



National Institutes of Health (NIH) Toolbox® V3 Administration Manual

**Edited by
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Chapter 1: Introduction to the National Institutes of Health (NIH) Toolbox® V3 App

The NIH Toolbox® V3 app provides access to the NIH Toolbox for Assessment of Neurological and Behavioral Function, a standard set of valid and reliable tests for assessing cognitive, emotional, motor, and sensory function. The app was designed to benefit healthcare professionals interested in investigating behavioral and neurological function, as well as educators and any properly trained professionals who are interested in measuring cognitive, behavioral, or emotional functioning. It is particularly well suited for measuring outcomes in longitudinal epidemiological studies along with prevention or intervention trials. NIH Toolbox measures have been normed and validated across the lifespan in participants ages 3–85, with recent research and normative studies expanding the age range above 85.

The NIH Toolbox has been cited in over 400 peer-reviewed studies from 2008 to 2023. It has been used in research, clinical, and pharmaceutical studies to evaluate the functioning of participants with a variety of physical and psychological conditions, such as cancer, autism, Alzheimer’s disease and other dementias, chronic pain, brain injury, substance use disorders, and stroke. It has also been used to track changes in community-dwelling people (i.e., individuals without clinical diagnoses) across time.

Since 2015, the NIH Toolbox has been available in the form of an iPad app that presents the following user-friendly features and functions:

- portable, easy-to-use technology
- stand-alone application (internet access is not required during test administration or scoring)
- easily mastered test administration
- minimal use of custom hardware
- enhanced normative scores for individual tests and composites
- ability to store results locally on the iPad or export results via iCloud, configurable web address, email, or directly to a computer
- basic reporting on an individual participant level
- availability of email support (help@nihtoolbox.org)

This NIH Toolbox V3 Administration Manual describes the history of the NIH Toolbox, development of NIH Toolbox V3, and administration procedures for NIH Toolbox V3 tests. Where appropriate, content has been adapted from the *NIH Toolbox® for Assessment of Neurological and Behavioral Function Administrator’s Manual* (2006-2020). This V3 Administration Manual will be updated as more tests and features are added to the NIH Toolbox V3 app.

Development of the NIH Toolbox

In 2004, 15 Institutes, Centers, and Offices at the National Institutes of Health (NIH) that support neuroscience research formed a coalition called the *Blueprint for Neuroscience Research*. The goal of the NIH Blueprint, as it's referred to, was to develop new tests, resources, and training opportunities to accelerate the pace of discovery in neuroscience research. Because the research community had long sought the development of standard tests to measure cognitive and emotional health, in 2006 the NIH Blueprint for Neuroscience Research awarded a contract to develop an innovative approach to meet this need (HHS-N-260-2006-00007-C). The outcome was the establishment of the NIH Toolbox.

The NIH Toolbox developed tests across four domains: Cognition, Emotion, Motor, and Sensation. Initial literature and database reviews and a "Request for Information" of NIH-funded researchers identified the subdomains for inclusion in the NIH Toolbox along with the criteria affecting test selection, creation, and norming.

The original NIH Toolbox validation studies were conducted across the entire age range, typically including 450 to 500 participants, and statistically compared NIH Toolbox measures to existing "gold standard" measures, whenever available. For tests using item response theory (IRT) approaches to scoring, calibration samples generally included several thousand participants, ensuring robust models. In total, data were collected from more than 16,000 participants as part of field-testing, calibration, and validation activities.

The original NIH Toolbox project conducted a large national norming study in both English and Spanish languages. This study is described in detail across two journal volumes in 2013: volume 78, article 4 of the *Monographs of the Society for Research in Child Development* and in volume 80, supplement 3 of *Neurology*. A sample of 4,859 subjects ages 3–85, demographically representative of the U.S. population, was administered all the NIH Toolbox measures at sites around the United States. The normative data obtained from this study were used to generate norms for the web-based version of NIH Toolbox (V1), which was released for general use in 2012. In 2015, the iPad app version (also known as "NIH Toolbox V2") was released to support the National Children's Study (HHSN2752012000071). Norms for the V2 version were inputted from V1.

NIH Toolbox test development has focused on the continuity of assessments throughout the lifespan. An expert team of early childhood and older adult assessment consultants was engaged to provide guidelines for administration, to offer input on test development, and to review all NIH Toolbox measures as they relate to the needs of young children and older adult participants.

NIH Toolbox measures utilize several advanced approaches in item development, test construction, and scoring. Two of these are item response theory (IRT) and computer adaptive testing (CAT), which are used in a subset of tests. IRT allows tests to be brief, yet precise and valid. Using IRT methodology, sets of items are calibrated along a continuum that covers the full range of the construct to be measured. This calibrated set of items enables the creation of

measures that employ CAT, a specialized type of computer-based testing in which administration of items is based on individuals' responses, with minimal burden on participants and precise evaluation at the individual level.

For more information about the original development of the NIH Toolbox, please refer to documentation on our website, NIHToolbox.org.

Redevelopment of the NIH Toolbox

Numerous grants funded the development of new tests which are included in V3. ARMADA: Advancing Reliable Measurement in Alzheimer's Disease and cognitive Aging (NIA/U2CAG057441) developed the new hearing and near vision tests and also supported other V3 development and norming activities. NIH Infant and Toddler Toolbox (75N94019D00005) supported the development of the Picture Vocabulary test, as well as infrastructure for translations. ECHO PRO Research Resource: A Developmentally-based Measurement Science Framework for Assessing Environmental Exposure and Child Health (NIH 1U24OD023319-01) developed the Participant App for remote administration of the NIH Toolbox and also provided some support for pediatric development and norming activities. A Cognitive Test battery for Intellectual Disabilities (NICHD 1R01HD076189-01A1) supported development and validation of the Speeded Matching Test. Adult norming for V3 was completed in conjunction with norming and validation of both The Mobile Toolbox for Monitoring Cognitive Function (NIA/1U2CAG060426-01) and MyCog: Rapid detection of cognitive impairment in everyday clinical settings (NINDS UG3NS105562). NIH Toolbox V2 subscription fees were also used in part to assist in the re-development efforts.

These activities took place from 2016–2022 and are reflected in the NIH Toolbox V3 app. The user interface and workflows were redesigned and streamlined to provide a more consistent appearance and user experience across the app. Changes to NIH Toolbox tests include implementing universal fonts, background color, and overall appearance. Instructions have been streamlined and are read aloud by the audio when appropriate. Test names have been shortened, and new features have been added to the examiner interface (also referred to as the app shell) to facilitate an improved examiner experience.

NIH Toolbox V3 was reviewed with accessibility and usability in mind for both the examiner and the participant. Experts in design and usability were engaged to ensure the app's examiner interface and participant screens were as compliant with current accessibility standards as possible. Specific attention was given to the Section 508 amendment (updates 2008 and 2018) of the Rehabilitation Act of 1998. Accessibility levels in design include A, AA, or AAA. These standards can be achieved through design elements (e.g., consistency, contrast, sizing, proportions).

In the Cognition domain, images in the Dimensional Change Card Sort and Pattern Comparison tests have been updated, as well as select images in Picture Vocabulary. NIH Toolbox V2 tests

that had multiple versions now have one version in V3. For instance, V2 had three NIH Toolbox Flanker Inhibitory Control and Attention Tests: ages 3–7, ages 8–11, and ages 12+. In V3, the instructions and items were streamlined so one Flanker Inhibitory Control and Attention test is appropriate for all participants ages 4+. Scoring, basal rules, ceiling rules, and age ranges for certain tests have been updated, and new normative data have been collected. Five new tests have been added and are detailed in Chapter 4: Face Name Associative Memory Exam, Face Name Associative Memory Exam Delay, Rey Auditory Verbal Learning Delay, Speeded Matching, and Visual Reasoning.

In the Emotion domain, a new scoring engine has been implemented and CAT stopping rules have been updated. Emotion short forms have been dropped, many fixed forms have been converted to computer adaptive tests (CATs), and each test is presented in one format. In the Motor domain, the Standing Balance test now produces a new accelerometer output file and a new “Balance by NIH Toolbox V3” app with which to collect the participant’s balance data. New hearing and near vision tests will be added to the Sensation domain in 2024.

In the summer of 2021, new normative data for the NIH Toolbox Cognition tests were collected. The sample of 3,904 participants, ages 3–85+, was representative of the United States population based on age, biological sex, race/ethnicity, and education. Data were collected by NIH Toolbox-trained examiners in 12 states across the U.S.; 17% of cases were collected in the Northeast, 36% in the South, 23% in the Midwest, and 24% in the West. The normative sample contained 52% females and 48% males, which were both within 2% of the U.S. 2020 Census. The normative sample comprised the following races: 56% White, 15% Black or African American, 19% Hispanic, and 10% Other, which are all within 5% of the U.S. 2020 Census.

Table 1.1 details the number of participants who were administered each test. It is important to note that the sample sizes for the tests listed in Table 1.1 differ due to the tests’ appropriate ages (e.g., Speeded Matching is intended only for young children, so it was not administered to older children and adults).

Table 1.1
NIH Toolbox V3 Norming Sample Size

<i>Test</i>	<i>N</i>
Dimensional Change Card Sort	3,753
Flanker Inhibitory Control and Attention	3,436
Face Name Associative Memory Exam	1,595
Face Name Associative Memory Exam Delay	1,595
List Sorting Working Memory	3,493
Oral Reading Recognition	3,666
Oral Symbol Digit	3,413
Pattern Comparison Processing Speed	3,532
Picture Sequence Memory	3,724

Picture Vocabulary	3,800
Rey Auditory Verbal Learning	3,502
Rey Auditory Verbal Learning Delay	3,458
Speeded Matching	838
Standing Balance (Ages 3–6)	437
Standing Balance (Ages 7+)	2,837
Visual Reasoning	3,761

For increased precision, NIH Toolbox V3 Cognition tests have continuous norms that use chronological age in years, half-years, or quarter-years, depending on how old the participant is. Change-sensitive scores are available for core Cognition tests, as well as a norming approach that is based on the change-sensitive scores. More details about the pilot and norming studies conducted on the NIH Toolbox V3, as well as more comprehensive information about reliability and validity analyses, can be found in the NIH Toolbox V3 Technical Manual.

It is critical to note that this Administration Manual details how to administer NIH Toolbox V3 tests in the NIH Toolbox V3 app. Do NOT use this manual or any other NIH Toolbox V3 materials while administering NIH Toolbox V2 tests in the original NIH Toolbox app.

Additional V3 Advancements and Support Documentation

To supplement the NIH Toolbox app, a new website—www.NIHToolbox.org—was fully re-designed and updated to explain the advancements made with the app, to detail the history of the product, and to offer easily accessible support and FAQs. Additionally, videos containing updated administration and troubleshooting tips are available on the website. Other resources are continuing to be developed to enhance training and support and to provide readily available answers to customers’ questions.

NIH Toolbox V3 Translations

The NIH Toolbox is used worldwide, and we acknowledge the growing desire for NIH Toolbox translations. As of February 2024, the NIH Toolbox V3 app has been translated into Spanish, Hebrew, and Arabic. This NIH Toolbox V3 Administration Manual is specific to the English version of the NIH Toolbox V3 app, though most information is applicable to the translated versions. Any differences or special notes are called out here in this “NIH Toolbox V3 Translations” section.

General Information About Translations

General information about translations is detailed here, with language-specific details listed in the sections below.

Each translation is available as a separate NIH Toolbox V3 app, and subscriptions can be purchased separately for each app. It is important to note that having an active subscription in one app does not mean you have an active subscription another NIH Toolbox app. For instance, a subscription for NIH Toolbox V3 English cannot be transferred or used for NIH Toolbox V3 Spanish; they are separate apps and require separate subscriptions.

Please be aware that Customer Support and other supporting documentation, such as this Administration Manual and knowledge articles, are currently only available in English. Any correspondence with Customer Support must be in English.

Each translation of the NIH Toolbox V3 app will be periodically updated to incorporate updates from the NIH Toolbox V3 English app. Additionally, the hope of the NIH Toolbox team is that additional tests and translated content will ultimately be added to translated apps.

Please note that the participant demographic options that are available in the apps are based on the English US-based normative data collection demographics, and therefore may not be as culturally appropriate in regions outside the United States. For example, some higher education options such as “Associate degree”, might not have a direct equivalent in other regions around the world. Examiners should either select the demographic option that most closely represents the participant or leave the field blank. As noted in Chapter 2, the only required participant demographic fields are Identifier and Date of Birth. Of note:

- “Professional degree” and “Doctorate degree” use the same normative formulas and indicate receiving a degree beyond a Master’s degree.
- “One or more years of college at a 2-year program, no degree”, “One year of college at a 4-year program, no degree”, “Two years of college at a 4-year program, no degree”, and “Three years of college at a 4-year program, no degree” use the same normative formula.
- “GED” should NOT be interpreted as “high school equivalent”. When “GED” is selected in the app, the examiner is asked to select the highest grade completed, and that grade is used where applicable in test routing and in normative formulas.

Unless otherwise noted, translations of NIH Toolbox V3 use the same scoring and normative formulas as NIH Toolbox V3 English. All results must be interpreted with caution and consider possible cultural or regional differences.

Spanish

The NIH Toolbox V3 Spanish app was released in March 2024. Test instructions, test items, supplemental Cognition materials, content in the examiner interface, score report, and exports were translated by fully bilingual Spanish speakers and reviewed by native Spanish speakers from Spain, central America, South America, and the United States. All translation procedures were performed in accordance with current industry standards and FDA guidance. Please be advised that although content in the NIH Toolbox V3 Spanish app and supplemental Cognition materials are translated, some content such as the score names, FAQ, Privacy Policy, and all user support currently remain in English.

Examiners can administer the same tests that are in the NIH Toolbox V3 English app to Spanish-speaking participants. However, it is important to be aware of the following differences in the NIH Toolbox V3 Spanish app:

- Where applicable, the participant's age determines whether you see and hear formal or informal test instructions.
- At this time, we have not collected normative data for V3 tests with a Spanish-speaking population. The normative scores that populate in the Cognition domain in the V3 Spanish app come from the US-based English speaking V3 normative sample; please use caution in any interpretations of these norm-referenced scores.
- The Face Name Associative Memory Exam (FNAME) and Face Name Associative Memory Exam Delay (FNAME Delay) have the same instructions as the English version, but the names and faces are different. Due to this difference in stimuli, V3 Spanish FNAME currently produces raw scores only.
- The Spanish Oral Reading Recognition test is not a direct translation of the English version; the word list is unique to Spanish. Therefore, item-level response data from the V2 Spanish research sample was utilized to equate the Spanish items to the scale underlying the V3 English norms. A Rasch common-item anchor equating design was used. Via this equating process, the V3 Spanish CSS scores and derived normative scores for Oral Reading can be interpreted in the frame of reference of the V3 English scores. As a note, some items were very discrepant and are therefore treated as exploratory/experimental (i.e., not used in test-level scoring) until we have more data.
- The Picture Vocabulary test has the same instructions and images as the English version, but because the words are translated, item-level response data from the V2 Spanish research sample was utilized to equate the Spanish items to the scale underlying the V3 English norms. A Rasch common-item anchor equating design was used. Via this equating process, the V3 Spanish CSS scores and derived normative scores for Picture Vocabulary can be interpreted in the frame of reference of the V3 English scores. As a note, some items were very discrepant and are therefore treated as exploratory/experimental (i.e., not used in test-level scoring) until we have more data.
- All Emotion tests that are present in V3 English are also present in V3 Spanish. Like in English, some of the tests were renamed (e.g., "Sadness CAT" renamed to "Sadness/Depression CAT"), some fixed forms were updated to CAT, and some tests were updated to a newer version. Please refer to Chapter 5 for more information about changes to Emotion tests. Scoring and normative data are the same as they were in V2 Spanish. Scoring and normative data for the Emotion tests are the same as they were in V2 Spanish.
- The overall appearance and user interface of all tests in the Motor domain have updated. Standing Balance uses scoring and normative data from the V3 English normative sample. Scoring and normative data for the other Motor tests are the same as they were in V2 Spanish.
- Other than updating the overall appearance and user interface, there were no significant changes to the Sensation tests since V2 Spanish. Scoring and normative data

are the same as they were in V2 Spanish. As a note, the words in Words-In-Noise are the same as they were in V2 Spanish (i.e., not the same words as V2 English or V3 English).

The NIH Toolbox team would like to acknowledge and thank all the scientists, experts, and professionals who provided their expertise in the Spanish language and culture to improve the Spanish translation of the NIH Toolbox V3. We would like to highlight the significant contributions of:

María J. Marquine, PhD
Duke University, USA

Hebrew

The NIH Toolbox V3 Hebrew app was released in February 2024. All content that appears from the beginning to the end of an administration has been translated, including test instructions, test items, audio, and the List Sorting Working Memory Answer Sheet. Please be advised that other content such as the examiner interface, score names, FAQ, Privacy Policy, and all user support currently remain in English. The NIH Toolbox team hopes to expand upon the current translation in the future. All translation procedures were performed in accordance with current industry standards and FDA guidance.

Examiners can administer the Fluid Cognition tests in Hebrew. It is important to be aware of the following in the NIH Toolbox V3 Hebrew app:

- The following tests are currently available in the V3 Hebrew app: Dimensional Change Card Sort, Flanker Inhibitory Control and Attention, List Sorting Working Memory, Pattern Comparison Processing Speed, Picture Sequence Memory, and Touch Screen Tutorial.
- At this time, we have not collected normative data with a Hebrew-speaking population. The normative scores that populate in the V3 Hebrew app come from the US-based English speaking V3 normative sample; please use caution in any interpretations of any norm-referenced scores.

The NIH Toolbox team would like to acknowledge the following individuals for their assistance with translation and cultural review:

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Shamir Medical Center, Israel

Abigail B. Sivan, Ph.D.
Northwestern University, USA

Arabic

The NIH Toolbox V3 Arabic app was released in February 2024. All content that appears from the beginning to the end of an administration has been translated, including test instructions, test items, audio, and the List Sorting Working Memory Answer Sheet. Please be advised that other content such as the examiner interface, score names, FAQ, Privacy Policy, and all user support currently remain in English. The NIH Toolbox team hopes to expand upon the current translation in the future. All translation procedures were performed in accordance with current industry standards and FDA guidance. This Arabic translation is localized to the Fertile Crescent.

Examiners can administer the Fluid Cognition tests in Arabic. It is important to be aware of the following in the NIH Toolbox V3 Arabic app:

- The following tests are currently available in the V3 Arabic app: Dimensional Change Card Sort, Flanker Inhibitory Control and Attention, List Sorting Working Memory, Pattern Comparison Processing Speed, Picture Sequence Memory, and Touch Screen Tutorial.
- At this time, we have not collected normative data with an Arabic-speaking population. The normative scores that populate in the V3 Arabic app come from the US-based English speaking V3 normative sample; please use caution in any interpretations of any norm-referenced scores.
- Where applicable, the participant's age determines whether you see and hear formal or informal test instructions.

The NIH Toolbox team would like to acknowledge the following individuals for their assistance with translation and cultural review:

Hanin Karawani Khoury, Ph.D.
University of Haifa, Israel

Mais Abbas, M.Sc.
University of Haifa, Israel

Chapter 2: Using the NIH Toolbox® App

The NIH Toolbox® is a user-friendly and effective resource that assesses individuals' functioning across the age span. This NIH Toolbox V3 Administrator's Manual and the NIH Toolbox V3 Training Videos (www.NIHToolbox.org/Training) are designed to be used together when learning how to use the NIH Toolbox V3 app. After reading this manual, test administrators should review the training videos and complete 8-10 mock assessments with a live person to better understand what might be expected with a real administration with a real participant. Once training is complete, this manual should be used for review as needed.

Getting the NIH Toolbox App

Hardware and Software Needed to Use the NIH Toolbox App

To get the NIH Toolbox V3 app, you will need an iPad and an Apple ID. These are described in more detail below. The NIH Toolbox V3 app is available for public use through the Apple "App Store," a digital distribution platform for mobile apps on Apple devices. At this time, only an iPad version of the NIH Toolbox V3 app has been developed; it is not available on Android devices or on the web. For more information, please contact Customer Support at help@nihtoolbox.org.

iPad

It is recommended that the NIH Toolbox is only used on the supported 9.7" through 11" iPad models running the current version of iOS. The NIH Toolbox is updated every time that Apple releases a new iOS update, so it is important for you to remain updated. To obtain the latest version of iOS, see *Settings > General > Software Updates* on your iPad. **Please be aware that newer versions of iOS automatically remove infrequently used apps. To ensure the NIH Toolbox app does not get offloaded by accident during your iOS update, we recommend turning off the automatic function that offloads unused apps from your iPad before updating your iPad's iOS system.** To turn off the automatic Offload Unused App function, please go to: *Settings > General > iPad Storage > Offload Unused Apps*.

It is recommended that the iPad be placed in a case both for its protection and so the angle of the iPad can be placed at multiple positions, to ensure participant comfort. Positioning the iPad so that it is at an angle of about 60 degrees from the table works best. However, if that setup is not effective for the participant, you should adjust the angle so that it is most comfortable while still being easily visible and accessible to touch. Placing the iPad flat on the table is generally not recommended. Please note that select tests (e.g., Visual Acuity) require that the iPad be placed perpendicular to the table and at eye level for the participant; an iPad "easel" or something similar may be used for this and all other tests if preferred. See Appendix 2 for more information on recommended equipment.

