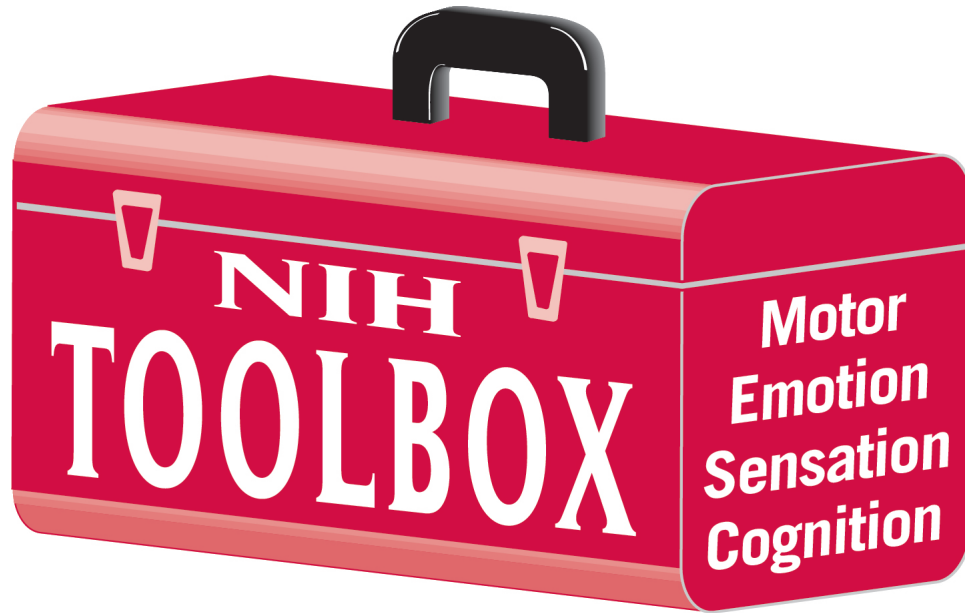


NIH Toolbox



Technical Manual

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September 27, 2012

NIH Toolbox Technical Manual

Domain:

SENSATION

Subdomain:

AUDITION

Measure:

NIH Toolbox Hearing Handicap Inventory

(Supplemental Measure)

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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 project is funded in whole or in part with Federal funds from the Blueprint for Neuroscience Research and the Office of Behavioral and Social Sciences Research, National Institutes of Health, under Contract No. HHS-N-260-2006-00007-C, with additional support from the National Children's Study, under Contract No. HHS-N-267-2007-00027-C.

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-Adults

Section 11: Measure Norms-Elderly

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 Sensation 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 Sensation domain measure validation, see: Coldwell et al., Gustation Assessment Using the NIH Toolbox, *Neurology*, in press; Cook et al., Pain Assessment Using the NIH Toolbox, *Neurology*, in press; Dalton et al., Olfaction Assessment using the NIH Toolbox, *Neurology*, in press; Dunn et al., Somatosensation Assessment Using the NIH Toolbox, *Neurology*, in press; Paz et al., Development of a Vision-Targeted Health-Related Quality of Life Item Bank, *manuscript submitted for publication*; Rine et al., Vestibular Function Assessment Using the NIH Toolbox, *Neurology*, in press; Varma et al., Vision Assessment Using the NIH Toolbox, *Neurology*, in press; Zecker et al., Audition Assessment Using the NIH Toolbox, *Neurology*, in press. These manuscripts describe 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: SENSATION

Sensation refers to the biochemical and neurologic process of detecting incoming nerve impulses as nervous system activity. Sensory processes are vital to one's level of independence, in relationships with others, in academic and occupational endeavors, and for activities of daily living. Objective measures of Sensation can systematically examine and determine if participants have intact sensory functioning. There is also fundamental overlap of certain sensory processes with cognitive and motor functioning. Measurement of sensory health and function is important to epidemiologic and longitudinal studies whether or not Sensation is the primary focus of the study. Given the changes in sensory functioning across the lifespan, there is value in characterizing age-related sensory improvement and decline. The Sensation domain includes measures of:

AUDITION

Measured by:

NIH Toolbox Words-in-Noise Test

NIH Toolbox Hearing Threshold Test (Supplemental Measure)

NIH Toolbox Hearing Handicap Inventory (Supplemental Measure)

