Information About the Motor Tasks

Hopefully, this will help clear up any confusion about the variables.

Please note, no variables involving demographic information are included as these variables are not reliable due to errors in inputting some of the participants' demographical data.

9-Hole Pegboard Dexterity

Description: This simple test of manual dexterity records the time required for the participant to accurately place and remove nine plastic pegs into a plastic pegboard. The protocol includes one practice and one timed trial with each hand. Raw scores are recorded as time in seconds it takes the participant to complete the task with each hand (separate score for each). The test takes approximately four minutes to administer and is recommended for ages 3-85.

Scoring Process: The 9-Hole Pegboard Dexterity Test provides a score for each hand, with the primary Toolbox score being the number of seconds it takes the participant to complete the task using his/her dominant hand ("handedness" is assessed at the outset of Toolbox testing). This score is then converted to the Toolbox normative scale scores. The non-dominant hand score is also reported as a raw score, showing number of seconds for completion, for those researchers interested in this additional information. This non-dominant hand information is provided in the Computed Score Non-Dominant column of the Toolbox Assessment Scores output file (see Appendix B2).

Interpretation: Dexterity is a central component of hand function and relates to both the speed and accuracy of hand movements during the manipulation of objects. For the 9-Hole Pegboard Dexterity Test, the raw score is commonly used for interpretation, with faster completion times (less time to complete) representing better manual dexterity. This also allows for raw comparisons between dominant and non-dominant hand performance. However, one can also evaluate performance with the dominant hand by looking at the normative scale scores provided. For NIH Toolbox Motor assessment, the fully adjusted scale score is the score that should be primarily utilized for the interpretation of normative scores because it takes into account gender, age, ethnicity and education differences. Thus, it provides a level playing field for evaluating participants' performance since differences may exist in performance as a function of some of these demographic variables (most notably, gender and age).

When interpreting dexterity normative scale scores, higher performance is indicative of better dexterity. A fully adjusted scale score that is 2 SDs below the mean (scale score of 70 or below) is suggestive of motor dysfunction; further evaluation by a physician or physical therapist is recommended. From an age perspective, dexterity in children is correlated with school performance and is a predictor of quality of handwriting, while a decline in manual dexterity is a common phenomenon in older adults and is associated with performance of activities of daily living and independent living.

<u>Grip Strength Test</u>

Description: This protocol is adapted from the grip strength testing protocol of the American Society of Hand Therapy. Participants are seated in a chair with their feet touching the ground. With the elbow bent to 90 degrees and the arm against the trunk, wrist at neutral, participants squeeze the Jamar Plus Digital dynamometer as hard as they can for a count of three. The dynamometer provides a digital reading of force in pounds. A practice trial at less than full force and one test trial are completed with each hand. The test takes approximately three minutes to administer and is recommended for ages 385.

Scoring Process: The Grip Strength Test provides a score for each hand, with the primary Toolbox score being the number of pounds of force the participant was able to generate using his/her dominant hand ("handedness" is assessed at the outset of Toolbox testing). This score is then converted to the Toolbox normative scale scores. The non-dominant hand score is also reported as a raw score, in pounds of force, for those researchers interested in this additional information. This non-dominant hand information is provided in the Computed Score Non-Dominant column of the Toolbox Assessment Scores output file (see Appendix B2).

Interpretation: Muscle strength is an essential element for humans to move against gravity and provide sufficient force to perform movements within the full range of motion. For the Grip Strength Test, the raw score has commonly been used for interpretation, with greater force (in pounds) representing greater strength. This also allows for raw comparisons between dominant and non-dominant hand performance. However, one can also evaluate performance with the dominant hand by looking at the normative scale scores provided. For NIH Toolbox Motor assessment, the fully adjusted scale score is the score that should be primarily utilized for the interpretation of normative scores because it takes into account gender, age, ethnicity and education differences. Thus, it provides a level playing field for evaluating participants' performance since differences in performance may exist as a function of some of these demographic variables (most notably, gender and age). When interpreting strength normative scale scores, higher performance is indicative of better strength. A fully adjusted scale score that is 2 SDs below the mean (scale score of 70 or below) is suggestive of motor dysfunction; further evaluation by a physician or physical therapist is recommended. More generally, grip strength has been used to characterize total body strength and predict mortality, postsurgical complications and future disability. Muscle strength of the limbs and trunk declines with age and is associated with an increased risk of falls, hip fractures, loss of bone mineral density, long-term survival in severe congestive heart failure, functional dependence in people aged 75 years or older, and loss of functional status in hospitalized patients.

Standing Balance Test

Description: The Standing Balance Test is a measure developed to assess static standing balance for ages 3-85 years. It involves the participant assuming and maintaining up to five poses for 50 seconds each. The sequence of poses is: eyes open on a solid surface, eyes closed on a solid surface, eyes open on a 17 foam surface, eyes closed on a foam surface, eyes open in tandem stance on a solid surface. Detailed stopping rules are in place to ensure participant safety with these progressively demanding poses. Postural sway is recorded for each pose using an accelerometer that the participant wears at waist level. This test takes approximately seven minutes to administer and is recommended for ages 3-85.