Apple ID

Users of the public version of the NIH Toolbox V3 app will need an Apple ID to use the “App Store” app, which comes preinstalled on your iPad. An Apple ID is your all-in-one account used to log into all Apple products and is associated with your billing information (i.e., credit card). You may use an existing Apple ID if you already have one. If you don’t already have an Apple ID, or if you want to create a new one for NIH Toolbox activity, please visit <https://www.apple.com> for more information. Although the NIH Toolbox V3 app is free to install, you must purchase a subscription to store data, score the tests, and export data. Please note that the Apple ID that purchases the NIH Toolbox subscription should remain signed in on your iPad; logging out or changing the Apple ID on your device may cause issues with the NIH Toolbox app.

Downloading the NIH Toolbox V3 App

The following instructions are for users of the public version of NIH Toolbox V3. Users of the business-to-business version of the NIH Toolbox should contact Customer Support at help@nihtoolbox.org.

1. Tap the *App Store* icon on your iPad.
2. Enter “NIH Toolbox V3” in the App Store’s *Search* field and tap *Search*.
3. Once the NIH Toolbox V3 app is displayed (a red toolbox on a white background with “V3” on a blue banner at the bottom), tap the *GET* button beside it.
 - If you are already signed in with your Apple ID, a pop-up window will ask you to provide your password and install the app. Tapping *Install* will initiate the download and installation process.
 - If you are not signed in, you will be asked to sign in to complete the purchase. Please note that this step is only to download the app; no purchase is made at this stage. After you are signed in with your Apple ID, a pop-up window will appear. Tapping *Install* will initiate the download and installation process.
4. When the download is complete, the NIH Toolbox V3 app will become available on your iPad. If you cannot see the app on your iPad after downloading, try swiping to the right or left to see all the apps installed on your iPad.
5. Open the NIH Toolbox V3 app by tapping the NIH Toolbox V3 icon.
6. When opening the app for the first time, you will be asked to agree to the NIH Toolbox V3 app Terms and Conditions (see NIHToolbox.org for more information) and set up an eight-digit passcode. You will be asked to enter this passcode every time you open the app in the future, as well as during key times when navigating the app. **Keep this passcode in a safe place. It cannot be recovered, and any data collected will be inaccessible if it is forgotten.**

Signing In and Selecting a Subscription

After setting up the eight-digit passcode in the public version of the NIH Toolbox V3 app, a screen will present the subscription options. The NIH Toolbox V3 app is free to download and explore but using the app in its entirety requires a paid subscription.

- **Limited Free Trial:** Prior to subscribing, you may explore the app via the Limited Free Trial, which allows access to the tests, batteries, participants, and test administration. This will give you the opportunity to get comfortable using the NIH Toolbox V3 app and

explore what it has to offer. However, while using the Limited Free Trial, no data will be saved and you will not have access to the reports or data exports. To begin collecting data you must first subscribe to the app. *To view tests in the Cognition domain, you must enter a Cognition access code, which users can request for free at NIHToolbox.org.*

- **Paid Subscriptions:** Each paid subscription grants 12 months of full access to the NIH Toolbox V3 app, *though users of Cognition tests must first request free access to the Cognition domain at NIHToolbox.org.* Each 12-month subscription will automatically renew unless auto-renew is turned off at least 24 hours before the end of the current subscription period. No cancellation of the current (paid) subscription is allowed during the subscription period. After expiration, you will still have access to view and export existing data on the iPad, but you will no longer be able to create new participants or collect new data (unless you reactivate a subscription on that device).

NIH Toolbox V3 subscriptions are linked to specific iPads but can be deactivated on one device and activated on another, if needed. Please note that custom batteries, participants, assessments, collected data, and settings do not move from one device to another. Subscriptions are specific to each app; if using translations, please be aware that a separate subscription is required for each app. For more information about subscriptions, please visit NIHToolbox.org.

Troubleshooting

If there are issues with the NIH Toolbox app, please try the following steps:

1. Update the app if there is an available update. At times there are major updates to the app, which require you to manually update the app through the App Store. Keeping the app up to date helps to avoid many potential issues users may face.
2. Force stop and restart the app.
3. Update the iPad software if there is an available update.
4. Restart the iPad.

If the app still requires troubleshooting after completing the steps above, please contact NIH Toolbox Customer Support at help@nihtoolbox.org.

It is crucial to note that all data is saved locally to the app/device it was collected on. If you are considering deleting and reinstalling the app, or if you want to install the app on a different device, your collected data will not be saved or transferred. Exporting the data is the only way to preserve and access the data outside of the app.

Common Terminology

- **Assessment:** A group of tests administered to a participant. An assessment contains tests and/or batteries.
- **Assessment Tools:** A term used to collectively refer to tests and/or batteries.
- **Battery:** A set of tests intended to be administered together in a specific order. NIH Toolbox V3 has a list of preset batteries, which are predefined collections of tests

determined by the NIH Toolbox development team. You can also create custom batteries by adding tests in a certain order for use in future assessments. As a note, once a custom battery has been administered to a participant, it cannot be modified.

- **Domain:** A broad area of health and function. The NIH Toolbox spans four domains: Cognition, Emotion, Motor, and Sensation. Each domain includes multiple tests that can be selected individually or used as part of a preset battery.
- **Item:** A question or task within a test. Each test comprises items.
- **Test:** A set of items administered in an order that cannot be changed by the administrator. Each test is an individual assessment resource that can be administered as a stand-alone measure, as part of a preset battery, as part of a custom battery, or as part of a custom administration. Tests are also referred to as “instruments” and “measures,” and these words can be used interchangeably.

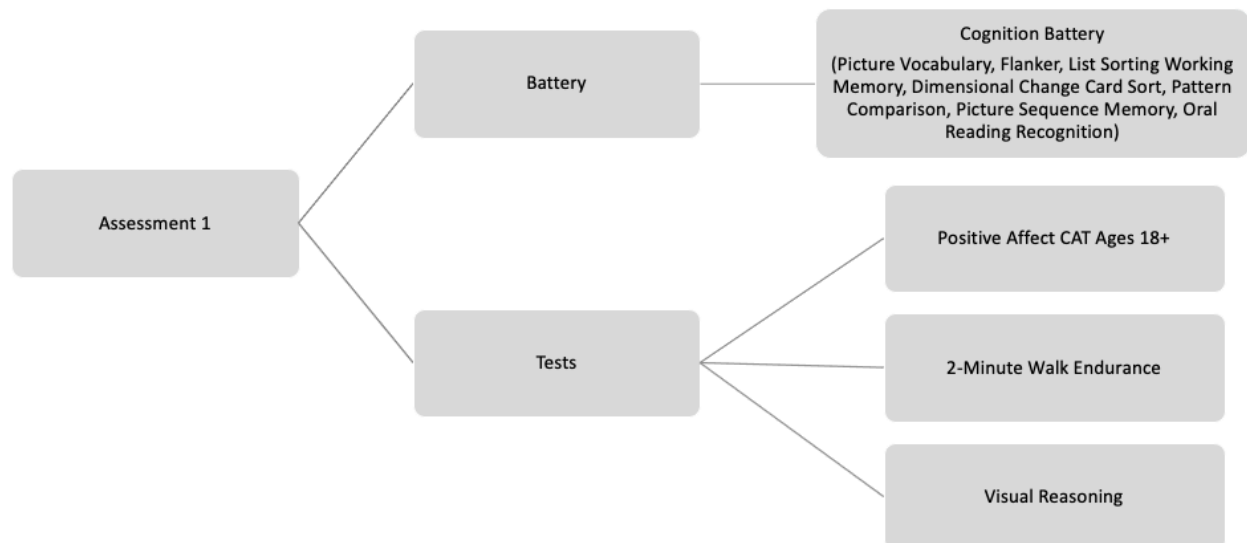


Figure 2.1: Example of NIH Toolbox assessment structure

NIH Toolbox App Structure

Dashboard

The Dashboard is the main landing screen after opening the app and entering the app passcode. The Dashboard displays Quick Links and Frequently Used Assessment Tools, which shows the most frequently used tests and/or batteries. To toggle between these lists, tap *Filter* in the top right corner of the Frequently Used Assessment Tools section.

The sidebar on the left side of the screen provides quick navigation to key sections in the app. Details about each of these sections are provided below.

The eight-digit passcode is required for examiners to navigate certain parts of the app. It provides a level of protection from individuals who might not be authorized to explore certain

sections (e.g., participants should not have the ability to view other participants' demographic information).

Assessment Tools

Tests

The Tests section can be accessed by tapping *Tests* on the left sidebar. All tests that are available in the app are listed here, in order of the domain they are associated with: Cognition, Emotion, Motor, and Sensation. Each test card (i.e., expandable row) contains the name of the test, which domain the test is associated with, the age range for which the test is appropriate, and a brief test description.

In addition to the NIH Toolbox tests, select tests from the PROMIS (Patient-Reported Outcome Measurement Information System) measurement system are available in the NIH Toolbox V3 app. These additional patient report outcome measures complement the NIH Toolbox Emotion tests and help to provide a more complete assessment of physical and emotional health. The PROMIS tests are located at the bottom of the Test section.

Batteries

The Batteries section can be accessed by tapping *Batteries* on the left sidebar. A battery is a collection of tests intended to be administered in a specific order, in one administration. Preset batteries, which can be viewed by tapping *Preset* under Batteries at the top of the screen, are collections of tests predefined by the NIH Toolbox team. Custom (i.e., user-created) batteries and archived batteries can also be viewed by tapping the appropriate tab at the top of the Batteries section.

Each battery card contains the name of the battery, the domain the battery is a part of (unless the battery has tests from multiple domains), and an age range for which the battery is appropriate. Although batteries can be administered to participants of any age, administering a non-age-appropriate test or battery is NOT recommended. Some battery cards, when expanded, have a cube icon, which indicates that there is additional information or additional requirements for at least one of the tests in that battery (i.e., it has a proxy report, or it requires additional equipment for administration).

Tapping on a battery card expands it and displays the tests that are part of that battery. It may be necessary to swipe left or right on the battery card to view all the tests. Beside each test there is an icon that indicates which domain the test is a part of (i.e., Cognition, Emotion, Motor, Sensation) and an age range for which the test is appropriate.

Creating a Custom Battery

To create a custom battery:

1. Tap the blue *+ New Battery* button at the bottom right corner of the screen.
2. Enter a unique name to identify the battery.
3. Add tests by tapping the *+ Add Tests* button. Tests are listed in alphabetical order by domain. Tap on the tests you would like to add to the battery. A blue circle with a

check mark to the left of the test indicates that that test has been added to the battery. At least one test must be added before the new battery can be saved.

4. When you are finished, tap *Save* at the top.
5. If you want to remove a test from the battery, tap the red circle to the left of the test.
6. The order in which the tests appear on this screen indicates the order in which the tests will be presented during administration. If you want to reorder the tests, tap the three horizontal lines to the right of the test to drag and drop it where you want it to go.
7. When you are finished, tap *Save* at the top.
8. The new battery will be displayed under the *Custom* tab on the Batteries screen.

Editing Custom Batteries

Custom batteries can be edited only if the battery has never been used in an assessment. To edit a custom battery, tap on the battery card to expand it. Then tap the *Edit* button at the bottom of that battery card. Here, you can edit the name, included tests, and order in which the tests will be administered.

Assigning a Battery to a Participant

Batteries can be assigned to participants either from the Batteries section or the Participants section. To assign a battery from the Batteries section, tap the battery card to expand it, then tap the *Assign to Participant* button at the bottom of the card. To assign a battery from the Participants section, select a participant, tap the *+ New Assessment* button, tap the *+ Add Tools* button, then tap the *Batteries* tab at the top of the Select Assessment Tools window.

Archiving Batteries

If a custom battery has been created but is not desired in the list of custom batteries, the entry can be archived. This may be useful in managing data after examiner training or practice, or if an entry has been created in error. Preset batteries cannot be archived. Custom batteries can be archived or unarchived at any time.

To archive a custom battery, tap the three vertical dots on the battery card. Tap the *Archive Battery* button that appears in the dropdown menu and then tap *Yes* in the pop-up window that appears. The battery will be moved to the *Archived* tab in Batteries. To unarchive a battery, tap the *Archived* tab at the top of the Batteries screen, then tap the three vertical dots on the battery card, and tap the *Unarchive Battery* button that appears in the dropdown menu.

Participants

The Participants section can be accessed by tapping *Participants* on the left sidebar. All active participants will be displayed on the main Participants screen. Archived participants can be viewed by tapping the *Archived* tab at the top of the screen.

Creating a New Participant

To create a new participant, tap the *+ New Participant* button at the bottom right corner of the main Participants screen. This will display the New Participant Information screen, which allows you to fill in the participant's demographic information.

Only Identifier and Date of Birth are required fields. However, Handedness is required to administer the Grip Strength and 9-Hole Pegboard tests, and Education Level is required for participants ages 19 and older to determine the starting point for the Oral Reading Recognition, Picture Vocabulary, and Visual Reasoning tests. The demographic fields are as follows:

- **Identifier:** Any unique alphanumeric combination you wish to assign to the participant. This is a required field.
- **First Name:** The participant's first name.
- **Last Name:** The participant's last name.
- **Date of Birth:** The participant's date of birth. This automatically calculates the participant's age, which is used to determine which tests and start points are appropriate for that participant.
 - If you would like to de-identify the date of birth (e.g., if you are concerned about protecting personal health information [PHI]), you may elect to enter the correct month and year but substitute an alternate number for the day. For example, if the participant's date of birth is 8/18/2017, you might enter 8/1/2017 instead. Please note that entering an alternate day may impact the participant's calculated age.
 - If the Date of Birth was entered incorrectly and is corrected after that participant has already been tested, some scores may be recalculated based on the updated age.
- **Sex Assigned at Birth:** The participant's biological sex at birth. According to the American Psychological Association, "sex is typically assigned at birth (or before during ultrasound) based on the appearance of external genitalia," [American Psychological Association, 2015, p. 862]. NIH Toolbox V3 scoring algorithms do not include sex assigned at birth; see NIHToolbox.org for alternative sources for norms.
- **Ethnicity:** The participant's ethnicity. NIH Toolbox V3 scoring algorithms do not include ethnicity; see NIHToolbox.org for alternative sources for norms.
- **Race:** The participant's race. NIH Toolbox V3 scoring algorithms do not include race; see NIHToolbox.org for alternative sources for norms.
- **Handedness:** The participant's dominant hand. If the participant is ambidextrous or unsure which hand is dominant, select the *Ambidextrous/Unknown* option. This will bring up a series of three questions that you should ask the participant to help determine which hand to mark as dominant for testing purposes. This field is required to administer the Grip Strength and 9-Hole Pegboard tests.
- **Education Level:** The participant's highest completed education level. This field is required if you are administering the Oral Reading Recognition, Picture Vocabulary, or Visual Reasoning tests to participants ages 19 and older because the start points for those tests are determined by the participant's education level. Participants 18 and

younger are routed based on age for Oral Reading Recognition, Picture Vocabulary, and Visual Reasoning. NIH Toolbox V3 scoring algorithms do not include education level; see NIHToolbox.org for alternative sources for norms. Please note “GED” should NOT be interpreted as “high school equivalent”; when “GED” is selected in the app, the examiner is asked to select the highest grade completed, and that grade is used where applicable in test routing and in normative formulas.

- **Mother’s Education, Father’s Education, Guardian’s Education:** The highest completed education level of the participant’s mother, father, and/or guardian. NIH Toolbox V3 scoring algorithms do not include relatives’ education level. Please note “GED” should NOT be interpreted as “high school equivalent”; when “GED” is selected in the app, the examiner is asked to select the highest grade completed, and that grade is used where applicable in test routing and in normative formulas.
- **Start Point Override:** This field applies to 5 tests: List Sorting Working Memory, Oral Reading Recognition, Picture Sequence Memory, Picture Vocabulary, and Visual Reasoning. If a value is selected in this field, all administrations of these tests will present age-appropriate instructions and practice items, but the live items will begin at the selected start point override level. This feature can be used if a participant is expected to function at a significantly lower or higher level than would be expected by their age or education level. The Start Point Override should be used judiciously and only in cases where you have prior evidence of lower or higher participant functioning. If no changes are made to the override, these tests will begin at the start point appropriate for the participant’s age.
 - Example 1: If a participant is 30 years old and you have evidence the participant functions at a 10 year old level, you can select “Age 10” in the Start Point Override dropdown. The instructions and practice items appropriate for adults will still be shown, but the live items will begin at a 10 year old level.
 - Example 2: If a participant is 15 years old and they have completed college-level coursework, you can select “Ages 19+: Some College” in the Start Point Override dropdown.
 - Example 3: If an older adult has had a traumatic brain injury or is experiencing cognitive impairment, you might select “Ages 19+: Less than HS”.

Table 2.1
How Demographic Fields Are Used

<i>Demographic Field</i>	<i>How Field Is Used</i>
Identifier	For examiner reference; not used in administration or scoring
First Name, Last Name	For examiner reference; not used in administration or scoring
Date of Birth	Automatically calculates age, which is used in administration to determine start points for many tests; used in some scoring
Sex Assigned at Birth	For examiner reference; not used in administration or scoring
Ethnicity	For examiner reference; not used in administration or scoring
Race	For examiner reference; not used in administration or scoring
Handedness	Used in administration of Grip Strength and 9-Hole Pegboard

Education Level	For ages 19+, used in administration to determine start points for Oral Reading Recognition, Picture Vocabulary, and Visual Reasoning; used in some scoring
Mother's Education, Father's Education, Guardian's Education	For examiner reference; not used in administration or scoring
Start Point Override	Can be used in administration to determine start points for List Sorting Working Memory, Oral Reading Recognition, Picture Sequence Memory, Picture Vocabulary, and Visual Reasoning; not used in scoring

Manually entering demographic information often results in errors. In addition to manually creating new participants, users may choose to scan QR codes with the participants' demographic data instead.

- To scan a QR code, tap the *Scan* symbol in the upper right corner of the New Participant Information screen. You may be asked to grant permission for the NIH Toolbox V3 app to use your iPad camera first time you try to scan a QR code.
- If your QR code was formatted correctly, all the demographic fields will be populated automatically. You will be notified of any possible errors in formatting and given an opportunity to fix them in the app.
- Any fields not included in the QR code will remain blank. For instance, if Education is left blank in the QR code information, it will also remain blank in the app once the QR code has been scanned.
- Please refer to NIHToolbox.org for information on how to generate correctly formatted QR codes.

Editing Existing Participants

To edit an existing participant, tap on the participant, then tap the *Edit* button in the top right corner of the *Demographics* tab. Please note that changes to Date of Birth, Sex Assigned at Birth, Ethnicity, and Race will be reflected in exports and reports for all assessments (i.e., completed assessments, started but not yet completed assessments, and assessments that have not yet been started). Changes to Date of Birth may cause age-based scores to be recalculated. Changes to the other demographic fields will only be reflected in exports and reports of assessments that have not yet been started. When you are finished, tap *Save*.

Assigning Batteries or Tests to a Participant

To assign batteries or tests to a participant, select the participant, then tap the *+ New Assessment* button at the bottom of the screen.

1. Either keep the auto-populated assessment name (e.g., "Assessment 1") or enter the name of the new assessment.
2. Tap the *+ Add Tools* button.
3. Tap the circle to the left of the test(s) you want to add to the assessment. Each test card indicates which domain that test is a part of and the appropriate age range for that test. Some tests have a cube icon, which indicates that there is additional information or

additional requirements (e.g., it is a proxy report, it requires a Bluetooth keyboard for administration).

4. To add one or more batteries, tap the *Batteries* button at the top of the screen to display the batteries, then tap the circle to the left of the battery or batteries you want to add to the assessment.
5. Once you have selected all the tests and/or batteries you would like in the assessment, tap *Save* at the top right corner.
6. The tests and/or batteries you have selected will be displayed. If you would like to reorder the tests and/or batteries, tap on the three horizontal lines to the right of the test or battery, then drag it up or down until they are in the order you would like.
7. When you are ready, tap *Save*.

Editing an Assessment

To edit an assessment, tap on a participant, then tap on the *Assessments* tab. Tapping on the assessment card you want to edit will cause the card to expand, showing what tests and/or batteries are a part of that assessment. Tap the *Edit* button to rename the assessment, add or remove tests and/or batteries, or reorder the tests and/or batteries.

Archiving Participants or Assessments

If a participant or assessment has been created but is not desired in the list of participants or assessments, the entry can be archived. This may be useful in managing data after examiner training or practice or if an entry has been created in error. Archived participants and their corresponding data (if any) are hidden from view but are not actually removed from the iPad.

Participants can be archived or unarchived at any time. If a participant is archived, the assessments belonging to that participant are also archived. If a participant is unarchived, the assessments belonging to that participant are also unarchived. If a participant or assessment is archived, it does NOT appear in the data exports when they are generated from within the app.

To archive a participant, tap the *Edit* button at the top right corner of the participant's *Demographics* tab. Scroll down, tap the *Archive Participant* button at the bottom of the screen, and then tap *Yes* in the pop-up window that appears. To view archived participants, tap the *Archived* tab at the top of the main Participants screen. To unarchive a participant, tap the three vertical dots on the participant's card, then tap the *Unarchive Participant* button that appears in the dropdown menu.