OLFACTION

Measured by:

NIH Toolbox Odor Identification Test

PAIN

Measured by:

NIH Toolbox Pain Intensity Survey

NIH Toolbox Pain Interference Survey

TASTE

Measured by:

NIH Toolbox Taste Intensity Test

VESTIBULAR

Measured by:

NIH Toolbox Dynamic Visual Acuity Test

NIH Toolbox Standing Balance Test (contained within the NIH Toolbox Motor battery)

VISION

Measured by:

NIH Toolbox Visual Acuity Test

NIH Toolbox Vision-Related Quality of Life Survey (Supplemental Measure)

SENSATION Batteries

The NIH Toolbox Sensation Battery for ages 3-5 includes Visual Acuity, Dynamic Visual Acuity, and Odor Identification tests. For ages 6-11, the Words-in-Noise Test is added to the battery. For ages 12-17, the Taste Intensity Test is included with the other four; and for ages 18-85, the two Pain surveys are added. There are individual scores provided for each measure, as described below, but no composite scores.

Section 6: Subdomain Definition

Subdomain: AUDITION

Audition involves both the physical processing of acoustic signals (e.g., intensity and frequency) and a determination of their psychological percepts (e.g., loudness and pitch). In the process of hearing, people detect, discriminate, and localize a wide variety of stimuli, including linguistic sounds (e.g., speech syllables, words, sentences), and non-linguistic sounds (e.g., clicks, tones, music). The NIH Toolbox includes an assessment of the ability to understand speech in a noisy

background, because a substantial portion of communication in the real world occurs in less-than-ideal environments. In NIH Toolbox, Audition is measured by:

NIH Toolbox Words-in-Noise Test

NIH Toolbox Hearing Threshold Test (Supplemental Measure)

NIH Toolbox Hearing Handicap Inventory (Supplemental Measure)

Section 7: Measure Description

AUDITION Supplemental Measure

The NIH Toolbox Hearing Handicap Inventory is the screening version of the Hearing Handicap Inventory; there are different versions for adults (ages 18-64) and the elderly (ages 65+). Both versions are 10-item self-report measures of hearing-related disability that have been widely used in hearing research. Each of the 10 items has three response options, indicating level of self-reported problem with hearing. This survey can be used with participants age 18 and older; it takes approximately three minutes to administer.

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

No notable Post-Validation/Post-Norming changes were made to the measure subsequent to what has been previously reported (Zecker et al., Audition 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

Measure length:

Fixed (10 items)

Response data:

Ordinal (3-point response option set: 0, 2, 4; higher score = greater self-reported problem)

Scores computed/available*:

Sum (range 0 to 40)

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

Section 10: Measure Norms-Adults

The following Table presents NIH Toolbox normative data associated with this measure:

Table 1. Measure Raw/Computed Score Statistics (N, Mean, Standard Deviation, Minimum/Maximum Observed, 25th/50th/75th Percentile) per Age Group (18-29, 30-39, 40-49, 50-59, 60-64)

Table 1. NIH Toolbox Hearing Handicap Inventory - HHIA (raw score) – Age 18-29		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	19	33	52	6	12	18	25	45	70
	Mean	0.95	2.09	1.53	0.00	1.29	0.78	0.87	2.00	1.46
	Standard Deviation	6.49	10.32	9.12	0.00	3.48	2.90	5.65	8.99	7.98
	Minimum Observed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	25th Percentile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	50th Percentile (Median)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	75th Percentile	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00
	Maximum Observed	14.00	22.00	22.00	0.00	10.00	10.00	14.00	22.00	22.00

Table 1. NIH Toolbox Hearing Handicap Inventory - HHIA (raw score) – Age 30-39		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	16	49	65	7	10	17	23	59	82
	Mean	1.15	0.75	0.88	0.00	0.21	0.10	1.02	0.72	0.82
	Standard Deviation	9.71	5.48	6.69	0.00	0.56	0.43	8.04	4.99	5.95
	Minimum Observed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	25th Percentile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	50th Percentile (Median)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	75th Percentile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Maximum Observed	26.00	20.00	26.00	0.00	2.00	2.00	26.00	20.00	26.00

