INTRODUCTION TO THE NIH TOOLBOX FOR THE ASSESSMENT OF NEUROLOGICAL AND BEHAVIORAL FUNCTION

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For more information, please visit www.nihtoolbox.org
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Disclosures

- I am primarily funded by numerous NIH and Department of Defense grants and contracts.
- I also do minor consulting work for several surgery boards, and educational service providers.
NIH Blueprint for Neuroscience Research

- Coordinate research efforts across Institutes
- Reduce duplication of effort
- Produce efficiencies of scale
- Create new cross-Institute avenues of discovery and translation
NIH Toolbox Goals

- Develop unified/integrated measures (assessment tool) of multiple indicators (cognitive, emotional, motor, sensory) of neural and behavioral health functioning for use in large cohort studies and clinical trials.
- Could be used as a form of “common currency” across diverse study designs and populations.
- Would maximize yield from large, expensive studies with minimal increment in subject burden and cost.
Working Teams

- Domains
  - Instrument Development
- NIH Project Team
- Epidemiology/Biostatistics
- Technology
- Spanish Language
- Multi-Cultural
- Pediatric
- Geriatric
By the numbers

80 Institutions
256 Scientists & Staff
20,000 Subjects
Four 30-minute domain-level batteries
(English and Spanish)
Fully normed for ages 3-85
108 Instruments in total
Including 34 Supplemental Instruments
Selection Criteria

- Applicable across the age span
- No intellectual property concerns
- Psychometrically sound
- Brief, easy to use
- Cover the full range of a trait
  - No Floor Effect
  - No Ceiling Effect
- Available for use across the age span
More on the issue

- Legacy measures can fail to identify treatment success, nor do they typically accurately assess anyone above the mean!
Free access/use of content: ROYALTY FREE!!!!

- But, revenue-neutral fees for technology
- “Open Access” for research, clinical use and education
- But, restricted where exposure would negate the value of the instruments (e.g. NIH Toolbox Cognition Battery)
or “CAT” is based on Item Response Theory

- For Dichotomous Items
  - Vocabulary
  - Reading
- For Rating Scale Items
  - Most of the health measures
What is CAT?

- Shorter
- Targeting
- Computerized Algorithm
Who uses CAT?
PASS!
Cognition Domain Framework

- Executive Function
- Attention
- Episodic Memory
- Language
- Processing Speed
- Working Memory
Task: Indicate the direction of a central target flanked by foils in the same (congruent) and opposite (incongruent) orientations

Scoring: Algorithm weighting accuracy and reaction time

Total time: 4 minutes
Language NIHTB Picture Vocabulary Test

Task: Point to/click on picture that shows meaning of the verbally presented word (picture-word matching)

Total time: 4 minutes

Spanish: Separate but parallel test was developed
Executive Function-Set Shifting
NIHTB Dimensional Change Card Sort Test (DCCS)

Task: Sort by color; sort by shape; shift according to instructions; 3 sets of trials – shape, color, mixed

Total time: 4 minutes

Validation Measures:
DKEFS Measures
WCST
NIHTB List Sorting Working Memory Test

Task: List sequentially presented test items in order of size (and within categories); establishes working memory span

Total time: 7 minutes

Validation Measures:
Wechsler Letter-Number Sequencing
PASAT
Episodic Memory
NIHTB Picture Sequence Memory Test

Task: Replicate spatial placement of a previously demonstrated sequence of pictures

Total time: 7 minutes

Validation Measures:
RAVLT Word List
Brief Visuospatial Memory Test-Rev
NEPSY Sentence Repetition
Task: The participant is asked to read words (or letters) as accurately as possible.

Total time: 3 minutes

Spanish: Separate but parallel test was developed

Validation Measure: Wide Range Achievement Test
Task: Decide as quickly as possible if two items are the same or not

Total trials: Single

Scoring: Total number of items correctly responded to in 90 seconds

Total time: 90 seconds

Validation Measure: Wechsler Processing Speed Index
Motor Domain Framework

- Dexterity
- Strength
- Balance
- Locomotion
- Endurance
Dexterity is a central component of hand function.
Balance allows people to orient their body in space and maintain an upright posture under a variety of conditions.
Sensation Domains

- Vision
- Olfaction
- Audition
- Vestibular
- Gustation
- Somatosensation
Audition (Hearing)
Words-In-Noise (WIN)

The ability to detect sound and use it functionally.

English version *(Wilson, 2003)* and

Spanish version *(McArdle et al, 2009)*

Hearing Threshold Test – Automated Audiometry for the NIH Toolbox (AANT)

Hearing Handicap Inventory for Adults/Elderly (HHIA/HHIE) *(Newman et al, 1990)*
Static Visual Acuity

**HOTV:** Children 3 to 6 years:

**ETDRS:** Ages 7 to 85 years:

Vision-Related Quality of Life (VRQOL)
4,859 subjects English and Spanish, ages 3-85
1-week retest (N=500)
Stratified random sampling from recruitment lists maintained at ten geographically diverse market research firms
- Single year age bands 3-17, 7 adult bands through 85
- Census balanced by age, race, ethnicity and education
- Separate English and Spanish samples
Since October 2012

500+ Studies Initiated

73 primary articles published

Cited in 579 articles
A common problem when using a variety of patient-reported outcome measures is the comparability of scales on which the outcomes are reported. Linking establishes relationships between scores on two different measures.

The PRO Rosetta Stone (PROsetta Stone®) developed and applied methods to PROMIS and other PCORR instruments with other related instruments (e.g., SF-36, Brief Pain Inventory, CES-D, MASQ, FACIT-Fatigue) to expand the range of PRO assessment options within a common, standardized metric. It provides equivalent scores for different scales that measure the same health outcome.
<table>
<thead>
<tr>
<th>PROMIS Anger</th>
<th>PROMIS Anger and BPAQ Linking Table</th>
<th>PROMIS Anger and BPAQ Full Report</th>
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<td>PROMIS Anger and BPAQ Full Report</td>
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<td>K6</td>
<td>PROMIS Anxiety and Neuro-QOL Anxiety Linking Table</td>
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<td>PROMIS Depression</td>
<td>PROMIS Depression and CES-D Linking Table</td>
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<td>PROMIS Depression and SF-36/Mental Health Linking Table</td>
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### Conversion Tables

Appendix Table 7: Raw Score to T-Score Conversion Table (IRT Fixed Parameter Calibration Linking) for CES-D to PROMIS Depression (PROMIS Study). RECOMMENDED

<table>
<thead>
<tr>
<th>CES-D Score</th>
<th>PROMIS Score</th>
<th>T-score</th>
<th>SE</th>
<th>CES-D Score</th>
<th>PROMIS Score</th>
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