To archive an assessment, tap the three vertical dots on the assessment card. Tap the *Archive Assessment* button that appears in the dropdown menu and then tap *Yes* in the pop-up window that appears. To view archived assessments, use the *Show archived assessments* toggle at the top right of the participant's screen under the *Assessments* tab. To unarchive an assessment, tap the three vertical dots on the assessment card, then tap the *Unarchive Assessment* button that appears in the dropdown menu.

Results

The Results section can be accessed by tapping *Results* on the left sidebar. Each assessment will have a result card. The *Status* column indicates two key points of information: (1) whether the assessment has been completed, is in progress (i.e., has been partially completed), or has not been started; and (2) whether the assessment has or has not been exported previously. All active results will be displayed on the *Active* tab, and archived results can be viewed by tapping the *Archived* tab.

We strongly encourage you to regularly back up your data based on your institution's best practices. Unless it is backed up, data remains on the iPad it was collected on, and in the event something happens to that iPad (e.g., if it breaks, if it is lost), your collected data cannot be recovered.

Viewing Score Reports

When an assessment has been completed, a PDF icon will appear in the assessment card in the *Results* section. Tapping on that PDF icon opens the Score Report. You can view the Score Report on the screen or tap the export icon at the top right corner of the pop-up window to email or print it.

Score Reports display information related to that assessment, including participant information, scores for administered tests, and any examiner comments that you may have entered.

Export File Formats

Data for each assessment is spread across three kinds of exports:

- Registration: Contains participant demographic information as well as details about the iPad used (e.g., app version, iPad version).
- Scores: Contains test-level scores and test-level information (e.g., the assessment was paused during the Pattern Comparison Processing Speed test).
- Item: Contains item-level information such as scores, responses, and response time.

Participant data can be linked across export files by the PID (i.e., participant identifier) and AssessmentName fields.

There are two export structures: Wide/Default and Narrow. That is, there is a Wide/Default Registration export file and a Narrow Registration export file for the Registration, Scores, and Item exports listed above. In total, there are six export files. Although content of the Wide/Default versus Narrow exports overlaps, the Narrow exports contain some additional fields. Narrow exports are modeled on key-value tables and pivot the data so there are many more rows than columns. The main purpose of the Narrow exports is to aid analysts in the creation of filtered and/or pivoted data sets. We strongly recommend using Narrow exports if values are to be imported into another system or database. *While we attempt to minimize changes to all export formats, the format of the Narrow exports is least likely to change over time.*

Exporting Individual Assessments

To export an individual assessment, tap the export icon to the far right of the assessment card. This will populate four options, which are listed below. Please note that access must first be granted to utilize these export functions. To do this, tap *Settings*, then tap *Data Security*, then toggle on the export options your organization supports.

- iPad File Sharing
 - After generating files to export, connect the iPad to a Mac or PC via cable.
 - On a Mac, open Finder and select your iPad from the sidebar, then select “Files” from the top navigation bar to view and access the files.
 - On a PC, open iTunes and click the iPad button near the top left of the iTunes window. Then select the NIH Toolbox V3 app in the list to view and access the files.
- Send via Email
 - To use this option, the Mail app on the iPad must be set up. For instructions on setting up the Mail app, please contact Apple Support.
 - The Email option will use the Mail app to attach the file(s) to a new email message, which you can send to a destination email.
 - When emailing the data files, exercise caution and only email the data to secure email accounts (e.g., the recipient’s institutional email).
 - As an extra security measure, you can choose to encrypt the file(s) sent via email with a password you must share with the recipient.
 - As a note, it is sometimes helpful to exit the app, open the app you are using to send emails, and navigate to your Sent folder to ensure the files have been sent.
- Upload to iCloud
 - To use this option, iCloud must be set up on the iPad. For instructions on setting up iCloud, please contact Apple Support.
 - If iCloud is enabled on the iPad AND in the NIH Toolbox V3 app, all the files generated by this app will be available in the iCloud Drive linked to the Apple ID used to install the app. These files can be accessed by logging into iCloud from any browser using the Apple ID associated with the app that generated the files.
- Upload to Web Server
 - This option is intended for use with an existing web location for data centralization. Many research projects have a data coordination center with the capability to set up a data server. For more information, please contact your institution’s information technology (IT) personnel.
 - After enabling this option in the app’s *Data Security* section and configuring the *Data Transfer URL*, *User ID*, and *Password*, test the connection to ensure smooth data transfer. Please refer to your institution’s IT personnel if you have any difficulties.
 - We strongly recommend that the Narrow data format be used for all server uploads.

Exporting Multiple Assessments

To export multiple assessments, tap the *Select* button at the top of Results screen. This will cause circles to appear to the left of each assessment. Select the assessments you would like to export by tapping each circle; a white circle means it is not selected, a blue circle means it is selected. You can also tap *Select All* at the bottom left of the Results screen to select all assessments in one tap. The text at the bottom right corner will indicate how many assessments are selected. When you are ready, tap that text or the export icon to populate the four export options listed above.

Settings

The Settings section can be accessed by tapping *Settings* on the left sidebar. Here you can do the following:

- General section: sign up for newsletters and update notifications, apply for access to Cognition tests
- Account section: view your subscription status, enter or view your institution name
- Security section: configure data security (for exporting data)
- Regional Formatting section: adjust the time and date formatting

You can also change your passcode by tapping *Change Passcode* at the top right of the *Settings* screen.

Help & Support

The Help & Support section can be accessed by tapping *Help & Support* on the left sidebar. Here, you can view Getting Started, What's New In This Version, Audit Logs, Frequently Asked Questions (FAQ), Knowledge Base, Contact Support, Terms and Conditions, Privacy Policy, and Diagnostic Information.

Audit Logs

There are three Audit Logs that can be used to identify all records that have been changed and where those changes occurred.

- Participant Audit Log
 - Contains audit entries identifying when a participant snapshot is first created and when it is modified. It creates a record of the demographic field values before and after the edits (i.e., old and new demographic data).
 - Participant Audit Logs are sorted by PIN, Date Created, and Date Modified, with the most recent record on top of the previous record.
- Rescore Audit Log
 - Includes changes related to any rescoring of data, which may happen if adjustments are made to demographic information (e.g., participant age is updated).
 - Rescore Audit Logs are sorted by PIN, then by Test Name, with the most recent record on top of the previous record. Composite scores, however, are only included in rescored (new) records.

- This is not designed to be used in analysis, but instead as a record of the changes in scores that were made.
- Battery Audit Log
 - Displays the custom batteries that have been updated due to replacement of retired test(s) with the new versions or due to the presence of retired test(s) in a custom battery.

NIH Toolbox Support

To access a copy of this manual, Privacy Policy, or Terms and Conditions, or to view more resources about the NIH Toolbox, please visit NIHToolbox.org. Contact help@NIHToolbox.org in English with questions or to report technical problems.

The NIH Toolbox is more than a set of tests: we are a community of users, and the NIH Toolbox continues to evolve. Please help us make this product the best it can be. If you have suggestions for changes or corrections, please share them with us in English at help@NIHToolbox.org.

Chapter 3: General Administration Guidelines

To be successful in testing children and/or adults, it is essential to

- establish and maintain rapport with the participant,
- create a testing environment that is comfortable and supportive, and
- enjoy interacting with people of all ages.

Toward that aim, this chapter provides detailed guidelines for administering the NIH Toolbox® to participants of all ages, reviews general administration procedures, and describes the Touch Screen Tutorial.

General Testing Practices for the NIH Toolbox®

Be sure to keep in mind the purposes for testing. Particularly, when testing in a research setting, it is of paramount importance to administer tests in a standardized fashion. Your aim is to elicit optimal performance from the participant while ensuring that the data obtained is accurate.

Testing should not be burdensome for either you or the participant. The NIH Toolbox testing protocol assists you in accomplishing this by building in variety and breaks. During testing sessions, you should project your enjoyment working with participants; otherwise, testing can become robotic and ineffective.

Regular feedback is built into the NIH Toolbox tests to help the participant understand the requirements of the task. As part of the NIH Toolbox testing protocol, practice trials provide positive reinforcement of correct performance and correction of errors. In contrast, feedback that you provide during test trials should be nondirective, intermittent, and focused on effort rather than accuracy of performance (e.g., “Good work” or “Good job” for children, or “Well done” or “Good job” for adults).

Below are administration guidelines pertaining to the testing environment, establishing and maintaining rapport, general testing recommendations, and testing individuals in different age categories.

Testing Environment

1. Having a quiet, comfortable, and uncluttered environment is important to obtaining reliable test data. The room should be conducive to easy interaction between you and the participant, as well as between the participant and the testing equipment.
2. For the ideal testing environment, the room should be away from noisy hallways, mechanical equipment, and other auditory distractions.
3. There should be few visual distractions, both inside and outside of the room. While windows and glass doorways provide natural light, they should not open onto distracting environments such as a playground or an active street.

4. In all situations (i.e., research and clinical), you should report interruptions and other unexpected events to the project manager, clinical director, or on whatever forms are generally used in your particular setting.
5. The room and the testing table should support only the equipment needed to complete the testing protocol. Other items, such as extraneous computer equipment, flashy posters, and food, are distractions. Nonetheless, having a box of facial tissues and a wastebasket nearby is often helpful.
6. For children, it is helpful to have furniture that is adapted to the child's size. In some settings, however, both adults and children use the testing room. Moreover, some examiners cannot sit comfortably at a low table. In this case, the easiest adaptation to allow both adults and children to work at a full-size table is to include a step stool on the floor to ensure the child's feet are not dangling.
7. Children should sit in straight-back chairs; swivel chairs are often too deep for children and always provide an additional distraction for the already distractible participant.
8. Generally, adults should sit in straight-back chairs.
9. Persons who use a wheelchair should be able to remain in their chair, should they want to do so. The wheelchair needs to fit under the table.
10. Both children and adults should be seated at a table under which they can put their feet. Sitting in front of the file drawers of a desk is not only uncomfortable but also not suited to the correct placement of the iPad.
11. Adults, more than children, may be sensitive to where you are sitting. While not crowding the participant, you need to be able to reach the iPad while demonstrating certain tasks. You might want to experiment with different table arrangements (e.g., a round table, sitting at the corner of a square table) to determine the setup which works best for you and your participants.
12. Using a stand for the iPad makes it easier to view the iPad from different angles and provides protection, should the iPad fall. During all tests using the iPad, center the iPad at the middle of the participant's body.
13. It is imperative for you to be able to see the iPad and demonstrate instructions in front of the iPad. You may use the participant's handedness to determine where to sit; this can prevent you from competing with the participant for space in front of the iPad screen, which sometimes occurs when each party is using the hand to the far side of the screen. If either you or the participant move the iPad for practice items, re-center the iPad in front of the participant before beginning live test items.
14. Participants should not be cued as to where to hold their hands or fingers during test administration. (Please note that NIH Toolbox V3 was not normed with, and therefore does not use, the "Home Base" used in V2).
15. Ensure that the participant cannot see the answer sheets for the List Sorting Working Memory and Oral Reading Recognition tests. Similarly, on tests that use the keyboard, place the keyboard in such a way that the participant does not see what you enter.

Establishing and Maintaining Rapport

1. Testing is not an activity that stands alone; it is a part of something bigger, such as a clinical assessment or a research project. Whatever the overall endeavor, begin each session with an introduction between you and the participant as well as an introduction to the tasks to be presented in the session.
2. It is your responsibility to ensure that all the equipment is close at hand and working correctly before the participant arrives. A list of the equipment required for each of the NIH Toolbox tests can be found in Appendix 2. The iPad used for testing should be dedicated to the NIH Toolbox, and notifications and background updates should be disabled. Background updates may also interfere with test timing. For example, enabling Mail on the iPad might result in large attachments being downloaded during a test, which may impact item-level timing.
3. Participants should not have access to their cell phone during the testing session. Similarly, when a participant is completing a test, you should not be checking your phone or computer or otherwise be disconnected from the testing itself.
4. Establishing rapport with the participant is important for maintaining their motivation and engagement. During testing, however, conversations not related to the task should be discouraged. You can redirect the participant to chat when the task is completed.
5. It is your responsibility to reassure participants of all ages (and their parents, if present), either before beginning the assessment, during the practice items, or at the end of the assessment, that the tests are designed so that no one correctly answers all the questions (to maximize reliability and minimize testing time, some of the tests are set such that even highly capable participants will only be able to answer 50% of the items correctly). Generally, the message should be that the tasks are difficult for persons of all ages and that this particular participant did a really good job. No participant should walk away from an individual test, nor the entire testing session, with the impression that they “failed.”
6. At the end of each session, thank the participant for their efforts and for their help with the activities. This should make the participant feel successful. If a parent accompanies a child, thank the parent for helping their child participate. The parent should feel good about their child’s participation.

General Testing Recommendations

1. Avoid psychological and other specialized jargon. It is often helpful to check that the participant understands the instructions and tasks.
2. It is important to establish whether the participant is familiar with a touchscreen device such as an iPad. If not, add the “Touch Screen Tutorial” to the beginning of the assessment to allow the participant to familiarize themselves with using the iPad. Additionally, opportunities to practice are built into the NIH Toolbox before administration of the live test items. During the practice items, you can work with the participant to ensure they understand the task.
3. During the live test items, do not give feedback regarding accuracy of the participant’s performance. Rather, your feedback should focus on their effort, with comments such as “Well done” to encourage continued effort. During the live test items, if the

participant looks like they are waiting for feedback that was present during the practice items, say, “Keep going” to encourage them to continue. Do not give feedback regarding the accuracy of the participant’s performance.

4. The timing of breaks must consider not only the participant’s needs but the test requirements as well. Ideally, a break should be only between tasks. However, a participant may request a break at a less-than-ideal time (e.g., a child may insist on a bathroom break). To avoid this, you may want to ask the participant if they need a break before a timed test, as taking a break in the middle of a timed test invalidates the results. If the participant cannot be encouraged to continue to a more appropriate break point, you should report the interruption to the project manager, clinical director, or on whatever forms are generally used.
5. Some participants become restless and present other challenges. You can usually overcome these challenges with short breaks for the restroom, a walk to the drinking fountain, or a brief conversation about the local sports team or a television show. It is inappropriate to discuss sensitive topics such as politics or religion.

Testing With Children

1. When testing children, particularly young ones, it is necessary to ensure that the child understands the task, is engaged in task performance, and maintains a positive attitude toward testing across multiple tasks.
2. Clearly, not all tasks are “fun and games” for the child, but when the experience is as enjoyable as possible, even reluctant children can become engaged and cooperative. When necessary, use breaks and/or other incentives to redirect the child’s attention to the tasks before them. Offering simple stickers at the end of each task is often enough to engage the child.
3. It is important to motivate the child to engage in each individual activity as well as the course of the entire testing session. Aim to make task participation enjoyable without setting up false expectations. You may not want to describe a difficult activity as a “game,” but calling a fun activity a “game” may help make the session seem more playful and entertaining.
4. As is common with younger children, if the child is reluctant to separate from the parent/caregiver, you may allow the accompanying adult to be present when the child is tested. The parent/caregiver should sit in such a way that they do not make eye contact with the child, see the iPad screen, or see what you are recording. It is best that the parent/caregiver sits behind you and to your side. With this setup, the parent/caregiver can be a reassuring presence for the child without actively interfering with the testing. A parent/caregiver should not be directly in view of the child; they should not talk to the child, urge the child to participate, or make comments on the child’s performance during the testing. The parent should be reminded that some of the tests are set such that even highly capable participants will only be able to answer 50% of the items correctly. Also inform that parent that you understand that children sometimes answer test questions incorrectly, even when they know the answer. The parent should not interrupt the testing session to improve child behavior. *If the adult is not able to remain in the background and be silent, the data collected may not be usable.* Different sites

may have different policies about how to use data like this. In any case, you should report the adult's interference to the project manager, clinical director, or on whatever forms are generally used.

5. With older children, it is neither expected nor appropriate for the parent/caregiver to sit in the room with the child. *If the parent/caregiver insists on being present*, then their seating should be oriented in the same way as described above.
6. It is normal for some children to become restless, to have a relatively short attention span, or to present other challenges. The younger the child, the more likely this is. These challenges can generally be overcome with short breaks involving something as simple as inviting the child to talk about their favorite activities, toys, books, TV shows, or animals. A more physical break might offer the child "wiggle time" to be silly and stand or move a bit after sitting still. A simple walk to the drinking fountain may be sufficient to refresh the child's engagement. Active children often have difficulty figuring out what to do with their nondominant hand. Offering them a small ball to hold in their nondominant hand sometimes solves this difficulty. Having them put their nondominant hand behind their back sometimes works as well. If snacks are used as rewards, they should never be eaten near the testing table and materials.
7. Even if you have permission from the parent to test the child, it is strongly encouraged to obtain the child's assent to participate as well.

Testing With Adults

1. Testing adults is not so different from testing children. Adults, however, are generally more sensitive to their own performance and may engage in strategies to avoid embarrassment. Some adults may try to engage you in this effort by making the activities into a game that minimizes their effort. Establishing good rapport between you and the adult participant is imperative for maintaining motivation and engagement.
2. Your aim is to make task participation enjoyable while not setting up false expectations. You may not want to describe a difficult activity as a "game," but calling a fun activity a "game" may help make the session seem more inviting. It is essential that the participant understands the task, is engaged in task performance, and maintains a positive attitude toward testing across multiple tasks.
3. If a participant wants definitive feedback about their performance, you should direct them to speak with the project manager or clinical director if you do not have access to the scores and/or their interpretations.
4. Older subjects may be more sensitive to issues of respect. Therefore, unless you are told otherwise, address the participant with more formal language, like "Mr./Mrs. Jones," and use phrases such as "Well done" instead of "Good job."

Testing Participants With Diminished Cognitive Capacity

1. It is important to introduce yourself clearly and remind the participant why they are doing the tests.
2. Participants with diminished cognitive capacity may exhibit higher levels of stress and fear than other participants. They may not express their concerns directly but may appear irritable or withdrawn and uninvolved. It is important to provide positive

reinforcement and encouragement and to reassure them that all participants find these tasks challenging. At the same time, it is important not to minimize their concerns or patronize these participants.

3. It is advisable to avoid hurrying participants. You may find that speaking at a pace slower and somewhat louder than normal is helpful, as some participants often process at a slower pace.

Testing Participants With Diminished Physical Capacity

1. The testing environment for an individual with diminished physical capabilities should be safe and minimize risk of falls. When scheduling the testing session, tell the participant to wear comfortable clothing and appropriate footwear.
2. It is important to be alert for signs of fatigue and physical distress and to take into consideration that medication use or time of day may affect performance. Always allow the participant time to take their medications on schedule or, when needed, to take another dose. Generally, do not push participants beyond their physical tolerance and capacity; this means giving frequent breaks, even if the breaks extend the session longer than usual.
3. It is important to be alert for sensory impairments. While you cannot change the test protocol, there are ways to compensate for hearing deficits. These include making sure that you can be heard, speaking slowly and clearly, facing the participant more directly when speaking, keeping your hands away from your face, reducing background noise, raising the volume on the iPad, indicating when you are changing the subject, and lowering your vocal pitch.
4. There are also ways to compensate for visual deficits, such as providing more adequate lighting and making sure the participant has the glasses they wear for reading.
5. Be sure to listen carefully; if a participant expresses overwhelming concerns about loss of function and independence, it might be helpful to suggest that they speak with their primary care physician about their concerns. Emphasize that the findings of the testing are confidential and are only released to others with the participant's permission. If the participant is part of a research project, reassure them that their performance is for the use of that project only and that particular persons are not identifiable.

Administration

Prior to administering an assessment, disable all pop-up messages (e.g., calendar alerts, email notifications) on the iPad to ensure smooth, uninterrupted data collection.

NIH Toolbox V3 normative data was collected with examiners and participants interacting directly with the screen. In 2022, Apple released a new feature that allows Mac users to use their mouse on a connected iPad. As this is not how the normative data sample was collected, we do not recommend the use of a mouse when administering assessments on the NIH Toolbox V3 app.

To start an assessment after it has been created, tap the right-facing arrow/chevron on the assessment card to expand it and display the list of tests and/or batteries that have been assigned to that assessment. When you and the participant are ready to begin, tap *Start Assessment*. Each test begins with a title screen that contains the test's abbreviated name to help orient the examiner without overtly stating to the participant which test they will be working on.

Test Interface Buttons

- **Slide to continue:** There is a *Slide to continue* button on the title screen of each test, as well as before each major transition (e.g., immediately before live test items). Touch the circle and drag it across the bar all the way to the right to continue to the next screen. Note that only you should slide this button; the participant should never interact with this button.
- **Play again button:** At the top of many screens, there is a *Play again* button, which you can tap to play the audio again. This is helpful in instances where the participant may need to hear that screen's instructions again (e.g., if the participant did not understand the instructions the first time). The *Play again* button is inactive while the audio reads the instructions and becomes active (i.e., tappable) when the audio stops.
- **Next button:** At the top of many screens, there is a *Next* button, which allows you to move to the next screen.
- **Back button:** At the top of some screens, there is a *Back* button, which allows you to go back to a previous screen. This is helpful in instances where the participant may need extra practice, or if there is an interruption (e.g., car alarm) that distracts the participant. Based on test logic and flow, the *Back* button either takes you and the participant back to the previous screen or goes all the way back to the start of the test. With a few exceptions, the *Back* button is not present after a certain point that would invalidate the test (e.g., it is not present during live items on a timed test).

