64	0.49	0.57				0.64	0.49	0.57
Minimum Observed	3.25	4.00	3.25				3.25	4.00	3.25
25th Percentile	7.15	7.30	7.26				7.15	7.30	7.26
50th Percentile (Median)	7.79	7.75	7.76				7.79	7.75	7.76
75th Percentile	8.19	8.21	8.21				8.19	8.21	8.21
Maximum Observed	9.75	9.88	9.88				9.75	9.88	9.88

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – 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	7.61	7.97	7.77				7.61	7.97	7.77
Standard Deviation	0.87	0.45	0.68				0.87	0.45	0.68
Minimum Observed	2.13	3.38	2.13				2.13	3.38	2.13
25th Percentile	7.26	7.64	7.40				7.26	7.64	7.40
50th Percentile (Median)	7.86	8.07	7.98				7.86	8.07	7.98
75th Percentile	8.39	8.41	8.41				8.39	8.41	8.41
Maximum Observed	9.75	9.51	9.75				9.75	9.51	9.75

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 13	English			Spanish			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	All
N	118	105	223	0	0	0	118	105	223
Mean	8.04	8.05	8.04				8.04	8.05	8.04
Standard Deviation	0.67	0.59	0.63				0.67	0.59	0.63
Minimum Observed	2.50	2.13	2.13				2.50	2.13	2.13
25th Percentile	7.65	7.73	7.69				7.65	7.73	7.69
50th Percentile (Median)	8.04	8.21	8.11				8.04	8.21	8.11
75th Percentile	8.63	8.72	8.66				8.63	8.72	8.66
Maximum Observed	9.75	9.88	9.88				9.75	9.88	9.88

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 14	English			Spanish			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	All
N	114	121	235	0	0	0	114	121	235
Mean	8.21	8.28	8.24				8.21	8.28	8.24
Standard Deviation	0.51	0.50	0.50				0.51	0.50	0.50
Minimum Observed	3.63	2.50	2.50				3.63	2.50	2.50
25th Percentile	7.79	7.89	7.83				7.79	7.89	7.83
50th Percentile (Median)	8.31	8.31	8.31				8.31	8.31	8.31
75th Percentile	8.64	8.81	8.71				8.64	8.81	8.71
Maximum Observed	9.90	9.88	9.90				9.90	9.88	9.90

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – 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	8.39	8.31	8.36				8.39	8.31	8.36
	Standard Deviation	0.59	0.66	0.62				0.59	0.66	0.62
	Minimum Observed	2.50	2.13	2.13				2.50	2.13	2.13
	25th Percentile	8.01	7.96	7.97				8.01	7.96	7.97
	50th Percentile (Median)	8.42	8.45	8.43				8.42	8.45	8.43
	75th Percentile	8.81	9.00	8.90				8.81	9.00	8.90
	Maximum Observed	10.00	10.00	10.00				10.00	10.00	10.00

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 16		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	108	108	216	0	0	0	108	108	216
	Mean	8.67	8.53	8.61				8.67	8.53	8.61
	Standard Deviation	0.55	0.48	0.52				0.55	0.48	0.52
	Minimum Observed	3.88	2.63	2.63				3.88	2.63	2.63
	25th Percentile	8.15	8.13	8.14				8.15	8.13	8.14
	50th Percentile (Median)	8.76	8.65	8.69				8.76	8.65	8.69
	75th Percentile	9.26	9.07	9.15				9.26	9.07	9.15
	Maximum Observed	10.00	9.89	10.00				10.00	9.89	10.00

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 17		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	111	113	224	0	0	0	111	113	224
	Mean	8.68	8.72	8.69				8.68	8.72	8.69
	Standard Deviation	0.62	0.37	0.51				0.62	0.37	0.51
	Minimum Observed	2.13	5.18	2.13				2.13	5.18	2.13
	25th Percentile	8.10	8.19	8.16				8.10	8.19	8.16
	50th Percentile (Median)	8.76	8.69	8.72				8.76	8.69	8.72
	75th Percentile	9.37	9.28	9.35				9.37	9.28	9.35
	Maximum Observed	10.00	10.00	10.00				10.00	10.00	10.00

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 18-29		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	60	113	173	21	72	93	81	185	266
	Mean	8.95	8.50	8.71	8.22	7.59	7.79	8.88	8.35	8.59
	Standard Deviation	1.61	1.81	1.80	1.01	1.85	1.72	1.55	1.90	1.86
	Minimum Observed	7.59	3.13	3.13	6.55	2.13	2.13	6.55	2.13	2.13
	25th Percentile	8.49	8.08	8.31	7.71	7.46	7.60	8.32	7.89	8.10
	50th Percentile (Median)	8.95	8.61	8.76	8.26	8.02	8.13	8.93	8.55	8.67
	75th Percentile	9.48	9.02	9.30	8.53	8.54	8.53	9.44	8.96	9.21
	Maximum Observed	10.00	10.00	10.00	9.86	9.78	9.86	10.00	10.00	10.00