Table 1. NIH Toolbox Hearing Handicap Inventory - HHIA (raw score) – Age 40-49		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	21	41	62	4	3	7	25	44	69
	Mean	2.57	3.23	2.97	3.81	4.42	4.03	2.64	3.25	3.00
	Standard Deviation	7.71	16.45	14.05	6.96	6.66	6.26	7.47	15.93	13.44
	Minimum Observed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	25th Percentile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	50th Percentile (Median)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	75th Percentile	4.00	0.00	2.00	12.00	12.00	12.00	4.00	0.00	2.00
	Maximum Observed	10.00	40.00	40.00	12.00	12.00	12.00	12.00	40.00	40.00

Table 1. NIH Toolbox Hearing Handicap Inventory - HHIA (raw score) – Age 50-59		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	18	23	41	4	3	7	22	26	48
	Mean	3.46	4.63	3.96	4.78	8.10	5.78	3.54	4.76	4.05
	Standard Deviation	16.10	17.28	16.61	8.96	6.90	7.75	14.90	16.37	15.60
	Minimum Observed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	25th Percentile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	50th Percentile (Median)	0.00	0.00	0.00	0.00	8.00	6.00	0.00	0.00	0.00
	75th Percentile	2.00	4.00	4.00	6.00	14.00	14.00	2.00	4.00	4.00
	Maximum Observed	26.00	32.00	32.00	14.00	14.00	14.00	26.00	32.00	32.00

Table 1. NIH Toolbox Hearing Handicap Inventory - HHIA (raw score) – Age 60-64		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	6	17	23	1	0	1	7	17	24
	Mean	6.86	2.65	4.04	0.00		0.00	6.47	2.65	3.96
	Standard Deviation	20.66	9.33	13.22				19.18	9.33	12.97
	Minimum Observed	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	25th Percentile	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	50th Percentile (Median)	2.00	0.00	0.00	0.00		0.00	2.00	0.00	0.00
	75th Percentile	10.00	4.00	4.00	0.00		0.00	10.00	4.00	4.00
	Maximum Observed	24.00	18.00	24.00	0.00		0.00	24.00	18.00	24.00

Section 11: Measure Norms-Elderly

The following Table presents NIH Toolbox normative data associated with this measure:

Table 1. Measure Raw/Computed Score Statistics (N, Mean, Standard Deviation, Minimum/Maximum Observed, 25th/50th/75th Percentile) per Age Group (65-69, 70-85)

Table 1. NIH Toolbox Hearing Handicap Inventory - HHIE (raw score) – Age 65-69		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	8	5	13	1	2	3	9	7	16
	Mean	6.00	10.61	7.04	20.00	0.00	7.28	6.33	9.27	7.05
	Standard Deviation	15.85	16.73	16.00		0.00	11.18	15.60	14.65	14.88
	Minimum Observed	0.00	0.00	0.00	20.00	0.00	0.00	0.00	0.00	0.00
	25th Percentile	2.00	4.00	2.00	20.00	0.00	0.00	2.00	0.00	0.00
	50th Percentile (Median)	4.00	10.00	4.00	20.00	0.00	0.00	4.00	4.00	4.00
	75th Percentile	8.00	24.00	8.00	20.00	0.00	20.00	8.00	24.00	8.00
	Maximum Observed	22.00	24.00	24.00	20.00	0.00	20.00	22.00	24.00	24.00

Table 1. NIH Toolbox Hearing Handicap Inventory - HHIE (raw score) – Age 70-85		English			Spanish			Total		All
		Males	Females	Total	Males	Females	Total	Males	Females	
	N	37	36	73	1	2	3	38	38	76
	Mean	11.26	7.67	9.85	2.00	4.98	3.89	11.20	7.63	9.80
	Standard Deviation	17.37	11.75	14.96		3.46	2.69	17.17	11.44	14.68
	Minimum Observed	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00
	25th Percentile	2.00	0.00	0.00	2.00	0.00	2.00	2.00	0.00	0.00
	50th Percentile (Median)	6.00	4.00	6.00	2.00	8.00	2.00	6.00	4.00	6.00
	75th Percentile	18.00	12.00	16.00	2.00	8.00	8.00	18.00	10.00	16.00
	Maximum Observed	38.00	34.00	38.00	2.00	8.00	8.00	38.00	34.00	38.00