Pausing an Assessment

An assessment can be paused at any time after it is started. If an assessment is paused, stopped, skipped, or delayed, it will be noted in the scores export along with the reason you provided. Follow these steps to pause, add notes, stop, skip, or delay a test:

1. Put three fingers vertically on the right side of the screen, then swipe your fingers across the screen to the left. This is called the "administrator gesture" or "admin gesture."
2. Enter the passcode.
3. Select from the five options presented on the screen:
 - a. **Add/Edit Test Notes:** This allows you to add or edit notes for any test within the current assessment.
 - b. **Stop Assessment:** Stopping the assessment ends the current testing session and brings you back to the participant's screen.
 - c. **Skip Test:** Skipping a test means the current test will be skipped and the next test in the assessment will be administered.
 - d. **Delay Test:** Delaying a test allows you to move the test to a later spot in the assessment.

- e. **Resume Test:** Resuming the test means the popup window will disappear and the test will continue.

For more information about pausing, stopping, delaying, and resuming a test, please refer to Appendix 1.

Examiner Training

Examiners who will be administering any assessments using the NIH Toolbox should be properly trained well in advance of any live administrations.

Prior to administering assessments to ‘real’ individuals, we recommend examiners review this Administration Manual in full, ideally alongside the app so they can navigate and become familiar with the app in real time. The examiner should create assessments that include all tests they will be administering and run through those tests at least 3 times on their own (with or without this Administration Manual). When the examiner is comfortable with the test(s) structure and workflow, we recommend the examiner administer at least 8-10 mock assessments with a live person to better understand what might be expected with a real administration with a real participant. A colleague should observe the examiner’s administration performance and offer tips.

Any mock participants and/or mock assessments that are created in the NIH Toolbox app should be labelled as such (e.g., Mock Participant 1, Training Assessment 4). Properly labelling training/mock participants and data will help users easily identify training data from real data.

Touch Screen Tutorial

The Touch Screen Tutorial is a practice session for participants of all ages who might not be familiar with using a touch screen. The Touch Screen Tutorial should only be added to assessments if the participant is unfamiliar with touch screens or if a refresher is needed. It is often helpful for young children and older adults who may need reassurance that they are able to complete the assessment competently. If used, the Touch Screen Tutorial should be added as the very first test in the assessment.

Administration

The Touch Screen Tutorial has two phases: Instructions and Practice.

Instructions

The instructions are presented on the screen and via audio: ***First, you will practice touching pictures on the screen.*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the practice items.

Practice

After the instructions, there are three screens, each with a different image in the center. As the participant touches each image, the next practice item appears. The first practice item is a flower, and the audio says: ***Touch the flower on the screen.*** When the participant touches the flower, the audio says: ***Good! Let's try another one.***

The second practice item is a star, and the audio says: ***Now, touch the star.*** When the participant touches the star, the audio says: ***Good! Let's try one more.***

The third practice item is an apple, and the audio says: ***Now, touch the apple.*** When the participant touches the apple, the audio says: ***Good!***

After all three practice items, a transition screen appears and the audio says: ***Now, you are ready to continue.***

Chapter 4: Cognition

Cognition refers to the mental processes involved in gaining knowledge and comprehension, 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. The following constructs compose the Cognition domain:

Table 4.1
NIH Toolbox V3 Cognition Domain Constructs

<i>Cognition Construct</i>	<i>Definition</i>
Attention	The allocation of one's limited capacities to deal with an abundance of environmental stimulation. It is measured by Flanker Inhibitory Control and Attention.
Delayed Memory	The ability to store information and recall it at a later time. The NIH Toolbox has two tests that present information and ask the participant to recall that information 5 to 25 minutes later. Face Name Associative Memory Exam (which also measures associative memory) asks adults to remember 12 faces paired with names, then recall the faces and names in the FNAME Delay. Rey Auditory Verbal Learning (which also measures immediate memory) presents the participant with 15 words over 3 trials, then after a delay asks the participant to free-recall as many words as they can in the RAVLT Delay.
Episodic Memory	The acquisition, storage, and retrieval of new information. It involves conscious recollection of information learned within a context. It is measured by Picture Sequence Memory.
Executive Function	The capacity to plan, organize, and monitor thoughts or behaviors. The NIH Toolbox® focuses on three components of executive function: (1) inhibition of automatic response tendencies that may interfere with achieving a goal, measured by Flanker Inhibitory Control and Attention; (2) set shifting, or the capacity for switching among multiple aspects of a strategy or task, measured by Dimensional Change Card Sort; and (3) nonverbal and visual reasoning, measured by Visual Reasoning.
Language	A set of mental processes that translate thought into symbols (words, gestures) that can be shared among individuals for purposes of communication. The NIH Toolbox focuses on two aspects of language: (1) vocabulary knowledge, measured by Picture Vocabulary; and (2) oral reading (decoding) skills, measured by Oral Reading Recognition.
Processing Speed	The amount of time it takes to mentally process a set amount of information, or the amount of information that can be processed within a certain unit of time. It reflects mental efficiency and is measured by Oral Symbol Digit and Pattern Comparison Processing Speed for participants ages 5+. This is measured in young children ages 3 to 6 by Speeded Matching.
Working Memory	The capacity of an individual to hold information in a short-term buffer and manipulate that information. It is measured by List Sorting Working Memory.

Cognition tests may be administered individually, as part of a battery, or in any combination with each other or tests from other domains. There are 15 Cognition tests and 2 Cognition batteries.

Table 4.2
NIH Toolbox V3 Cognition Test Details

<i>Test Name</i>	<i>Acronym</i>	<i>Ages</i>	<i>Time to Administer (minutes)</i>
Dimensional Change Card Sort	DCCS	4+	4
Face Name Associative Memory Exam	FNAME	18+	3
Face Name Associative Memory Exam Delay	FNAME Delay	18+	4
Flanker Inhibitory Control and Attention	Flanker	4+	3
List Sorting Working Memory	LSWM	5+	7
Oral Reading Recognition	ORR	7+	4
Oral Symbol Digit	OSD	5+	3
Pattern Comparison Processing Speed	PC	5+	4
Picture Sequence Memory Form A	PSM Form A	3+	7
Picture Sequence Memory Form B	PSM Form B	3+	7
Picture Vocabulary	PV	3+	3
Rey Auditory Verbal Learning	RAVLT	5+	3
Rey Auditory Verbal Learning Delay	RAVLT Delay	5+	1
Speeded Matching	SM	3–6	3
Visual Reasoning	VR	4+	7

Note. The “Time to Administer (minutes)” column gives users an idea of how long each test might take. Please note that test times may vary based on how prepared the examiner is going into the session, individual differences among participants, and/or unplanned activities that may occur during testing.

Some tests are supplemental and are therefore not part of any Cognition batteries. Supplemental tests may be administered either in addition to or, more likely, in lieu of Cognition battery tests assessing the same construct.

Early Childhood Cognition Battery

The Early Childhood Cognition Battery was designed to be developmentally appropriate for participants ages 4–6, but it can also be administered to participants ages 7 and 8 and will produce “extended” normative data. This battery includes tests that assess the following constructs: attention, episodic memory, executive function, processing speed, and language. Tests in this battery include Picture Vocabulary, Flanker Inhibitory Control and Attention, Dimensional Change Card Sort, Picture Sequence Memory, and Speeded Matching. Administering all tests in the Early Childhood Cognition Battery will produce an Early Childhood Composite score.

Cognition Battery

The Cognition Battery is recommended for participants ages 7+, but it can also be administered to participants down to age 6 and will produce “extended” normative data. This battery includes tests that assess the following constructs: attention, episodic memory, executive

function, language, processing speed, and working memory. Tests in this battery include Picture Vocabulary, Flanker Inhibitory Control and Attention, List Sorting Working Memory, Dimensional Change Card Sort, Pattern Comparison Processing Speed, Picture Sequence Memory, and Oral Reading Recognition. Administering all tests in the Cognition Battery will produce a Fluid Cognition score, a Crystallized Cognition score, and a Total Cognition Composite score.

Accessing Cognition Tests

Cognition tests are not available for immediate use in the app. To preserve test integrity, access to the Cognition tests is limited to users who have appropriate credentials, such as training in interpreting test results. New users are asked to submit credentials demonstrating they have the appropriate knowledge, skills, training, and experience to responsibly use NIH Toolbox Cognition tests or are working under the supervision of someone qualified to use those tests. For a full list of credentials, please visit NIHToolbox.org. Users who already have Cognition Access credentials from previous versions of the NIH Toolbox may use those credentials in the NIH Toolbox V3 app.

To apply for access to the Cognition tests, either navigate to the Settings screen and tap the *Access to Cognition* section, tap on the lock symbol beside locked Cognition tests on the test selection screen, or go to www.NIHToolbox.org/get-the-toolbox/#approval-for-cognition-measures-1 and tap the *Request access to Cognition tests* button to submit a Cognition Access request. Application for Cognition access is free, but it is required for all users in order to administer the Cognition tests, whether you have a paid subscription or are exploring the app via the free trial. Cognition access on NIHToolbox.org also gives you access to other restricted materials needed to administer Cognition tests (e.g., List Sorting Working Memory Examiner Answer Sheet).

Once the request is submitted and approved by NIH Toolbox Customer Support, you must enter the credentials into the NIH Toolbox V3 app on each device your subscription is installed on. To do this, navigate to the Settings screen, tap the *Access to Cognition* section, and then *Enter Unlock Code*. The name, email, institution, and code must be entered exactly as they were provided to you. Cognition tests can be administered immediately after the Cognition access code has been entered.

For more information about access to Cognition tests and restricted materials, please visit NIHToolbox.org.

V3 Revision Details

Instructions for Cognition tests have been streamlined and made consistent across tests where possible. Many tests in NIH Toolbox V2 had separate instructions for different age groups and simpler practice items for younger participants. These instructions and practice items were

revisited in V3, and there is now one version of each test that is appropriate for participants of all ages. For example, the three NIH Toolbox V2 Dimensional Change Card Sort tests (for ages 3–7, ages 8–11, and ages 12+) were streamlined into one Dimensional Change Card Sort test in V3. Additionally, the instructions for each test were recorded and are now played by audio to facilitate more standardized test administration (except for Oral Symbol Digit, which has a printed Examination Sheet that requires more hands-on examiner instruction).

Images in the DCCS and PC tests have been updated and some outdated images from PV have been replaced (e.g., old flip phone). The “Home Base” sheet in V2, which was used for the administration of DCCS and Flanker, is no longer required for these tests in V3. Removing this administration requirement eliminated a relatively significant motor component for participants who needed to return their finger to Home Base after each item. It also allows participants to use a tapping strategy that works best for them (e.g., finger hovering approach). Another change in the administration requirements is for PC, in which it is no longer required to enter the participant’s dominant hand prior to administration of the test.

Five new tests have been added and are detailed in the sections below: Face Name Associative Memory Exam, Face Name Associative Memory Exam Delay, Rey Auditory Verbal Learning Delay, Speeded Matching, and Visual Reasoning.

Normative data were collected on the revisions listed above, and the resulting analyses informed some updates to the scoring, updates to fail rules, and slight changes to appropriate test age ranges. More details about scoring and normative analyses can be found in the NIH Toolbox V3 Technical Manual.

Tests

Dimensional Change Card Sort

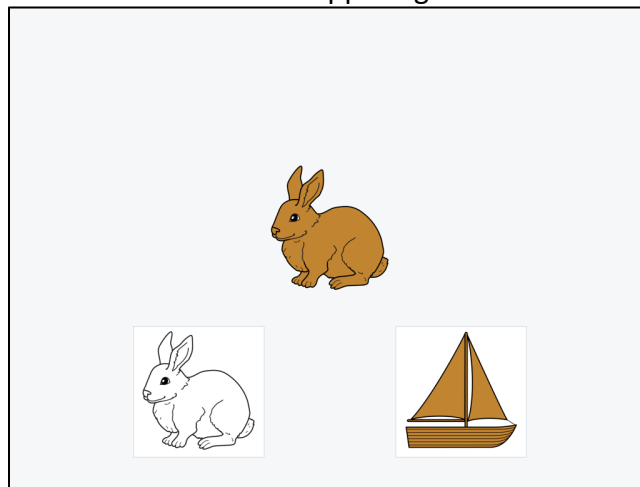
The Dimensional Change Card Sort test is an assessment of cognitive flexibility and attention. Two target pictures are presented that vary between two dimensions (i.e., shape and color). Participants ages 4 and older are asked to match a series of bidimensional test pictures (e.g., orange balls and blue trucks) to the target pictures, first according to one dimension (i.e., color) and then, after several trials, according to the other dimension (i.e., shape). The relevant dimension of sorting is indicated by a cue word (i.e., “shape” or “color”) that appears on the screen and via audio.

Administration

Dimensional Change Card Sort has four phases: Color Practice, Color Trials, Shape Trials, and Live Items.

Color Practice

The instructions are presented on the screen and via audio: ***We are going to play some games. In the COLOR game, choose the picture that's the same COLOR as the picture in the middle of the screen. If it's BROWN, choose this picture.*** The border around the correct picture turns blue and flashes. The participant should tap the picture of the brown boat to advance to the next screen. If the participant does not tap the correct picture, point to the brown boat, then tap the *Next* button in the upper right corner.



The next screen says: ***If it's WHITE, choose this picture.*** The border around the correct picture turns blue and flashes. If the participant does not tap the correct picture, point to the white rabbit, then tap the *Next* button in the upper right corner.

After the instructions are presented, the test advances to a transition screen to begin the practice items. The audio says: ***Now you try.*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the practice items.

There are five practice items. As each practice item appears on the screen, the audio says: ***COLOR.*** The audio provides feedback after the participant responds to each practice item. If

the participant responds correctly by tapping the correct picture, the audio says: ***That's right!*** Then, the test automatically advances to the next practice item or to the next set of instructions that appears after the last practice item.

If the participant responds incorrectly by tapping the incorrect picture, the audio provides corrective feedback: ***This is the same color, so you should choose this picture.*** The border around the correct picture turns blue and flashes. The test automatically advances to the next practice item or to the next set of instructions that appears after the last practice item.

Color Trials

After the Color practice items, the next set of instructions is presented on the screen and via audio: ***Now, we're going to play with some different SHAPES and COLORS. This time we'll use BALLS and TRUCKS that are ORANGE and BLUE.*** Tap the *Next* button.

The next screen says: ***Like the COLOR game before, choose the picture that's the same COLOR as the picture in the middle of the screen. If it's a BLUE one, choose this picture.*** The border around the correct picture turns blue and flashes. The participant should tap the picture of the blue ball to advance to the next screen. If the participant does not tap the correct picture, point to the blue ball, then tap the *Next* button.

The next screen says: ***And if it's an ORANGE one, choose this picture.*** The border around the correct picture turns blue and flashes. The participant should tap the picture of the orange truck to advance to the next screen. If the participant does not tap the correct picture, point to the orange truck, then tap the *Next* button.

After the instructions are presented, the test advances to a transition screen to begin the Color trial items. The audio says: ***Now it's your turn. Go as fast as you can without making mistakes.*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the trial items.

There are five trial items. As each trial item appears on the screen, the audio says: ***COLOR.*** After the participant responds to each trial item, the test automatically advances to the next screen. These trial items are scored, so no corrective feedback is presented by the test, and you should not offer any assistance to the participant. If the participant does not respond after 5 seconds, prompt them by saying, ***"Choose one of the pictures."*** If the participant does not respond within 10 seconds, the test automatically advances to the next item or to the next set of instructions that appears after the last item.

Shape Trials

After the Color trial items, the next set of instructions is presented on the screen and via audio: ***Now, we're going to play the SHAPE game. In the SHAPE game, choose the picture that's the same SHAPE as the picture in the middle of the screen. If it's a TRUCK, choose this picture.*** The border around the correct picture turns blue and flashes. The participant

should tap the picture of the orange truck to advance to the next screen. If the participant does not tap the correct picture, point to the orange truck, then tap the *Next* button.

The next screen says: ***And if it's a BALL, choose this picture.*** The border around the correct picture turns blue and flashes. The participant should tap the picture of the blue ball to advance to the next screen. If the participant does not tap the correct picture, point to the blue ball, then tap the *Next* button.

After the instructions are presented, the test advances to a transition screen to begin the Shape trial items. The audio says: ***Now it's your turn. Go as fast as you can without making mistakes.*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the trial items.

There are five trial items. As each trial item appears on the screen, the audio says: ***SHAPE.*** After the participant responds to each of the trial items, the test automatically advances to the next set of instructions. These trial items are scored, so no corrective feedback is presented by the test, and you should not offer any assistance to the participant. If the participant does not respond after 5 seconds, prompt them by saying, ***"Choose one of the pictures."*** If the participant does not respond within 10 seconds, the test automatically advances to the next item or to the transition screen that appears after the last item.

Live Items

Regardless of performance on the practice and trial items, all participants move on to the live items. If the participant has answered every practice and trial item incorrectly and you believe they do not understand the task, you may choose to perform the admin gesture to pause and skip this test.

After the participant completes the practice and trial items, the test advances to the transition screen for the live items. The audio says: ***We can also play both games together. Remember, when you hear the word SHAPE, choose the picture that is the same shape as the picture in the middle of the screen. When you hear the word COLOR, choose the picture that is the same color as the picture in the middle of the screen. Go as fast as you can without making mistakes. Are you ready?*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the live items.

If the participant uses two fingers to tap both response options at the same time, prompt them by saying, ***"Tap only one picture at a time."*** If the participant continues to use two fingers to tap both response options at the same time, the test should be considered invalid.

All 30 live items are administered, regardless of the number of errors the participant made on the practice items. The items will switch between color and shape. The participant should respond as quickly as possible. If the participant does not respond after 10 seconds, the test automatically advances to the next item.

Face Name Associative Memory Exam

Face Name Associative Memory Exam (FNAME) is an assessment of associative memory given in two parts. Participants ages 18 and older are asked to remember a set of twelve faces and the names they are paired with.

FNAME Delay is an assessment of associative memory that is administered 5 to 25 minutes after FNAME. NIH Toolbox V3 FNAME normative data were collected with the administration of the Visual Reasoning and Oral Symbol Digit tests between FNAME and FNAME Delay. Participants ages 18 and older are asked to recall which of the faces they saw earlier, to recall the first letter of the name for each face, and then to match each face with the correct name.

Part 1: Face Name Associative Memory Exam

Administration

Face Name Associative Memory Exam (FNAME) has two phases: Instructions and Learning.

Instructions

The instructions are presented on the screen and via audio: ***You will see some pictures of faces with names below them. Each face-name pair will appear for a few seconds. For each face, decide whether it will be easy or hard for you to remember the name that goes with it. Tap Easy if you think it will be easy to remember the face-name pair. Tap Hard if you think it will be hard to remember the face-name pair. Choose as quickly as you can before the next picture appears.*** To move to the next screen, tap the *Next* button in the upper right corner.

The next screen shows a picture of a woman's face and a name below it. At the bottom of the screen are two buttons: *Easy* and *Hard*. The test will progress either when the participant has selected one of the two buttons or after 5 seconds of no response.

Learning

After the screen with the picture of the woman's face, the test advances to a transition screen to begin the learning trial. The audio says: ***You will now see more pictures of faces paired with names. For each face, decide whether it will be easy or hard for you to remember the name that goes with it. Choose as quickly as you can before the next picture appears. Try to remember the name that goes with each face.*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the learning trial.

There are twelve learning items, each with a picture of a face and a name below it. For each item, the participant should decide whether it will be easy or hard to remember the face-name pair and then tap the corresponding button.

After all twelve face-name pairs are presented, a transition screen appears and the audio says: ***Good job! We will ask you about these names and faces later.***

Part 2: Face Name Associative Memory Exam Delay

Please note that FNAME should be administered to the participant 5 to 25 minutes *before* FNAME Delay. During this delay, it is recommended either that the participant take a break or that you administer tests that do not tax memory (e.g., Visual Reasoning). If you attempt to begin FNAME Delay too soon, too late, or without first administering FNAME, a warning message will appear, giving you the option to continue or to stop the assessment. Any deviations in standard testing procedure (e.g., beginning FNAME Delay less than 5 minutes after FNAME) should be recorded in the assessment notes.

Administration

FNAME Delay has three phases: Face Seen Before, First Letter of Name, and Matching.

Face Seen Before (FSB)

The instructions are presented on the screen and via audio: ***Now you are going to be asked some questions about the faces and names you saw earlier. On the next screen, you will see three faces. Tap the face that you have already seen. Choose as quickly as you can.*** When the participant indicates that they are ready, tap the *Next* button in the upper right corner to advance to the practice item.

On the next screen, there are three faces, and the participant should select which of the faces were presented in FNAME.

After the practice item, there is a transition screen to begin the FSB live items. The audio says: ***Now you're going to do some more. You will see three faces. Tap the face that you have already seen. Choose as quickly as you can before the next pictures appear.*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the live items.

Twelve items are presented, each with three faces. For each item, the participant should select the face that appeared in FNAME.

First Letter of Name (FNL)

Then, the test advances to the transition screen for the next set of items. The audio says: ***On the next screen, look at the picture and tap the FIRST letter of the person's name.*** When the participant indicates that they are ready, tap the *Next* button to advance to the practice item.