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 30-39		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	55	157	212	21	76	97	76	233	309
	Mean	8.45	8.43	8.44	7.92	7.24	7.45	8.40	8.28	8.32
	Standard Deviation	1.94	0.95	1.28	2.13	1.51	1.67	2.00	1.28	1.49
	Minimum Observed	2.50	6.69	2.50	2.13	2.13	2.13	2.13	2.13	2.13
	25th Percentile	7.93	8.04	8.04	7.58	7.01	7.18	7.93	7.95	7.94
	50th Percentile (Median)	8.54	8.46	8.47	8.38	7.76	7.90	8.54	8.39	8.41
	75th Percentile	9.05	8.81	8.86	9.01	8.24	8.38	9.05	8.77	8.84
	Maximum Observed	10.00	10.00	10.00	9.75	9.51	9.75	10.00	10.00	10.00

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – 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	8.13	8.24	8.20	6.58	7.25	6.90	7.94	8.16	8.06
	Standard Deviation	2.93	1.57	2.13	2.77	1.65	2.19	3.02	1.65	2.24
	Minimum Observed	2.25	2.13	2.13	2.13	2.00	2.00	2.13	2.00	2.00
	25th Percentile	7.73	7.95	7.91	6.05	6.93	6.59	7.63	7.90	7.79
	50th Percentile (Median)	8.41	8.28	8.36	7.60	7.74	7.61	8.36	8.22	8.32
	75th Percentile	8.87	8.75	8.76	8.49	8.32	8.38	8.75	8.73	8.73
	Maximum Observed	9.84	10.00	10.00	8.75	9.34	9.34	9.84	10.00	10.00

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 50-59	English			Spanish			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	All
N	56	85	141	23	26	49	79	111	190
Mean	7.79	7.74	7.76	7.40	6.88	7.18	7.75	7.67	7.71
Standard Deviation	2.79	1.82	2.25	1.99	1.36	1.69	2.58	1.76	2.14
Minimum Observed	2.13	3.75	2.13	2.13	2.13	2.13	2.13	2.13	2.13
25th Percentile	7.54	7.44	7.46	6.98	6.67	6.95	7.41	7.27	7.34
50th Percentile (Median)	7.96	7.86	7.90	7.56	7.08	7.41	7.96	7.85	7.89
75th Percentile	8.53	8.30	8.35	7.99	7.76	7.96	8.53	8.27	8.35
Maximum Observed	9.19	9.56	9.56	9.57	8.56	9.57	9.57	9.56	9.57

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 60-69	English			Spanish			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	All
N	49	71	120	20	25	45	69	96	165
Mean	7.55	7.56	7.56	6.03	4.87	5.53	7.40	7.35	7.38
Standard Deviation	2.52	1.90	2.16	2.65	2.01	2.35	2.68	2.23	2.42
Minimum Observed	2.00	2.13	2.00	2.13	2.13	2.13	2.00	2.13	2.00
25th Percentile	7.32	7.13	7.28	3.25	2.88	3.00	7.09	7.01	7.07
50th Percentile (Median)	7.62	7.68	7.68	6.59	3.88	6.27	7.62	7.58	7.62
75th Percentile	8.06	8.21	8.06	7.96	7.18	7.62	8.06	8.13	8.06
Maximum Observed	9.71	9.56	9.71	9.13	8.98	9.13	9.71	9.56	9.71

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – Age 70-85		English			Spanish			Total		
		Males	Females	Total	Males	Females	Total	Males	Females	All
	N	98	106	204	24	18	42	122	124	246
	Mean	6.49	6.61	6.54	4.32	4.37	4.33	6.37	6.52	6.43
	Standard Deviation	2.51	1.67	2.11	1.33	1.32	1.31	2.42	1.70	2.08
	Minimum Observed	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13
	25th Percentile	5.86	6.34	6.14	2.38	2.50	2.38	5.69	6.21	5.95
	50th Percentile (Median)	7.03	6.87	6.95	4.00	3.38	3.88	6.95	6.84	6.87
	75th Percentile	7.70	7.51	7.61	6.19	6.67	6.19	7.66	7.50	7.60
	Maximum Observed	9.13	8.91	9.13	7.92	9.13	9.13	9.13	9.13	9.13

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – NCS Sample of Mothers	English	Spanish	All
N	80	34	114
Mean	8.31	7.51	8.07
Standard Deviation	0.89	1.37	1.12
Minimum Observed	2.13	2.13	2.13
25th Percentile	7.97	7.01	7.80
50th Percentile (Median)	8.43	7.79	8.18
75th Percentile	8.76	8.19	8.72
Maximum Observed	9.65	9.51	9.65

Table 2. NIH Toolbox Dimensional Change Card Sort Test (0-10) – NCS Sample of Pregnant Women	English	Spanish	All
N	82	44	126
Mean	8.39	7.45	8.06
Standard Deviation	0.78	1.71	1.27
Minimum Observed	3.13	2.13	2.13
25th Percentile	8.08	7.46	7.77
50th Percentile (Median)	8.46	7.74	8.27
75th Percentile	8.73	8.34	8.68
Maximum Observed	9.64	9.78	9.78

Figure 1
Least Squares Means