Scoring Process: The participant's anterior-posterior postural sway information is fed wirelessly to the computer. A normalized path length score is then calculated as follows:

$$Normalized\ Path\ Length = \frac{1}{t}\sum_{j=1}^{N-1}\left|p_{j+1} - p_j\right|$$

Where t is the time duration, N is the number of time samples, and is accelerometer data at time sample j. These data are then further converted using an IRT model to derive a theta score for each participant representing the relative overall balance ability or performance of the participant. AgeAdjusted, Fully Adjusted and Unadjusted Scale Scores, as well as a national percentile rank that corresponds to the age-adjusted scale score, are then provided for the Standing Balance Test. In addition, the theta score is converted to a Computed Score, which ranges from roughly 200 to 800 and can be used for simple balance ability comparisons over time. Finally, two ratio scores are provided, comparing performance on balance position 2 to position 1, and position 4 to position 1. These ratios can provide some potentially useful information for clinicians in evaluating certain subjects' risk of falling. These ratios are labeled columns on the Toolbox Assessment Scores Output file (Appendix B2).

Interpretation: Balance allows humans to be able to orient the body in space, maintain an upright posture under static and dynamic conditions, and move without falling. To evaluate motoric balance with the Standing Balance Test, one can look at the normative scale scores provided. For NIH Toolbox Motor assessment, the fully adjusted scale score is the score that should primarily be utilized for the interpretation of normative scores because it takes into account gender, age, ethnicity and education differences. Thus, it provides a level playing field for evaluating participants' performance since differences in performance may exist as a function of some of these demographic variables (most notably, gender and age). When interpreting balance normative scale scores, higher performance is indicative of better balance. A fully adjusted scale score that is 2 SDs below the mean (scale score of 70 or below) is suggestive of motor dysfunction; further evaluation by a physician or physical therapist is recommended. When evaluating ratio scores, the position 2/position 1 ratio represents the participant's ability to use input from the somatosensory and vestibular systems to maintain balance, while the position 4/position 1 ratio reflects the relative reduction in postural stability when visual and somatosensory inputs are simultaneously disrupted (typically representative of the effectiveness of vestibular function for postural control). Generally, lower ratio scores (those closer to 1) are better. As noted, these may be of use to clinicians. Examination of balance is important as it predicts a person's ability to safely and independently function in a variety of environments. Maintaining stance stability under varying sensory environments is an essential function for the elderly to avoid falling and among patients for better functional outcomes. Several studies have found that changes in balance ability correlate significantly with changes in function.

<u>4-Meter Walk Gait Speed Test</u>

Description: This test is adapted from the 4-meter walk test in the Short Physical Performance Battery. Participants are asked to walk a short distance (four meters) at their usual pace. Participants complete one practice and then two timed trials. Raw scores are recorded as the time in seconds required to walk 4 meters on each of the two trials, with the better trial used for scoring. The test takes approximately three minutes to administer (including instructions and practice). This test is recommended for ages 7-85.

Scoring Process: The raw score on the 4-Meter Walk Test is the number of seconds it takes to walk four meters, using the better of two trials. This is then transformed into a computed score reported in meters per second. For example, if it took a participant two seconds to walk four meters, one would divide four by two to get two meters per second as the score. Toolbox norms and scale scores are not available for this test; however, descriptive statistics obtained from the sample of participants who were administered the test during the Toolbox norming study are available in the NIH Toolbox Technical Manual.

Interpretation: On the 4-Meter Walk Gait Speed Test, higher computed scores are indicative of better gait speed (i.e., fewer seconds to walk four meters). One can evaluate the descriptive statistics in the NIH Toolbox Technical Manual to get a sense of how individual or group performance compares to results obtained from the national norming sample, though care should be exercised in specific interpretation. Gait speed as a measure of bipedal locomotion is both a good way to summarize the overall burden of disease as well as a generic indicator of health status, prognosis and the co-morbid burden of disease in older persons. The speed at which older individuals walk is relevant to their functioning in the community. Moreover, gait speed is an important predictor of outcomes such as: length of stay and discharge disposition of patients admitted for acute rehabilitation after stroke, mortality, incident ischemic stroke and incident dementia.

Appendix B2: Sample NIH Toolbox Data Output File Score Fields for Motor Battery, with Annotations

Study Name:
ToolBoxSample2
Report Generated: 8/20/2012 5:45:21 PM

PIN	Inst	Raw Score	Computed Score	Unadjusted Scale Score	Age Adjusted Scale Score	National Percentile (age adjusted)	Fully Adjusted Scale Score	Computed Score Non-dominant	Age-adjusted scale score non-dominant	Fully adjusted scale score non-dominant	Standing Balance Ratio Position 2/Position 1	Balance Ratio Position 4/Position 1
PIN57343	NIH TB 9-Hole Pegboard Dexterity Age 3+	8.99		146.79	130.77		131.33	8.21	132.15	132.19		
PIN57343	NIH TB Grip Strength Age 3+	55.5		103.29	91.62	28.8	80.32	37.1	77.55	65.34		
PIN57343	NIH TB Standing Balance Age 3+		351	89.69563	72.93301	3.6	71.36654				3.6725	6.3811
PIN57343	NIH TB 4-Meter Walk Gait Speed Age 7+	7	0.57									
PIN57343	NIH TB 2-Minute Walk Endurance Age 3+	672.1		109.37	105.7	64.8	103.89					

Range is about 200-800

Speed in meters/second

Force in pounds for non-dominant hand

Time in seconds for non-dominant hand

Lower ratios are better.