On the next screen, there is a face at the top and a keyboard with letters below it. The participant should select the first letter of the name that face is associated with from FNAME.

After the practice item, there is a transition screen to begin the FNL live items. The audio says: ***Now you're going to do some more. Look at the picture and tap the FIRST letter of***

the person's name. Choose as quickly as you can before the next picture appears. When the participant indicates that they are ready, slide the purple button all the way to the right to begin the live items.

Twelve items are presented, each with one of the faces that appeared in FNAME and a keyboard. For each item, the participant should select the first letter of the person's name that was presented in FNAME.

Matching (FNM)

Then, the test advances to a transition screen for the next set of items. The audio says: ***On the next screen, look at the picture and tap the name that goes with the face. Choose as quickly as you can.*** When the participant indicates that they are ready, tap the *Next* button to advance to the practice item.

On the next screen, there is a face at the top and three names below it. The participant should select the name that face is associated with from FNAME.

After the practice item, there is a transition screen to begin the FNM live items. The audio says: ***Now you're going to do some more. Look at the picture and tap the name that goes with the face. Choose as quickly as you can before the next picture appears.*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the live items.

Twelve items are presented, each with one of the faces that appeared in FNAME and three names. For each item, the participant should select the name that was presented with the face in FNAME.

Flanker Inhibitory Control and Attention

The Flanker Inhibitory Control and Attention test is an assessment of inhibitory control and attention. Participants ages 4 and older are asked to focus on a particular stimulus while inhibiting attention to the stimuli flanking it.

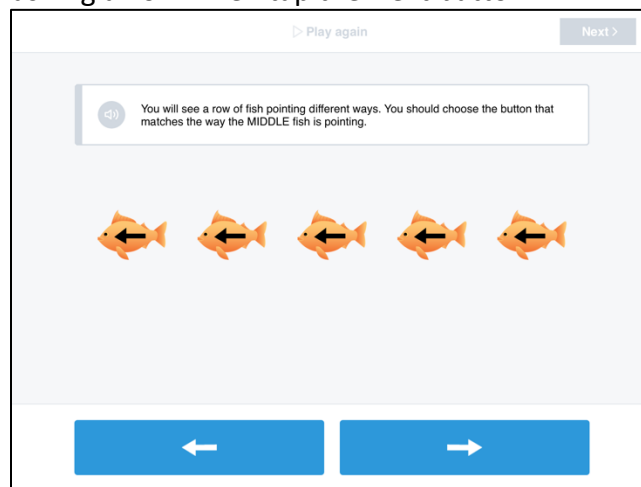
Administration

Flanker Inhibitory Control and Attention has three phases: Instructions, Practice, and Live Items.

Instructions

The instructions are presented on the screen and via audio. After each instruction is presented, the correct arrow will flash on the bottom of the screen. Demonstrate how to perform the task by pointing to the appropriate button. To automatically move to the next screen, tap the flashing arrow button or the *Next* button in the upper right corner.

The first instruction screen says: You will see a row of fish pointing different ways. You should choose the button that matches the way the MIDDLE fish is pointing. A red circle around the middle fish will flash for 3 seconds, and then the arrow at the bottom of the screen that matches the direction of the middle fish will begin flashing. Point to the middle fish and then to the flashing arrow. Then tap the Next button.



The second instruction screen says: If the MIDDLE fish is pointing this way (red circle around middle fish flashes), choose this button (button on bottom flashes). Point to the middle fish as the red circle flashes, and then point to the matching arrow. Then tap the Next button.

The third instruction screen flips the direction of the fish and says: If the MIDDLE fish is pointing this way (red circle around middle fish flashes), choose this button (button on bottom flashes). Point to the middle fish as the red circle flashes, and then point to the matching arrow. Then tap the Next button.

The fourth and last instruction screen shows the middle fish pointing in a different direction than the other fish and says: ***Sometimes all the fish will point the same way. Sometimes the MIDDLE fish will point a different way like this*** (red circle around middle fish flashes): ***You should always choose the button that matches the way the MIDDLE fish is pointing***

(button on bottom flashes). Point to the middle fish as the red circle flashes, and then point to the matching arrow. Then tap the *Next* button.

Practice

After the instructions are presented, the test advances to a transition screen to begin the practice items, which says: ***Now you try. Keep your eyes on the star. Go as fast as you can without making mistakes. Are you ready to practice?*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the practice items.

There are five practice items. Before each practice item, a screen with a star in the middle flashes briefly to help the participant focus on the center of the screen. After the participant responds to each of the five practice items, the audio provides feedback. If the participant responds correctly by tapping the correct arrow button, the audio says: ***Great job!*** Then, the test automatically advances to the next practice item or to the transition screen that appears after the last practice item.

If the participant responds incorrectly by tapping the incorrect arrow button, the incorrect arrow button will change color to red and the audio will provide corrective feedback: ***The fish is pointing this way, so you should choose this button.*** The correct arrow button stays blue and will flash. The test automatically advances to the next practice item or to the transition screen that appears after the last practice item.

Live Items

Regardless of performance on the practice items, all participants move on to the live items. If the participant has answered every practice item incorrectly and you believe they do not understand the task, you may choose to perform the admin gesture to pause and skip this test.

After the participant completes the five practice items, the test advances to the transition screen for the live items, which says: ***Now you're ready to do this without me. Keep your eyes on the star in the middle of the screen. Go as fast as you can without making mistakes. Are you ready?*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the live items.

If the participant uses two fingers to tap both response options at the same time, prompt them by saying, ***“Tap only one button at a time.”*** If the participant continues to use two fingers to tap both response options at the same time, the test should be considered invalid.

All 30 live items are administered automatically, regardless of the number of errors the participant made on the practice items.

List Sorting Working Memory

The List Sorting Working Memory test is an assessment of working memory. Participants ages 5 and older are asked to recall and sequence different stimuli that are presented visually and via audio. Pictures of different foods and animals are displayed on the screen with written text and an accompanying audio recording that names the picture/item. The participant is asked to say the names of the items back to the examiner in size order from smallest to largest.

There are two different conditions: 1-List and 2-List. In the 1-List condition, participants are asked to order either food *or* animals in size order. In the 2-List condition, participants are asked to order both food *and* animals in size order, starting with the foods, then moving to the animals.

The examiner uses an external keyboard wirelessly connected to the iPad to record scores for each item. For an item to be marked as correct, the participant must name all the foods and/or animals in the correct order without any intrusions. Self-corrections are scored as correct. It is also acceptable for the participant to provide a synonym. For example, in English, responses such as these should be marked as correct: puppy for dog, bunny for rabbit, and lamb for sheep.

If necessary, the participant may take short breaks between items. Throughout the test, it may be necessary to give the participant the following reminder: **“It is important to pay attention to the size of the foods and animals that you see on the screen when putting things in size order from smallest to biggest.”** It is also acceptable during the 2-List condition to remind the participant of the rules: **“Tell me the foods first, then the animals.”**

Setting up Bluetooth Wireless Keyboard

- Go to the Settings app of the iPad and enable Bluetooth.
- Make sure the keyboard is in discovery mode. A small light on the keyboard starts to blink on many keyboards when discovery mode is enacted.
- Select the keyboard when it appears on the My Devices list on the iPad.
- If a pop-up window appears on the iPad screen, follow the instructions, and enter the required code on the keyboard.
- The onboard/on-screen keyboard that normally appears on the iPad screen will not work when the external keyboard is working.

Using the Keyboard

- After the participant responds to each item, type **1** or **0** (see Administration section below) into the keyboard. Then press the spacebar to move to the next item.
- Once the spacebar is pressed, you cannot change the answer to the previous item.
- Control + Command + L on the keyboard is equivalent to the NIH Toolbox administrator gesture used on other tests to pause or stop an administration. Like the NIH Toolbox administrator gesture, when Control + Command + L is entered on the keyboard, a passcode screen will appear and ask for the passcode of the user who started the

assessment. Select from among the options: Add/Edit Test Notes, Stop Assessment, Skip Test, Delay Test, Resume Test.

Administration

List Sorting Working Memory has six phases: 1-List Instructions, 1-List Practice, 1-List Live Items, 2-List Instructions, 2-List Practice, and 2-List Live Items.

1-List Instructions

The instructions are presented on the screen and via audio: ***You are going to see some pictures one at a time on the screen. When you hear the chime, tell me the pictures you just saw in size order from smallest to biggest. For example, if you see a motorcycle, a bus, and a car, you would say: motorcycle, car, bus. Are you ready to practice?*** When the participant indicates that they are ready, press the spacebar on the wireless keyboard.

1-List Practice

There are two practice items. The test displays the pictures and plays the associated audio. If the participant responds incorrectly to either practice item, there is a second trial that provides the opportunity to answer again. The test will only advance to the items if the participant answers at least one of the practice trials correctly. If the participant answers all practice trials incorrectly, the test ends.

Practice Item 1:

For the first practice item, two pictures appear, one at a time, with an audio prompt: ***Horse. Dog.*** After the presentation of the item, the screen goes blank and a chime dings to signify that the list has ended and the participant should begin responding. The participant should respond by saying, "Dog. Horse." If the participant responds correctly, press **1** on the keyboard and then press the spacebar. The audio says: ***That's right!*** Then, the test automatically advances to the next practice item.

If the participant responds incorrectly, press **0** on the keyboard and then press the spacebar. The audio says: ***Let's try that again. You saw a dog and a horse. The dog is smaller than the horse. Now say the animals in size order.***

If the participant responds correctly to the second trial, press **1** and then press the spacebar. The audio says: ***That's right!*** If the participant responds incorrectly, press **0** and then press the spacebar. The audio says: ***You saw a dog and a horse, so you would say: "Dog. Horse." Let's try another one.***

Practice Item 2:

A transition screen to the second practice item appears and the audio says: ***Are you ready?*** When the participant indicates that they are ready, press the spacebar.

For the second practice item, three pictures appear, one at a time, with an audio prompt: ***Elephant. Rabbit. Sheep.*** After the presentation of the item, the screen goes blank and a

chime dings. The participant should respond by saying, “Rabbit. Sheep. Elephant.” If the participant responds correctly, press **1** on the keyboard and then press the spacebar. The audio says: ***That’s right!*** Then, the test automatically advances to the live item transition screen.

If the participant responds incorrectly, press **0** and then press the spacebar. The audio says: ***Let’s try that again. You saw a rabbit, a sheep, and an elephant. The rabbit is smaller than the sheep, and the sheep is smaller than the elephant. The rabbit is the smallest animal, the sheep is the next-biggest animal, and the elephant is the biggest animal. Now say the animals in size order, starting with the smallest animal.***

If the participant responds correctly to the second trial, press **1** and then press the spacebar. The audio says: ***That’s right!*** If the participant responds incorrectly, press **0** and then press the spacebar. The audio says: ***You saw a rabbit, a sheep, and an elephant, so you would say: “Rabbit. Sheep. Elephant.”*** If the participant answered both practice items incorrectly both times (i.e., all four trials), the test ends.

1-List Live Items

After the participant completes the two practice items, the test advances to the transition screen for the live items and the audio says: ***Let’s look at some more pictures. Remember, when you hear the chime, you should tell me the pictures you saw from smallest to biggest. Are you ready?*** When the participant indicates that they are ready, press the spacebar to begin the live items.

Participants ages 5 to 8 begin the live items with a two-picture item. Participants ages 9 and older begin the live items with a four-picture item. If the participant answers correctly, press **1** on the keyboard to advance to the next item. If the participant answers incorrectly, press **0** on the keyboard to advance to the next item. No feedback is given for live items. After entering a score for each item, a new screen appears and the audio says: ***Are you ready?*** When the participant is ready, press the spacebar to advance to the next item.

To score the List Sorting Working Memory test, you must use the [NIH Toolbox List Sorting Working Memory Examiner Answer Sheet](#), which is available for free on NIHToolbox.org after you have gained Cognition access. For each item, there is a letter on the bottom of the screen that corresponds to the item code on the [NIH Toolbox List Sorting Working Memory Examiner Answer Sheet](#). For each item, refer to the Examiner Answer Sheet to determine if the participant’s response is correct or incorrect. Press **1** on the keyboard for correct responses and **0** for incorrect responses.

1-List has items of each sequence length, from two items/pictures to seven items/pictures. To move to the next sequence length, the participant must respond correctly to at least one of the two items at each sequence length. Once a basal (answering both items of a sequence length correctly) and a ceiling (answering both items of a sequence length incorrectly) have both been reached, the test automatically advances to the instructions for

the 2-List items. If the participant does not respond correctly to any 1-List items, the test ends.

2-List Instructions

The next set of instructions are presented on the screen and via audio: ***We are going to look at more pictures. This time, you will see both foods and animals in a set of pictures. When you hear the chime, tell me the foods first from smallest to biggest, and then tell me the animals from smallest to biggest. Let's try some for practice.*** When the participant indicates that they are ready, press the spacebar on the keyboard.

2-List Practice

There are two practice items. The test displays the pictures and plays the associated audio. If the participant responds incorrectly to either practice item, there is a second trial that provides the opportunity to answer again. The test will only advance to the live items if the participant answers at least one of the practice trials correctly. If the participant answers all practice trials incorrectly, the test ends.

Practice Item 3:

For the third practice item, two pictures appear, one at a time, with an audio prompt: ***Bear. Banana.*** After the presentation of the item, the screen goes blank and a chime dings. The participant should respond by saying, "Banana. Bear." If the participant responds correctly, press **1** and then press the spacebar. The audio says: ***That's right!*** Then, the test automatically advances to the next practice item.

If the participant responds incorrectly, press **0** and then press the spacebar. The audio says: ***Let's try that again. The bear is an animal. The banana is a food. Now say the food first, and then the animal.***

If the participant responds correctly to the second trial, press **1** and then press the spacebar. The audio says: ***That's right!*** If the participant responds incorrectly, press **0** and then press the spacebar. The audio says: ***You saw a bear and a banana, so you would say: "Banana. Bear." Let's try another one.***

Practice Item 4:

A transition screen to the fourth practice item appears and the audio says: ***Are you ready?*** When the participant indicates that they are ready, press the spacebar.

For the fourth practice item, three pictures appear, one at a time, with an audio prompt: ***Frog. Pineapple. Tiger.*** After the presentation of the item, the screen goes blank and a chime dings. The participant should respond by saying, "Pineapple. Frog. Tiger." If the participant responds correctly, press **1** and then press the spacebar. The audio says: ***That's right!*** Then, the test automatically advances to the live item transition screen.

If the participant responds incorrectly, press **0** and then press the spacebar. The audio says: ***Let's try that again. You saw a frog, a pineapple, and a tiger. The pineapple is a food; the frog is the smallest animal, and the tiger is the biggest animal. Now, say the food in size order starting with the smallest food, and then the animals in size order starting with the smallest animal.***

If the participant responds correctly to the second trial, press **1** and then press the spacebar. The audio says: ***That's right!*** If the participant responds incorrectly, press **0** and then press the spacebar. The audio says: ***You saw a frog, a pineapple, and a tiger, so you would say: "Pineapple. Frog. Tiger."*** If the participant answered both practice items incorrectly both times (i.e., all four trials), the test ends.

2-List Live Items

After the participant completes the two practice items, the test advances to the transition screen for the live items: ***Let's look at some more pictures. Remember, when you hear the chime, tell me all the foods first from smallest to biggest, and then the animals from smallest to biggest. Are you ready?*** When the participant indicates that they are ready, press the spacebar to begin the live items.

The test uses the participant's age to determine which items it initially presents. If you feel that a participant should begin the test at a level higher or lower than that determined by their age, you should use the Start Point Override feature on the participant's *Demographics* screen. Using the override may shorten the test. It is important to note that the test will eventually arrive at the same score whether you used the override or not.

Participants ages 5 to 8 begin the test with a two-picture item. Participants ages 9 and older begin the test with a four-picture item. If the participant answers correctly, press **1** on the keyboard to advance to the next item. If the participant answers incorrectly, press **0** on the keyboard to advance to the next item. No feedback is given for live items. After entering a score for each item, a new screen appears and the audio says: ***Are you ready?*** When the participant is ready, press the spacebar to advance to the next item.

For each item, there is a letter on the bottom of the screen that corresponds to the item code on the [NIH Toolbox List Sorting Working Memory Examiner Answer Sheet](#). For each item, refer to the Examiner Answer Sheet to determine if the participant's response is correct or incorrect. Press **1** on the keyboard for correct responses and **0** for incorrect responses.

The 2-List test has two items of each sequence length, from two pictures to seven pictures. To move to the next sequence length, the participant must respond correctly to at least one of the two items at each sequence length. Once a basal (answering both items of a sequence length correctly) and a ceiling (answering both items of a sequence length incorrectly) have both been reached, the test ends.

Oral Reading Recognition

The Oral Reading Recognition test is an assessment of reading decoding skills and crystallized abilities administered in a computer adaptive test (CAT) format. Participants ages 7 and older are asked to read letters and words aloud, pronouncing them as accurately as possible. The examiner uses an external keyboard wirelessly connected to the iPad to record scores for each item.

Setting up Bluetooth Wireless Keyboard

- Go to the Settings app of the iPad and enable Bluetooth.
- Make sure the keyboard is in discovery mode. A small light on the keyboard starts to blink on many keyboards when discovery mode is enacted.
- Select the keyboard when it appears on the My Devices list on the iPad.
- If a pop-up window appears on the iPad screen, follow the instructions, and enter the required code on the keyboard.
- The onboard/on-screen keyboard that normally appears on the iPad screen will not work when the external keyboard is working.

Using the Keyboard

- After the participant responds to each item, type **1** or **0** (see Administration section below) into the keyboard. Then press the spacebar to move to the next item.
- Once the spacebar is pressed, you cannot change the answer to the previous item.
- Control + Command + L on the keyboard is equivalent to the NIH Toolbox administrator gesture used on other tests to pause or stop an administration. Like the NIH Toolbox admin gesture, when Control + Command + L is entered on the keyboard, a passcode screen will appear and ask for the passcode of the user who started the assessment. Select from among the options: Add/Edit Test Notes, Stop Assessment, Skip Test, Delay Test, Resume Test.

Administration

Oral Reading Recognition has two phases: Instructions and Live Items.

Instructions

The instructions are presented on the screen and via audio: ***Now, we're going to look at some letters and some words. Read each letter or word out loud. Some will be easy, and some will be hard. Don't worry if you don't know the word or its meaning—just read it out loud the best you can. Are you ready?*** When the participant indicates that they are ready, press the spacebar on the wireless keyboard.

Live Items

Letters (for younger children) and words are presented one at a time on the screen in an untimed fashion, until the test is completed. When the first item appears, say, ***“What is this letter/word (say whichever is appropriate)?”*** You may repeat this prompt as many times as needed throughout the test. As the participant says the word out loud, check the *Oral Reading Recognition Pronunciation Guide*, which is available for free on NIHToolbox.org

after you have gained Cognition access. Type **1** on the keyboard if the response is correct or **0** if the response is incorrect. For the youngest children, some items may require them to identify the letters in an array with three symbols or to identify a specific letter in an array of four letters. In such cases, the audio will instruct the participant to point to the correct answer on the screen.

It is possible to go back one previous item to change an answer before pressing the spacebar, if the participant self-corrects or if you made an error while entering that score. To do this, press the left arrow on the keyboard, then press **1** or **0** to correct the score for that previous item, then press the spacebar to move to the next item. The next item may or may not be the same word/letter that was presented before going back to a previous item or changing an answer.

If the participant says they don't know the word or cannot read it, say, **"It is OK if you don't know the word or what it means—just try to read it out loud the best you can."** This prompt can be used to reassure the participant if they refuse to read the letters or words. If, after prompting, the participant still refuses to offer a response, mark the item as incorrect (**0**) and press the spacebar to move on to the next item.

The test uses a variable-length CAT format, so some participants will see fewer items than others. The start point is determined by the participant's age (for participants younger than 19) or education (for participants 19 and older). Specific words presented depend on the participant's performance, and the number of items presented depends on age/education and performance. For most participants, the test will last approximately 4 minutes and will contain about 30 items.

The test uses age (for participants younger than 19) or education (for participants 19 and older) to determine which items it initially presents. If you feel that a participant should begin the test at a level higher or lower than that determined by their age/education, you should use the Start Point Override feature on the participant's *Demographics* screen. Using the override may shorten the test. It is important to note that the test will eventually arrive at the same score whether you used the override or not.

Oral Symbol Digit

The Oral Symbol Digit test is an assessment of processing speed. Participants ages 5 and older are given a laminated Examination Sheet and asked to use the key at the top of the page to orally call out the number that corresponds to each symbol in the grid below. The key matches the numbers 1 through 9 with 9 unique symbols. The examiner marks correct responses on the screen.

Administration

Oral Symbol Digit has three phases: Instructions, Practice, and Live Items.

Instructions

Turn the iPad screen away from the participant so they do not see it throughout this test.

The instructions are presented on the screen. Read the black text aloud and demonstrate the motions that are in blue text. Place the Oral Symbol Digit Examination Sheet in front of the participant with Side 1 facing up, and say: ***Please look at the symbols at the top of this page. Each symbol is matched with a number.*** Point to the numbers and symbols in the key to show how they are matched, then say: ***Now look here.*** Point to the row of symbols without numbers, then say: ***Here are symbols, but no numbers. Tell me the number that goes with each symbol. See this symbol?*** Point to O, then say: ***It is matched with the number 6*** (point to the key), ***so you would say, "six."*** ***This symbol*** (point to X), ***is matched with the number 8*** (point to the key), ***so you would say, "eight."*** ***Does this make sense?*** After the first screen of instructions, tap the *Next* button in the upper right corner.

Practice

The next screen presents instructions for administering the practice items. Read the black text aloud and follow the directions that are in blue text. Say: ***Now you try the rest for practice. Say each number out loud so I can hear you.*** The correct answers, in order, are: 6, 8, 3, 9, 5, 4, 1, 7, 2. If the participant responds correctly, say: "That's right!" If the participant responds incorrectly, correct the response. Repeat the practice items if necessary until the participant understands and answers correctly.

After the participant has completed the practice row successfully, say: ***Good. Now you are going to do some more.*** Tap the *Next* button.

The next screen presents the final set of instructions to the participant. Say: ***When I turn this sheet over, you will see more rows that have symbols but no numbers with them. When I say "begin," tell me the number that matches each symbol. Work as quickly as you can without skipping any symbols or making any mistakes. When you are finished with the first row, go on to the next one, without skipping any rows. Keep working until you hear a bell sound. If you make a mistake, just tell me the correct answer and keep going. Are you ready?*** When the participant indicates they are ready, tap the *Next* button.

Live Items

Turn over the Oral Symbol Digit Examination Sheet so the full grid of items is facing up. Then tap *Start Test* to begin the timer and say, “**Begin.**”

All 143 items, with the correct responses, appear on the scrollable screen as selectable buttons. For legibility, all 143 items do not appear on the screen at once, so scroll down on the screen to view more items as needed. Tap each item the participant answers correctly to mark it as correct; tap it again to deselect it. Do not tap items that the participant answers incorrectly. Self-corrections should be marked as correct. Skipped items should be marked as incorrect (i.e., remain unselected on the screen).

Allow the participant to use their finger to move along the row, should they choose to do so.

The time remaining is displayed (for your information only) at the bottom of the screen. At the end of 120 seconds, the test will play a sound to alert the participant that time is up. When the 120 seconds has expired, say, “**Stop.**”

After 120 seconds, a window appears on the screen that says: *Are you finished marking the correct answers from the participant? If you tap No, please finish marking correct answers and then tap Next.* Tap *Yes* if you have finished scoring the items. Otherwise, tap *No* and continue marking the participant’s responses that were given before time was up. When you are finished, tap *Next* to end the test.

Pattern Comparison Processing Speed

The Pattern Comparison Processing Speed test is an assessment of processing speed. Participants ages 5 and older are asked to quickly determine whether two stimuli are the same or not the same.

Administration

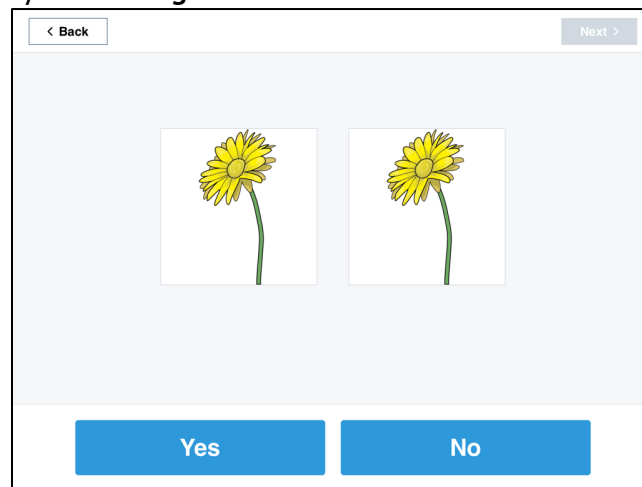
Pattern Comparison Processing Speed has three phases: Instructions, Practice, and Live Items.

Instructions

The instructions are presented on the screen and via audio: ***You are going to see two pictures on the screen. Sometimes, the pictures are the same and sometimes, the pictures are not the same. If the pictures are the SAME, tap YES.*** The Yes button at the bottom of the screen flashes four times, then the audio continues: ***If the pictures are NOT the same, tap NO.*** The No button at the bottom of the screen flashes four times, then the audio continues: ***Use only one finger to tap.*** When the participant indicates that they are ready, tap the Next button in the upper right corner.

Practice

There are three practice items. Each practice item has two pictures in the middle of the screen, with the Yes and No buttons at the bottom of the screen. As each practice item appears on the screen, the audio says: ***Are these the same?*** If the participant responds correctly, the audio says: ***That's right!***



If the participant does not respond within 10 seconds, the audio prompts the participant: ***Are these the same?***

If the participant responds incorrectly, the response they selected turns red and the audio says either: ***These pictures are the same, so you should tap YES*** (Yes button flashes four times) OR ***These pictures are NOT the same, so you should tap NO*** (No button flashes four times). Then that practice item is presented a second time. Based on the participant's response, the audio will either say: ***That's right!*** or provide corrective feedback. Then the

test automatically advances to the next practice item or to the transition screen that appears after the last practice item.

Live Items

Regardless of performance on the practice items, all participants move on to the live items. If the participant has answered every practice item (i.e., all 6 trials) incorrectly and you believe they do not understand the task, you may choose to perform the admin gesture to pause and skip this test.

After the participant completes the three practice items, the test advances to the transition screen for the live items. The audio says: ***Now you'll do some more. Go as fast as you can without making mistakes. Are you ready?*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the live items.

If the participant uses two fingers to tap both response options at the same time, prompt them by saying, ***“Tap only one button at a time.”*** If the participant continues to use two fingers to tap both response options at the same time, the test should be considered invalid.

The participant is given 80 seconds to respond to as many of the 133 live items as possible. If the participant needs a reminder to stay on task, provide one or more succinct prompts, such as: ***“Look at the screen,” “Are these the same?” “Yes or no?” “Remember to tap a button,”*** or ***“Remember to go as fast as you can.”***

Picture Sequence Memory

The Picture Sequence Memory test is an assessment of episodic memory. Participants ages 3 and older are shown a series of activities and then asked to reproduce the sequence of pictures as it was presented to them.

Administration

Picture Sequence Memory has three phases: Instructions, Practice, and Live Items.

Instructions

First, the introduction is presented on the screen and via audio: ***You are going to play a memory game, but first you are going to see how to move the pictures on this screen.*** To move to the next screen, tap the *Next* button in the upper right corner.

Then a series of animations are presented, showing the participant how to move the pictures as the audio describes what to do. The first instruction screen says: ***You will be able to move the pictures from the big, yellow box to the small boxes. Touch the picture you want to move. Then drag that picture to the small box where you want to move it. When you let go, the picture will stay in the small box.***

The second instruction screen says: ***You can also move the pictures from one small box to another. Touch the picture in one small box. Then, drag that picture to the small box where you want the picture to go.***

The third instruction screen says: ***You can also move pictures from the small boxes back to the yellow box. Touch the picture you want to move. Then, drag that picture back to the yellow box.***

Practice

After the instructions are presented, the test advances to a transition screen to begin the practice items, which says: ***Now, you're going to play the game. You will see some pictures on the screen. You should remember them and put them back the same way you saw them on the screen.*** Tap the *Next* button. The participant's age determines which practice item(s) are shown.

Regardless of age, the practice items follow the same general format. A transition screen introduces the item (e.g., "Now, you will see how to eat ice cream"). When the participant indicates that they are ready, slide the purple button all the way to the right to begin the practice items. The pictures are presented one at a time, first appearing in the big, yellow box, then moving to one of the smaller boxes below or to the sides of the yellow box, always in order from left to right. As each item is presented, the audio gives a brief description of the picture (e.g., "First, put a scoop on the cone"). After all the pictures are presented, the pictures return to the yellow box and the audio says: ***Now, you try it.***

The participant should drag each picture to the boxes below or to the side in the same order they were presented. When all pictures are moved to the smaller boxes, a pop-up window appears that says: *Are you finished?* If the participant is not finished or wants to rearrange the pictures, they should tap anywhere outside the pop-up window. When the participant indicates that they are finished, slide the purple button all the way to the right.

If the participant answers a practice item incorrectly, they are given a second attempt to respond, and the item is presented again before the next item. If the participant answers all practice trials incorrectly, the test ends. If the participant answers correctly at least one time, the test proceeds to the live items.

Ages 3–5

Practice Item 1: Ice Cream

The transition screen before the first practice item says: ***Now, you will see how to eat ice cream.*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the practice item.

If the participant responds correctly, the test advances to the second practice item. If the participant responds incorrectly, the audio says: ***Let's try that again.*** Then the two pictures are presented again as a second trial.

Practice Item 2: Birthday Party

If the participant answered either trial of the first practice item correctly, the next transition screen says: ***That's right! Now, you will see how to have a birthday party.*** If the participant answered both trials of the first practice item incorrectly, the next transition screen says: ***Now, you will see how to have a birthday party.*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the practice item.

If the participant responds correctly to the second practice item, the test advances to the live item transition screen. If the participant responds incorrectly, the audio says: ***Let's try that again.*** Then the three pictures are presented again. If the participant answers both practice items incorrectly both times (i.e., all four trials), the test ends.

Ages 6+

Practice Item 1: Camping

The transition screen before the practice item says: ***Now, you will see how to go camping.*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the practice item. There is only one practice item for participants ages 8 and older.

After the sequence of pictures is presented, the participant should move the pictures from the big, yellow box to the smaller boxes. When they have moved all the pictures to the small boxes, a pop-up window appears that says: *Are you finished?* When the participant indicates that they are finished, slide the purple button all the way to the right. If the

participant is not finished, they should select and move the picture(s) they want to move until they are ready to proceed.

If the participant responds correctly to the practice item, the test advances to the live item transition screen. If the participant responds incorrectly, the audio says: ***Let's try that again.*** Then the four pictures are presented again as a second trial. If the participant answers the practice item incorrectly both times, the test ends.

Live Items

After the participant completes at least one practice item trial correctly, the test advances to a transition screen for the live items, which says: ***Now you're going to play with different pictures. This time you will see how to ____.*** If the participant answered the previous practice item correctly, the transition screen says: ***That's right! Now you are going to play with different pictures. This time you will see how to ____.***

The participant's age determines how many pictures are presented on the first live item. Subsequently, the participant's performance on the first live item determines which and how many pictures they see in the next scene. That is, they will see more pictures in the second scene if they perform well on the first item, they will see fewer pictures in the second scene if they perform poorly on the first item, and they will see the same number of pictures in the second scene if they have average performance on the first item. For example, if a 4-year-old taking PSM Form A performs poorly on the first live item, they will move from six pictures of the fair in the first item to three pictures of the park in the second item; if they perform well, they will instead see nine pictures of the park in the second item.

Regardless of which form is selected, the live items follow the same general format. A transition screen introduces the item (e.g., "Now, you will see how to play in the park"). When the participant indicates that they are ready, slide the purple button all the way to the right to begin the next item. The pictures are presented one at a time, first appearing in the big, yellow box, then moving to one of the smaller boxes below or to the sides of the yellow box, always in order from left to right. As each item is presented, the audio gives a brief description of the picture (e.g., "First, open a picnic basket"). After all the pictures are presented, the pictures return to the yellow box and an audio prompt says: ***Now, you try it.***

The participant should drag each picture to the small boxes in the same order they were presented. When all pictures are moved to the small boxes, a pop-up window appears that says: *Are you finished?* If the participant is not finished or wants to rearrange the pictures, they should tap anywhere outside the pop-up window. When the participant is finished, slide the purple button all the way to the right.

The participant may verbalize the picture labels as they move the pictures. However, if this seems to interfere with their performance, say, ***"You don't need to say the words/labels."*** If the participant indicates that verbalizing the label is helpful, you may provide reassurance that they may say the labels if they want to.

If the participant looks away from the screen while the pictures are being presented, say, **“Watch the screen.”**

Do not allow the participant to touch the screen while the pictures are being presented or during the instructions. If the participant tries to do so, say, **“Do not touch the screen until I tell you that it is your turn.”** If necessary, remind the participant, **“Wait until I tell you it is your turn (to touch the screen).”**

The test uses the participant’s age to determine which items it initially presents. If you feel that a participant should begin the test at a level higher or lower than that determined by their age, you should use the Start Point Override feature on the participant’s *Demographics* screen. Using the override may shorten the test. It is important to note that the test will eventually arrive at the same score whether you used the override or not.

Picture Vocabulary

The Picture Vocabulary test is an assessment of receptive vocabulary administered in a computer adaptive test (CAT) format. Participants ages 3 and older are asked to listen to a word presented by the audio, then select which of the four pictures on the screen means the same as that word.

Administration

Picture Vocabulary has three phases: Instructions, Practice, and Live Items.

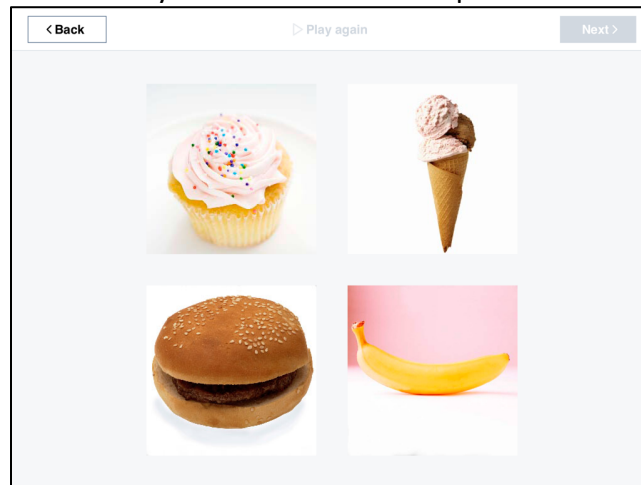
Instructions

The instructions are presented on the screen and via audio. The audio says: ***You will hear a word and see four pictures on the screen. Tap the picture that means the same as the word you just heard. Some words will be easy and some will be harder. Just do the best you can. If you need to hear a word again, you can tap the Play again button. If you think you made a mistake and want to change your last answer, tap the Back button to hear the last word again. Are you ready?***

When the participant indicates that they are ready, tap the *Next* button in the upper right corner to begin the practice items.

Practice

There are two practice items, each with four pictures. As the first practice item is presented, the audio says: ***Let's try one for practice. Banana. Touch the picture of Banana.*** If the participant responds correctly by tapping the picture of the banana, the audio says: ***That's right!*** Then the test automatically advances to the next practice item.



If the participant responds incorrectly by tapping any picture except the banana, the test provides corrective feedback and says: ***This is a banana. Let's try again.*** The first practice item will repeat until the participant selects the correct picture of a banana. If the participant is unsuccessful after three attempts, tap the picture of the banana and say: "This is a banana." Then the test automatically advances to the next practice item.

Four more pictures will appear for the second practice item. The audio says: ***Let's try another one. Spoon. Touch the picture of Spoon.*** If the participant responds correctly by tapping the picture of a spoon, the audio says: ***That's right!*** Then the test automatically advances to the transition screen.

If the participant responds incorrectly by tapping any picture except the spoon, the test provides corrective feedback and says: ***This is a spoon. Let's try again.*** The second practice item will repeat until the participant selects the correct picture of a spoon. If the participant is unsuccessful after three attempts, tap the picture of the spoon and say: "This is a spoon." Then the test automatically advances to the transition screen.

Live Items

After completing the two practice items, the test advances to the transition screen for the live items, which says: ***Now you're going to do some more. Remember, you will hear a word and then you will see four pictures. One of the pictures will show what the word means. Tap that picture. Then you will hear a new word and see four more pictures. Just do the best you can. Are you ready?*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the live items.

The test uses a variable-length CAT format, so some participants will see fewer items than others. The start point is determined by the participant's age (for participants younger than 19) or education (for participants 19 and older). The specific words presented depend on the participant's performance, and the number of items presented depends on their age/education and performance. For most participants, the test will last approximately 3 minutes and will contain about 30 items. The items will be administered one by one, in an untimed fashion, until the test is completed.

The test uses age (for participants younger than 19) and education (for participants 19 and older) to determine which items it initially presents. If you feel that a participant should begin the test at a level higher or lower than that determined by their age/education, you should use the Start Point Override feature on the participant's *Demographics* screen. Using the override may shorten the test. It is important to note that the test will eventually arrive at the same score whether you use the override or not.

If the participant has difficulty touching the screen, you can select the answers the participant indicates. Say, ***"You can point to your choice and then I will tap the screen for you."***

If the participant says that they do not understand the word after several repetitions, you may say the word **once more**, then ask the participant to select a picture.

Rey Auditory Verbal Learning

The Rey Auditory Verbal Learning test (RAVLT) is an assessment of immediate memory and verbal learning. Participants ages 5 and older are given three trials to recall as many words as possible from a list of 15 unrelated words.

The Rey Auditory Verbal Learning Delay test (RAVLT Delay) is an assessment of delayed memory that is administered 5 to 25 minutes after RAVLT. NIH Toolbox V3 RAVLT normative data were based on the administration of the Visual Reasoning and Oral Symbol Digit tests between RAVLT and RAVLT Delay. Participants ages 5 and older are asked to free-recall as many of the fifteen words as they can remember.

Part 1: Rey Auditory Verbal Learning

Administration

Rey Auditory Verbal Learning has three trials.

Trial 1

The instructions are presented on the screen and via audio: ***You will hear a list of words. Listen carefully and try to remember them. When you hear the chime, say as many of the words as you can remember. Don't worry if you don't remember them in the right order. Are you ready?*** When the participant indicates that they are ready, turn the screen away so the participant does not see it, then tap the *Next* button in the upper right corner.

Ensure the screen is turned so the participant does not see it for the remainder of the test, and check that the volume is loud enough for the participant to clearly hear the audio.

On the next screen, tap the *Play* button in the upper left corner to play the list of 15 words. As the words are being presented, they also appear on the screen as selectable buttons. After the chime, you will need to work quickly to keep pace with the participant as they recall words. For each word recalled after the chime, tap the appropriate button to select it. If you make an error, tap the button again to deselect it. Do not tap items that the participant stated incorrectly or did not recall. If the participant says a word that is very close, but not the same as what's in the test (e.g., plural of a word that is singular, or 'gardening' vs 'garden'), it should be scored as incorrect. There is no score and no penalty for words stated that were not part of the list.

When the participant finishes recalling words, tap the *Next* button to move to the next trial.

Trial 2

Instructions are presented on the screen and via audio: ***Let's do that again. When you hear the chime, say as many words as you can remember, even if you said them the first time. Are you ready?*** When the participant indicates that they are ready, tap the *Next* button.

On the next screen, tap the *Play* button in the upper left corner to play the list of 15 words. Like before, the participant should start recalling words after the chime. For each word recalled after the chime, tap the appropriate button to select it. If you make an error, tap the button again to deselect it. Do not tap items that the participant stated incorrectly or did not recall. If the participant says a word that is very close, but not the same as what's in the test (e.g., plural of a word that is singular, or 'gardening' vs 'garden'), it should be scored as incorrect. There is no score and no penalty for words stated that were not part of the list.

When the participant finishes recalling words, tap the *Next* button to move to the next trial.

Trial 3

Instructions are presented on the screen and via audio: ***Let's do that one more time. When you hear the chime, say as many words as you can remember, even if you said them before. Are you ready?*** When the participant indicates that they are ready, tap the *Next* button.

On the next screen, tap the *Play* button in the upper left corner to play the list of 15 words. Like before, the participant should start recalling words after the chime. For each word recalled after the chime, tap the appropriate button to select it. If you make an error, tap the button again to deselect it. Do not tap items that the participant stated incorrectly or did not recall. If the participant says a word that is very close, but not the same as what's in the test (e.g., plural of a word that is singular, or 'gardening' vs 'garden'), it should be scored as incorrect. There is no score and no penalty for words stated that were not part of the list.

When the participant finishes recalling words, tap the *Next* button to end the test.

Part 2: Rey Auditory Verbal Learning Delay

Please note that RAVLT should be administered to the participant 5 to 25 minutes *before* RAVLT Delay. During this delay, it is recommended either that the participant take a break or that you administer tests that do not tax memory (e.g., Visual Reasoning). If you attempt to begin RAVLT Delay too soon, too late, or without first administering RAVLT, a warning message will appear, giving you the option to continue or to stop the assessment. Any deviations in standard testing procedure (e.g., beginning RAVLT Delay less than 5 minutes after RAVLT) should be recorded in the assessment notes.

Administration

Rey Auditory Verbal Learning Delay has one free-recall trial.

Free-Recall

The instructions are presented on the screen and via audio: ***A while ago, you heard a list of words several times, and you had to repeat back the words. Tell me all the words you can***

remember from that list. When the participant indicates that they are ready, turn the screen away so the participant does not see it, then tap the *Next* button in the upper right corner.

You will need to work quickly to keep pace with the participant as they recall words. For each word recalled, tap the appropriate button to select it. If you make an error, tap the button again to deselect it. Do not tap items that the participant stated incorrectly or did not recall. If the participant says a word that is very close, but not the same as what's in the test (e.g., plural of a word that is singular, or 'gardening' vs 'garden'), it should be scored as incorrect. There is no score and no penalty for words stated that were not part of the list.

When the participant finishes recalling words, tap the *Next* button to end the test.

Speeded Matching

The Speeded Matching test is an assessment of processing speed. Participants ages 3 to 6 are asked to identify which of four pictures matches the target picture at the top of the screen.

Administration

Speeded Matching has three phases: Demonstration, Practice, and Live Items.

Demonstration

There is one demonstration screen, which has a picture of a pig at the top of the screen and four pictures of animals at the bottom. The audio says: **Look at this picture.** A blue border flashes around the picture at the top of the screen. Then the audio continues: **We're going to tap the picture down here** (borders around the bottom four pictures flash) **that looks the same.** Point to the second picture on the bottom (pig), then tap it without providing any further instruction or feedback.

Then the audio says: **Now you try it. Use only one finger to tap.** The participant should select one of the pictures at the bottom of the screen. If the participant responds correctly, the audio says: **Great job!**

If the participant responds incorrectly, the border around the picture they selected turns red and the audio says: **These pictures are the same** (borders around both pig pictures flash). **Let's try that again. Which picture down here** (borders around the bottom four pictures flash) **is the same as the top one** (border around the top picture flashes)? The audio will repeat the same prompts until the participant responds correctly.

Practice

When the participant responds to the demonstration correctly, the test advances to a transition screen to begin the practice items. The audio says: **Now let's try some more!** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the practice items.

There are four practice items. For the first practice item only, the audio says: **Which of these pictures** (borders around the bottom four pictures flash) **is the same as this one** (border around the top picture flashes)?

If the participant responds correctly, the audio says: **Great job!**

If the participant does not respond within 10 seconds, the audio prompts the participant: **Which picture is the same as the one on top?**

If the participant responds incorrectly, the border around the picture they selected turns red and the audio says: **These pictures are the same** (borders around the matching pictures flash). **Let's try that again. Which picture down here** (borders around the bottom four pictures flash) **is the same as the top one** (border around the top picture flashes)?

If the participant responds incorrectly to any of the practice items, they are given one more attempt at that practice item. If on the second attempt the participant responds correctly, the audio says: **Great job!** Then, the test automatically advances to the next screen.

If the participant responds incorrectly to any of the practice items a second time, the audio says: **These pictures are the same** (borders around the matching pictures flash). Then, the test automatically advances to the next screen. If the participant answers all practice items incorrectly each time (i.e., all eight trials), the test ends.

Live Items

After the participant completes the practice items, the test advances to a transition screen for the live items. The audio says: **Now you will do some more. Remember to tap the picture that looks the same as the one on top. Go as fast as you can without making mistakes. Are you ready?** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the live items.

The participant is given 90 seconds to respond to as many live items as possible.

Visual Reasoning

The Visual Reasoning test is an assessment of nonverbal and visual reasoning administered in a computer adaptive test (CAT) format. Participants ages 4 and older are asked to select which of the response options is most like or missing from the target image(s) at the top or in the middle of the screen.

Administration

Visual Reasoning has three phases: Instructions, Practice, and Live Items.

Instructions

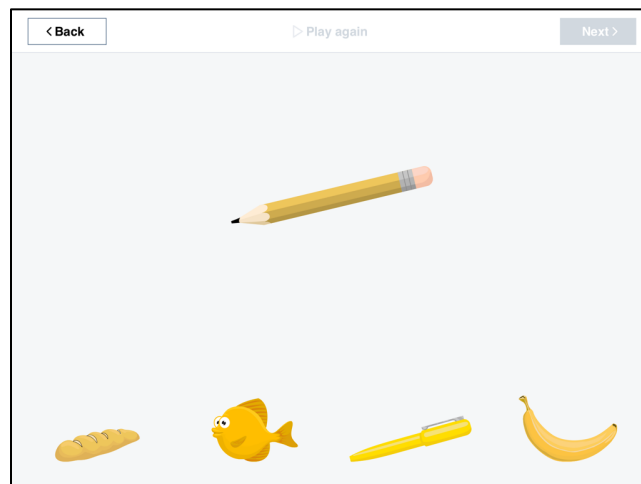
The instructions are presented on the screen and via audio: ***Let's look at some pictures. You will see a picture in the middle of the screen and some pictures at the bottom. Tap the picture at the bottom that is most like the picture in the middle of the screen, or shows the missing picture. Some pictures will be easy and some will be harder. Just do the best you can.*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the practice items.

Practice

After the instructions, there are three practice items.

Practice Item 1:

The first practice item has a picture of a pencil in the middle of the screen and four pictures at the bottom. The audio says: ***Let's try one for practice. Which one of these*** (borders around the bottom four pictures flash) ***is most like the picture in the middle of the screen*** (border around the picture in the middle of the screen flashes)? If the participant responds correctly, the audio says: ***That's right!*** Then, the test automatically advances to the next practice item.



If the participant responds incorrectly by tapping an incorrect picture, the border around that picture turns red and the audio provides corrective feedback: ***Let's try that again. Of all the pictures at the bottom, this one*** (border around the pen flashes) ***looks most like the***

picture in the middle of the screen, so you should choose this picture. Then the participant is given a second trial.

During the second trial, the audio says: **Which one of these** (borders around the bottom four pictures flash) **is most like the picture in the middle of the screen** (border around the picture in the middle of the screen flashes)? If the participant responds correctly, the audio says: **That's right!** Then, the test automatically advances to the next practice item.

If the participant responds incorrectly to the second trial by tapping an incorrect picture, the border around that picture turns red. Then the border around the pen flashes as the audio provides corrective feedback: **This one looks most like the picture in the middle of the screen, so you should choose this picture.** Then, the test automatically advances to the next practice item.

Practice Item 2:

The second practice item has three pictures and a blank space with a question mark at the top of the screen and four pictures at the bottom. The audio says: **Let's try another one. Look at these pictures** (borders around the top three pictures and the blank space flash). **One picture is missing. Which one of these** (borders around the bottom four pictures flash) **goes here** (border around the blank space at the top of the screen flashes)? If the participant responds correctly, the audio says: **That's right!** Then, the test automatically advances to the next practice item.

If the participant responds incorrectly by tapping an incorrect picture, the border around that picture turns red and the audio provides corrective feedback: **Let's try that again. First, there is a rocket** (border around the first picture at the top flashes). **Then, the planet comes next** (border around the second picture at the top flashes). **Then, there is a rocket again** (border around the third picture at the top flashes). **That means the planet comes next** (border around the blank space at the top flashes). **So you should choose this picture** (border around the planet at the bottom flashes). Then the participant is given a second trial.

During the second trial, the audio says: **Look at these pictures** (borders around the top three pictures and the blank space flash). **One picture is missing. Which one of these** (borders around the bottom four pictures flash) **goes here** (border around the blank space at the top of the screen flashes)? If the participant responds correctly, the audio says: **That's right!** Then, the test automatically advances to the next practice item.

If the participant responds incorrectly to the second trial by tapping an incorrect picture, the border around that picture turns red. Then the border around the planet at the bottom flashes as the audio provides corrective feedback: **This one is the missing picture, so you should choose this picture.** Then, the test automatically advances to the next practice item.

Practice Item 3:

The third practice item has a grid of three pictures and a blank space with a question mark in the middle of the screen and four pictures at the bottom. The audio says: ***Let's try one more. Look at these pictures. One picture is missing. Which one of these*** (borders around the bottom four pictures flash) ***goes here*** (border around the blank space in the middle of the screen flashes)? If the participant responds correctly, the audio says: ***That's right!*** Then, the test automatically advances to the transition screen.

If the participant responds incorrectly by tapping an incorrect picture, the border around that picture turns red and the audio provides corrective feedback: ***Let's try that again. The pictures in the top two boxes are both circles. Below that, there is a star and a missing picture. Of the pictures at the bottom, this one*** (border around the star flashes) ***is a star, and is the missing picture, so you should choose this picture.*** Then the participant is given a second trial.

During the second trial, the audio says: ***Look at these pictures. One picture is missing. Which one of these*** (borders around the bottom four pictures flash) ***goes here*** (border around the blank space in the middle of the screen flashes)? If the participant responds correctly, the audio says: ***That's right!*** Then, the test automatically advances to the transition screen.

If the participant responds incorrectly to the second trial by tapping an incorrect picture, the border around that picture turns red. Then the border around the star flashes as the audio provides corrective feedback: ***This one is the missing picture, so you should choose this picture.*** Then, the test automatically advances to the transition screen.

Live Items

Regardless of performance on the practice items, all participants move on to the live items. If the participant has answered every practice item (i.e., all 6 trials) incorrectly and you believe they do not understand the task, you may choose to perform the admin gesture to pause and skip this test.

After the participant completes the three practice items, the test advances to a transition screen for the live items. The audio says: ***Now, let's look at some more pictures. Remember, you will see a picture in the middle of the screen and some pictures at the bottom. Tap the picture at the bottom that is most like the picture in the middle of the screen or shows the missing picture. Are you ready?*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the live items. If the participant does not provide a response in 60 seconds, the audio says: ***Please choose an answer.***

The test uses a variable-length CAT format, so some participants will see fewer items than others. The start point is determined by the participant's age (for participants younger than 19) or education (for participants 19 and older). The specific items presented depend on the

participant's performance, and the number of items presented depends on age/education and performance. Most participants will complete the test in under 7 minutes and will complete 20 to 30 items. The test will administer each item one by one, in an untimed fashion, until the test is completed.

The test uses age (for participants younger than 19) or education (for participants 19 and older) to determine which items it initially presents. If you feel that a participant should begin the test at a level higher or lower than that determined by their age/education, you should use the Start Point Override feature on the participant's *Demographics* screen. Using the override may shorten the test. It is important to note that the test will eventually arrive at the same score whether you used the override or not.

Chapter 5: Emotion

Emotion refers to any strong feeling, such as elation or melancholy. Emotion is an affective state of consciousness in which joy, sorrow, fear, hate, or the like is experienced, as distinguished from cognitive and volitional states of consciousness. Emotions can be negative and distressing, or positive and reflective of well-being. The NIH Toolbox® Emotion domain consists of four subdomains: Psychological Well-Being, Social Relationships, Stress & Self-Efficacy, and Negative Affect. These constructs and subdomains for the Emotion domain are detailed below:

Psychological Well-Being: includes both hedonic and eudaimonic components. Hedonic constructs are more subjective and experiential, and emphasize pleasure and positive affect (e.g., happiness, serenity, and cognitive engagement). Eudaimonic well-being is more evaluative and emphasizes fulfillment and purpose (e.g., meaning, life satisfaction).

Social Relationships: refers to the interactions between two or more people. Dimensions of social relationships include structure, extent, and quality.

Stress & Self-Efficacy: describes individual perceptions about the nature of events and their relationship to the perceived coping resources of an individual.

Negative Affect: refers to unpleasant feelings or emotions, which exist on a continuum ranging from common and normal feelings of sadness, fear, and anger to more extreme feelings along the same continuum.

Table 5.1
NIH Toolbox V3 Emotion Domain Constructs

<i>Emotion Construct</i>	<i>Definition</i>
<i>Psychological Well-Being</i>	
Positive Affect	Feelings that reflect a level of pleasurable engagement with the environment, such as happiness, joy, excitement, enthusiasm, and contentment.
General Life Satisfaction	The cognitive evaluation of life experiences; whether people like their lives or not. Life satisfaction includes both general (e.g., my life is going well) and domain-specific (e.g., I am satisfied with my family life) aspects.
Meaning and Purpose	The extent to which people believe their life matters or makes sense.
<i>Social Relationships</i>	
Social Support	The extent to which an individual views their social relationships as available to provide aid in times of need or when problems arise. It includes instrumental and emotional social support. Instrumental support is the perception that people in one's social network are available to provide material or functional aid in completing daily tasks. Emotional support is the perception that people in one's

	social network are available to listen to one's problems with empathy, caring, and understanding.
Companionship	Characterized by perceptions of the availability of friends or companions with whom to interact or affiliate (i.e., friendship) and perceptions that one is alone, lonely, or socially isolated.
Social Distress	The extent to which an individual perceives their daily interactions as negative or distressing.
Positive Social Development	Characterized by parents' evaluation of their child's empathic behaviors.
<i>Stress & Self-Efficacy</i>	
Perceived Stress	An individual's perceptions about the nature of events and their relationship to the individual's values and coping resources.
Self-Efficacy	A person's belief in their capacity to manage their functioning and have control over meaningful events.
<i>Negative Affect</i>	
Fear	Characterized by symptoms of anxiety that reflect autonomic arousal and perceptions of threat.
Sadness	Distinguished by low levels of positive affect and symptoms that are primarily affective (poor mood) and cognitive (negative perceptions of self, the world, and the future) indicators of depression.
Anger	Characterized by attitudes of hostility and cynicism; often associated with experiences of frustration impeding goal-directed behavior.

NIH Toolbox Emotion Batteries

There are five NIH Toolbox Emotion batteries that vary by age and rater (i.e., self-report versus parent-report). They are: Emotion Battery (Ages 8–12), Emotion Battery (Ages 13–17), Emotion Battery (Ages 18+), Emotion Parent Report Battery (Ages 3–7), and Emotion Parent Report Battery (Ages 8–12). These batteries include tests that assess the following constructs: Negative Affect, Psychological Well-Being, Stress & Self-Efficacy (not included in the Emotion Parent Report Battery [Ages 3–7]), and Social Relationships.

Relationship between NIH Toolbox and PROMIS **PROMIS**

The NIH Toolbox Emotion tests and the PROMIS tests have long worked hand-in-hand to complement each other. Therefore, a few of the key PROMIS tests have been included in the NIH Toolbox V3 app to allow NIH Toolbox users to obtain a more complete picture of their participants. The specific PROMIS tests that are included in the NIH Toolbox V3 app are listed at the end of this chapter.

Revision Details

Many of the NIH Toolbox Emotion fixed forms (FFs) have been converted to computer adaptive test (CAT) measures to facilitate more efficient test administration. Short forms have been removed. A new scoring engine has been implemented to update the CAT stopping rules. The Emotion tests' user interface (e.g., font, background color) has also been updated for consistency with other NIH Toolbox V3 tests.

Renamed NIH Toolbox Emotion Tests

As with all the other tests in the NIH Toolbox V3 app, test names have been shortened by removing the "NIH Toolbox" prefix and the version number suffixes. Age ranges have been dropped from tests that do not share the same name with other tests (e.g., there is only one Anger FF, so the ages have been removed, but there are two Anger Parent Rpt CAT tests, which would have identical names were it not for the different age ranges (i.e., ages 3–7 and ages 8–12). The table below shows which tests were renamed from V2 to V3.

Table 5.2
Renamed NIH Toolbox V3 Emotion Tests

<i>NIH Toolbox V2 Test Name</i>	<i>NIH Toolbox V3 Test Name</i>
NIH TB Anger-Affect CAT Age 18+ v1.1	Anger CAT
NIH TB Emotional Support FF Age 18+	Emotional Support CAT Ages 18+
NIH TB Emotional Support FF Ages 8–17	Emotional Support CAT Ages 8–17
NIH TB Fear Parent Rpt CAT Ages 8–12	Fear/Anxiety Parent Rpt CAT
NIH TB Fear-Affect CAT Age 18+	Fear/Anxiety CAT Ages 18+
NIH TB Friendship FF Age 18+	Friendship CAT Ages 18+
NIH TB Friendship FF Ages 8–17	Friendship CAT Ages 8–17
NIH TB Instrumental Support FF Age 18+	Instrumental Support CAT
NIH TB Peer Rejection Parent Rpt FF Ages 3–12	Peer Rejection Parent Rpt CAT
NIH TB Perceived Hostility FF Age 18+	Perceived Hostility CAT
NIH TB Perceived Rejection FF Age 18+	Perceived Rejection CAT
NIH TB Perceived Stress FF Ages 13–17	Perceived Stress CAT
NIH TB Sadness CAT Age 18+	Sadness/Depression CAT Ages 18+
NIH TB Sadness Parent Rpt CAT Ages 8–12	Sadness/Depression Parent Rpt CAT Ages 8–12
NIH TB Sadness Parent Rpt FF Ages 3–7	Sadness/Depression Parent Rpt CAT Ages 3–7

Administration

Each Emotion test is administered in either a CAT or FF format. Additionally, tests are either self-report, in which a respondent answers questions about themselves, or parent-/proxy-report, in which a respondent answers questions about a child.

CATs

Emotion CATs begin with a standard item that is specific to that measure. An algorithm utilizes the participant's response to determine which item should be administered next. CATs are typically four to six items in length.

FFs

Emotion FFs present all items in their item banks in a set (sequential) order.

Pediatric Self-Report

Tests completed by the participant, ages 8–17.

Adult Self-Report

Tests completed by the participant, ages 18+.

Parent-Report

Tests completed by the parents or guardians of the participant, ages 3–12.

General Instructions

The participant responds to Emotion tests at their own speed. After a question is answered, the screen automatically advances to the next question, so after orienting the participant, there is no need for examiner involvement.

All tests for children ages 3–7 are parent-/proxy-report measures. On these tests, the parent or guardian responds to questions about the child according to how they think the child is doing.

For children ages 8–12, tests are available in self- and parent-report versions. All tests for participants ages 13+ are available as self-report tests.

Age-Specific Instructions

Self-report and parent-report tests have slightly different on-screen instructions. When using individual tests to set up an assessment or build a custom battery, users must select the correct version of the instructions to be displayed before the rest of the Emotion tests. There are two versions of NIH Toolbox Emotion instructions which can be found in the list of Emotion tests: Emotion Instructions (Adult/Child) and Emotion Instructions (Parent Report).

When using preset batteries, age-appropriate instructions are included automatically.

Instructions for Self-Report Tests

The instructions for self-report tests read: ***On the next screens, we will ask you questions about your thoughts, feelings, and behaviors. Read each question carefully and answer as well as you can. There is no right or wrong answer, only what is true for you and describes your thoughts, feelings, and behaviors.***

Select an answer by tapping your answer choice on the screen. After you make your choice, the screen will automatically go on to the next question. If you want to change your answer, tap the Back button to return to the question, then tap a different answer choice.

Instructions for Parent-Report Tests

The instructions for parent-report tests read: ***On the next screens, you will see questions about your child's feelings and behaviors. Read each question carefully and answer as best you can. Please consider each question by itself and choose an answer that you believe honestly shows how your child feels and acts.***

Select an answer by tapping your answer choice on the screen. After you make your choice, the screen will automatically go on to the next question. If you want to change your answer, tap the Back button to return to the question, then tap a different answer choice.

Tests

Emotion tests may be given individually, as part of a battery, or in any combination with each other or tests from other domains. There are 46 NIH Toolbox Emotion tests, 6 PROMIS tests, and 5 NIH Toolbox Emotion batteries. All individual Emotion and PROMIS tests take approximately 1–2 minutes to complete.

Table 5.2
NIH Toolbox V3 Emotion Test Details

<i>Test Name</i>	<i>Description</i>	<i>Ages</i>	<i># of Items</i>
<i>Psychological Well-Being</i>			
General Life Satis. CAT Ages 13–17	A self-report assessment of the participant’s cognitive evaluation of life experiences and whether the participant likes their life.	13–17	CAT
General Life Satis. CAT Ages 18+	A self-report assessment of the participant’s cognitive evaluation of life experiences and whether the participant likes their life.	18+	CAT
General Life Satis. FF	A self-report assessment of the participant’s cognitive evaluation of life experiences and whether the participant likes their life.	8–12	5
General Life Satis. Parent Rpt FF	A parent-report assessment of the child’s cognitive evaluation of life experiences and whether the child likes their life.	3–12	5
Meaning and Purpose CAT	A self-report assessment of feelings around whether life has purpose and there are good reasons for living, including hopefulness, optimism, and goal-directedness.	18+	CAT
Positive Affect CAT Ages 8–12	A self-report assessment of the participant’s feelings of pleasurable engagement with the environment, such as happiness, joy, excitement, enthusiasm, and contentment.	8–12	CAT
Positive Affect CAT Ages 13–17	A self-report assessment of the participant’s feelings of pleasurable engagement with the environment, such as happiness, joy, excitement, enthusiasm, and contentment.	13–17	CAT
Positive Affect CAT Ages 18+	A self-report assessment of the participant’s feelings of pleasurable engagement with the environment, such as happiness, joy, excitement, enthusiasm, and contentment.	18+	CAT
Positive Affect Parent Rpt CAT Ages 3–7	A parent-report assessment of the child’s feelings of pleasurable engagement with the environment, such as happiness, joy, excitement, enthusiasm, and contentment.	3–7	CAT
Positive Affect Parent Rpt CAT Ages 8–12	A parent-report assessment of the child’s feelings of pleasurable engagement with the environment, such as happiness, joy, excitement, enthusiasm, and contentment.	8–12	CAT
<i>Social Relationships</i>			
Emotional Support CAT Ages 8–17	A self-report assessment of the participant’s perception that people in their social network are available to listen to their problems with empathy, caring, and understanding.	8–17	CAT

Emotional Support CAT Ages 18+	A self-report assessment of the participant's perception that people in their social network are available to listen to their problems with empathy, caring, and understanding.	18+	CAT
Empathic Behaviors Parent Rpt CAT	A parent-report assessment that asks the parent's perceptions of the child's prosocial behaviors.	3–12	CAT
Friendship CAT Ages 8–17	A self-report assessment of the participant's perceptions of the availability of friends or companions with whom to interact or affiliate.	8–17	CAT
Friendship CAT Ages 18+	A self-report assessment of the participant's perceptions of the availability of friends or companions with whom to interact or affiliate.	18+	CAT
Instrumental Support CAT	A self-report assessment of the participant's perceptions that the people in their social network are available to provide material or functional aid in completing daily tasks, if needed.	18+	CAT
Loneliness FF Ages 8–17	A self-report assessment of perceptions of being alone, lonely, or socially isolated from others.	8–17	7
Loneliness FF Ages 18+	A self-report assessment of perceptions of being alone, lonely, or socially isolated from others.	18+	5
Peer Rejection Parent Rpt CAT	A parent-report assessment of how often the child is left out, avoided, or teased by peers.	3–12	CAT
Perceived Hostility CAT	A self-report assessment of the participant's perceptions of hostility in their daily social interactions.	18+	CAT
Perceived Hostility FF	A self-report assessment of the participant's perceptions of hostility in their daily social interactions.	8–17	5
Perceived Rejection CAT	A self-report assessment of the participant's perceptions of rejection in their daily social interactions.	18+	CAT
Perceived Rejection FF	A self-report assessment of the participant's perceptions of rejection in their daily social interactions.	8–17	5
Pos. Peer Interact. Parent Rpt FF	A parent-report assessment of the child's perceptions of the availability of friends or companions with whom to interact or affiliate.	3–12	4
Social Withdrawal Parent Rpt FF	A parent-report assessment of the child's perceptions of being alone, lonely, or socially isolated from others.	3–12	4
<i>Stress & Self-Efficacy</i>			
Perceived Stress CAT	A self-report assessment of the participant's perceptions about how unpredictable, uncontrollable, and overloaded their life is.	13–17	CAT
Perceived Stress FF	A self-report assessment of the participant's perceptions about how unpredictable, uncontrollable, and overloaded their life is.	18+	10
Perceived Stress Parent Rpt CAT	A parent-report assessment of the child's perceptions about how unpredictable, uncontrollable, and overloaded their life is.	8–12	CAT

Self-Efficacy CAT Ages 8–12	A self-report assessment of the participant's belief in their capacity to manage problems and have control over meaningful events.	8–12	CAT
Self-Efficacy CAT Ages 13–17	A self-report assessment of the participant's belief in their capacity to manage problems and have control over meaningful events.	13–17	CAT
Self-Efficacy CAT Ages 18+	A self-report assessment of the participant's belief in their capacity to manage problems and have control over meaningful events.	18+	CAT
Self-Efficacy Parent Rpt CAT	A parent-report assessment of the participant's belief in their capacity to manage problems and have control over meaningful events.	8–12	CAT
<i>Negative Affect</i>			
Anger CAT	A self-report assessment of irritability, frustration, interpersonal sensitivity, envy, disagreeableness, and efforts to control anger.	18+	CAT
Anger/Hostility FF	A self-report assessment of the participant's attitudes of hostility, cynicism, and mistrust of others.	18+	5
Anger Parent Rpt CAT Ages 3–7	A parent-report assessment of the child's mood and behavior associated with anger.	3–7	CAT
Anger Parent Rpt CAT Ages 8–12	A parent-report assessment of the child's mood and behavior associated with anger.	8–12	CAT
Anger/Physical Aggression FF	A self-report assessment of aggression as a behavioral component of anger.	18+	5
Apathy FF	A self-report assessment of deficits in goal-oriented behavior and decrements in goal-related thought.	18+	7
Fear/Anxiety CAT Ages 18+	A self-report assessment of fear, anxious misery, hyperarousal, and somatic symptoms related to arousal.	18+	CAT
Fear/Anxiety Parent Rpt CAT	A parent-report assessment of the child's symptoms of anxiety reflecting autonomic arousal and perceptions of threat.	8–12	CAT
Fear/Over Anxious Parent Rpt FF	A parent-report assessment of the child's fear, worry, and hyperarousal.	3–7	6
Fear/Separation Anxiety Parent Rpt FF	A parent-report assessment of the child's fear of being separated from home and from loved ones.	3–7	7
Fear/Somatic Arousal FF	A self-report assessment of symptoms of anxiety that reflect autonomic arousal and perceptions of threat.	18+	6
Sadness/Depression CAT Ages 18+	A self-report assessment of downcast mood and negative perceptions of the self, the world, and the future.	18+	CAT
Sadness/Depression Parent Rpt CAT Ages 3–7	A parent-report assessment of whether the child has downcast mood and negative perceptions of the self, the world, and the future.	3–7	CAT
Sadness/Depression Parent Rpt CAT Ages 8–12	A parent-report assessment of whether the child has feelings of sadness, guilt, self-criticism, worthlessness, loneliness, and interpersonal alienation.	8–12	CAT

Table 5.3
PROMIS Test Details in the NIH Toolbox V3 App

<i>Test Name</i>	<i>Description</i>	<i>Ages</i>	<i># of Items</i>
PROMIS Ability to Participate in Social Roles and Activities	A self-report assessment of the participant's perceived ability to perform their usual social roles and activities.	18+	CAT
PROMIS Cognitive Function	A self-report assessment of mental acuity, concentration, verbal and nonverbal memory, verbal fluency, and perceived changes in these cognitive functions.	18+	CAT
PROMIS Fatigue	A self-report assessment of a range of symptoms from mild subjective feelings of tiredness to an overwhelming, debilitating, and sustained sense of exhaustion.	18+	CAT
PROMIS Physical Function	A self-report assessment of capability rather than actual performance of physical activities. This includes the functioning of one's upper extremities, lower extremities, and central regions.	18+	CAT
PROMIS Sleep Disturbance	A self-report assessment of the participant's perceptions of sleep quality, sleep depth, and restoration associated with sleep.	18+	CAT
PROMIS Upper Extremity	A self-report assessment of the participant's capabilities to use the upper extremity, including shoulder, arm, and hand activities.	18+	CAT

Chapter 6: Motor

Motor function is the ability to use and control muscles and movements. Motor performance includes voluntary control of both fine and gross motor functions including dexterity, strength, balance, locomotion, and endurance. Motor performance also requires the interaction of multiple body systems including the nervous, muscular, cardiovascular, and sensory-perceptual systems. The following constructs compose the Motor domain:

Table 6.1
NIH Toolbox V3 Motor Domain Constructs

<i>Motor Construct</i>	<i>Definition</i>
Balance	The ability to orient the body in space, maintain an upright posture under both static and dynamic conditions, and move and walk without falling. It is measured by Standing Balance.
Dexterity	The coordination of small muscle movements that occur in body parts, such as the ability to coordinate fingers to manipulate objects quickly and accurately. It is measured by 9-Hole Pegboard Dexterity.
Endurance	Refers to how long a person can perform a particular activity requiring cardiopulmonary function, biomechanical, and neuromuscular function at a particular intensity. Endurance assesses overall cardiovascular endurance. It is measured by 2-Minute Walk Endurance.
Locomotion	The act of moving from one place to another place, which reflects ambulation ability, including walking distance, velocity, and quality of the gait over different environments and ground surfaces. It is assessed by 4-Meter Walk Gait Speed.
Strength	A muscle's ability to generate force against physical objects. Measuring how strong one's hand grip is provides a good approximation of overall muscle strength. It is measured by Grip Strength.

Motor tests may be given individually, as part of a battery, or in any combination with each other or tests from other domains. There are 5 Motor tests and 2 Motor batteries.

Table 6.2
NIH Toolbox V3 Motor Test Details

<i>Test Name</i>	<i>Ages</i>	<i>Time to Administer (minutes)</i>
2-Minute Walk Endurance	3+	4
4-Meter Walk Gait Speed	7+	3
9-Hole Pegboard Dexterity	3+	4
Grip Strength	3+	3
Standing Balance	3+	7

Note. The "Time to Administer (minutes)" column gives users an idea of how long each test might take. Please note that test times may vary based on how prepared the examiner is going

into the session, individual differences among participants, and/or other unplanned activities that may occur during testing.

For more information about additional equipment and materials needed to administer tests in the Motor domain, please refer to Appendix 2.

Early Childhood Motor Battery

The NIH Toolbox Early Childhood Motor Battery was designed to be developmentally appropriate for ages 3-6. This battery includes tests that assess the following constructs: Dexterity, Strength, Balance, and Endurance.

Motor Battery

The NIH Toolbox Motor Battery is recommended for ages 7+. This battery includes tests that assess the following constructs: Dexterity, Strength, Balance, Locomotion, and Endurance.

Revision Details

The Motor tests' user interface (e.g., font, background color) has been updated for consistency with the other NIH Toolbox® V3 tests and the Standing Balance test has been renormed.

Tests

2-Minute Walk Endurance

The 2-Minute Walk Endurance test is an assessment of overall physical fitness and endurance. Participants ages 3 and older are asked to walk at a normal speed on a flat surface for 2 minutes.

For more information about additional equipment and materials needed to administer this test, please refer to Appendix 2.

Participants should be wearing comfortable shoes, such as athletic sneakers. They should not do this test in bare feet, high heels, open-back shoes, sandals, or flip-flops.

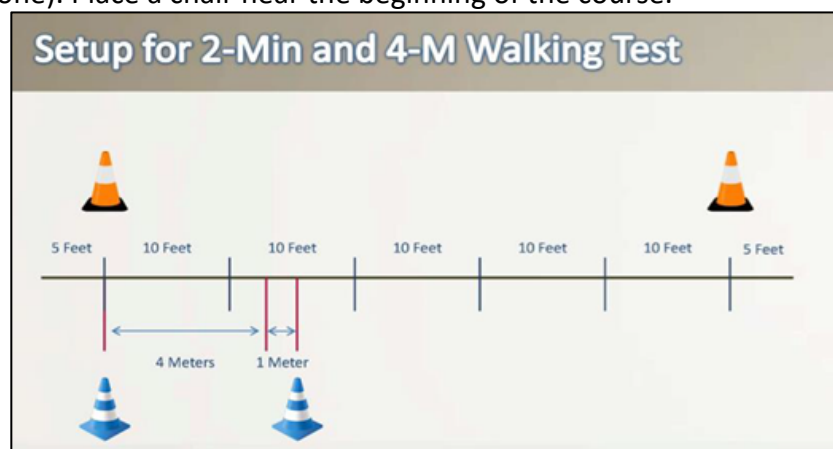
Observe how the participant normally walks. If the participant uses a cane or other walking device and feels they need it for this test, they may use it. Make a note if the participant uses any kind of aid.

Setup: Prior to administering the 2-Minute Walk Endurance test, you must set up the walking course. This requires the following: a tape measure with both feet and meter increments, colored masking tape, two cones, a chair, and an open space at least 60 feet in length (an open hallway is recommended).

Please note that if both the 2-Minute Walk Endurance test and the 4-Meter Walk Gait Speed test are being administered, it is possible to set up the walking courses concurrently, as illustrated in the schematic diagram below. If you are not administering the 4-Meter Walk Gait Speed test, disregard the blue cones and the two red lines 1 meter apart in the diagram.

Following the diagram below, place a piece of tape 2' to 3' long across the hallway, 5' from the start point. Put shorter pieces of tape at four 10' intervals from that piece of tape. At the fifth 10' interval, put another piece of tape 2' to 3' long across the hallway.

Place one cone beside the first long mark and another cone at the last mark of the course (50' from the first cone). Place a chair near the beginning of the course.



Administration

2-Minute Walk Endurance has three phases: Instructions, Practice, and Live Trial.

Instructions

Ensure the participant is sitting in a chair near the beginning of the walking course. Read aloud the instructions that are presented on the screen: ***This is an activity that shows how physically fit you are by seeing how far you can walk in 2 minutes. I will ask you to walk as fast as you can until I ask you to stop. I know this is hard for some people, so don't worry if you have to slow down or rest. If you do stop or slow down, start walking again as soon as you feel you are ready to do so.***

Is there any reason you cannot do the walk? Does anything hurt or are you in pain? What I would like here is to have you walk as far as you can in this short period of time. If the participant does not feel like they can do this task, make a note and continue with another test.

You and I will not talk while you are walking because this might make you walk more slowly. I will, however, let you know how much time you have to walk and when you are almost done. To move to the next screen, tap the *Next* button in the upper right corner.

Practice

After reading the instructions, you will demonstrate the task, then let the participant practice. Read the black text aloud and follow the directions that are in blue text. Say: ***Let me show you what you are going to do. You will start with your feet behind this line.*** Point to the starting line, then say: ***When I say "Go," you will walk back and forth around the cones as fast as you can without running or hurting yourself. You will begin after I say "Ready, 3, 2, 1, Go!" As you pass the cone, do not stop or slow down. When I tell you to stop, stop where you are on the path until I come to you.***

Demonstrate the task and say: ***Watch me as I show you. You see that I am walking fast but not running and that I am not slowing or stopping when I pass the cone. Do you have any questions?*** Answer any questions the participant might have, then tap the *Next* button.

Read the black text aloud and follow the directions that are in blue text. Say: ***Now you can practice. Walk the path, out and back one time; go around the cone without slowing down. Ready, 3, 2, 1, Go!***

When the participant finishes the practice, ask: ***Do you have any questions?*** Answer any questions the participant might have, then slide the purple button all the way to the right to begin the live trial.

Live Trial

Say: ***This time, I will be timing you. Remember, when I say “Go,” walk back and forth around the cones as fast as possible for 2 minutes without running or hurting yourself. Ready, 3, 2, 1, Go!*** Tap *Start* immediately to begin the timer.

If you need to restart the timer, tap the *Reset* button beside the timer. If the trial is reset, a window appears that says: *Are you sure you want to reset the timer? Tap “OK” if you want to reset the timer.*

Each time the participant makes a turn, tap the *Turn* or *+* button. Tap the *–* button if you made an error and need to subtract a turn. There is a counter at the bottom of the screen that actively keeps track of the number of turns. As a note, two turns = one lap.

The time remaining is displayed at the bottom of the screen. When there is 1 minute remaining (1:00 on the screen), say: ***You are doing well. You have 1 minute to go.*** If the participant is resting at the 1-minute reminder, encourage them by saying: ***You have only 1 minute left. Rest as long as you need; start walking again as soon as you feel able to do so.***

When there are 15 seconds remaining (0:15 on the screen), say: ***In a moment, I’m going to ask you to stop. When I do, just stop right where you are and I will come to you.***

When there are 5 seconds remaining (0:05 on the screen), start counting down: ***5, 4, 3, 2, 1, Stop. Please stay where you are and rest.***

Place a piece of tape on the floor beside the participant’s heel to mark where the participant stopped. Then, direct the participant to sit in the chair while you measure the distance from the last cone passed to the piece of tape. Tap the *Next* button at the top of the screen to move to the next screen to record the trial data.

This screen requires four pieces of information. If the number of turns needs to be updated, use the *+* or *–* buttons to adjust accordingly. Then, count the number of 10-foot intervals from the last cone passed to the tape marking where the participant stopped, and record that in the field *# 10-foot Marks*. Then, measure the distance from the last 10-foot interval passed to where the participant stopped and record feet and inches in the corresponding fields: *Additional Feet Walked* and *Additional Inches Walked*. These fields may be edited until you tap the *Next* button.

After you have entered all the data, tap the *Next* button to end the test.

4-Meter Walk Gait Speed

The 4-Meter Walk Gait Speed test is an assessment of locomotion. Participants ages 7 and older are asked to walk 4 meters at a normal speed on a flat surface.

For more information about additional equipment and materials needed to administer this test, please refer to Appendix 2.

Participants should be wearing comfortable shoes, such as athletic sneakers. They should not do this test in bare feet, high heels, open-back shoes, sandals, or flip-flops.

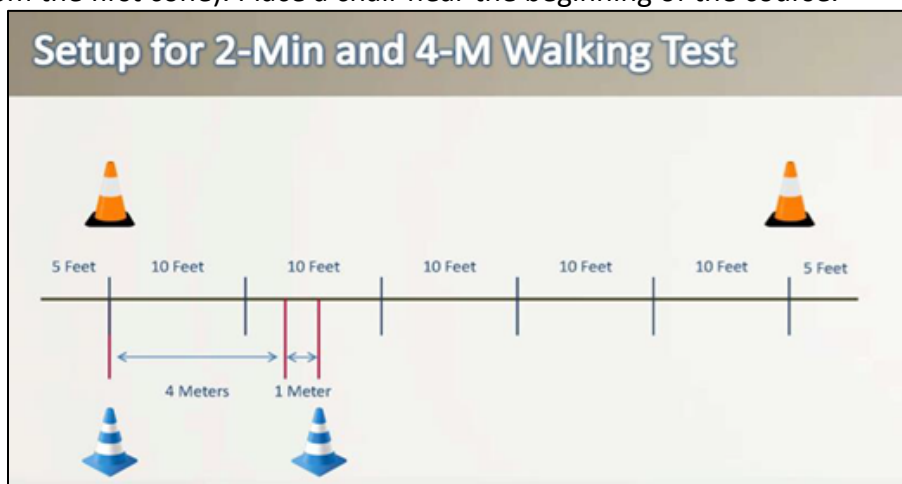
Observe how the participant normally walks. If the participant uses a cane or other walking device and feels they need it for this test, they may use it. Make a note if the participant uses any kind of aid.

Setup: Prior to administering the 4-Meter Walk Gait Speed test, you must set up the walking course. This requires the following: a tape measure with both feet and meter increments, colored masking tape, two cones, a chair, and an open space at least 60 feet in length (an open hallway is recommended).

Please note that if both the 2-Minute Walk Endurance test and the 4-Meter Walk Gait Speed test are being administered, it is possible to set up the walking courses concurrently, as illustrated in the schematic diagram below. If you are not administering the 2-Minute Walk Endurance test, disregard the five short lines beginning at the 15' point.

Following the diagram below, place a piece of tape 2' to 3' long across the hallway, 5' from the start point. Measure 4 meters from the piece of tape and put another piece of tape 2' to 3' long across the hallway. Then, 1 meter from that piece of tape, put another piece of tape 2' to 3' long across the hallway.

Place one cone beside the first long mark and another cone at the last long mark of the course (5 meters from the first cone). Place a chair near the beginning of the course.



Administration

4-Meter Walk Gait Speed has three phases: Instructions, Practice, and Live Trials.

Instructions

Ensure the participant is sitting in a chair near the beginning of the walking course. The instructions are presented on the screen. Read the black text aloud and follow the directions that are in blue text. Say: ***This activity involves walking from one place to another. This is our walking course.*** Point to the course, then say: ***I want you to walk to the other end of the course at your usual speed, just as if you were walking down the street to go to the store.*** To move to the next screen, tap the *Next* button in the upper right corner.

Practice

After reading the instructions, you will demonstrate the task, then let the participant practice. Read the black text aloud and follow the directions that are in blue text. Say: ***Let me show you what I want you to do. Put both of your feet together behind this line.*** Point to the starting line, then say: ***Walk all the way past the cone on the other end before you stop. 3, 2, 1, Go!*** Demonstrate the task, then tap the *Next* button.

After demonstrating the task, return and ask the participant to stand with both feet touching the start line. Say: ***Now you try. Remember to walk at your usual speed and keep walking until you pass the cone. When I want you to start, I will say, “3, 2, 1, Go.” Do you have any questions?*** Answer any questions the participant might have, then say: ***Ready? 3, 2, 1, Go!***

When the participant passes the cone, say: ***That’s good. Do you have any questions?*** Answer any questions the participant might have, then tap the *Next* button.

Live Trials

Ensure you can easily see when the participant steps across each line; if necessary, walk behind and to the side of the participant as they walk. Then say: ***This time, I am going to time you as you walk at your usual speed. Are you ready? 3, 2, 1, Go!*** Tap *Start* immediately to begin the timer. Tap *Stop* as soon as one of the participant’s feet is completely on the ground across the finish line (the line is at 4 meters—not the line at 5 meters).

If you need to restart the timer (e.g., if the participant stumbles or tries to run), tap the *Stop* button, then tap the *Reset* button underneath the timer. If the test is reset, a window appears that says: ***Are you sure you want to reset the timer? Tap “OK” if you want to reset the timer.***

When you are ready to move on, tap the *Next* button. Say: ***Now I want you to repeat the walk. Remember to walk at your usual pace, and go all the way past the cone at the other end of the course. Are you ready? 3, 2, 1, Go!*** Tap *Start* immediately to begin the timer. Tap

Stop as soon as one of the participant's feet is completely on the ground across the finish line.

If you need to restart the timer (e.g., if the participant stumbles or tries to run), tap the *Stop* button, then tap the *Reset* button underneath the timer. If the test is reset, a window appears that says: *Are you sure you want to reset the timer? Tap "OK" if you want to reset the timer.*

When you are ready to end the test, tap the *Next* button.

9-Hole Pegboard Dexterity

The 9-Hole Pegboard Dexterity test is an assessment of fine motor dexterity. Participants ages 3 and older are asked to place nine pegs into a board with nine holes, then remove them as quickly as possible, one hand at a time. 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 more information about additional equipment and materials needed to administer this test, please refer to Appendix 2.

Handedness: If the participant's dominant hand has not been entered in the demographics, this test cannot be administered. If the participant is unsure which hand is dominant, select *Unknown/Ambidextrous* in the Handedness dropdown in the Participant Demographics section. This will bring up a set of questions to ascertain the dominant hand. Once handedness is entered, it will automatically update the instructions on the test so that "RIGHT" and "LEFT" are displayed where appropriate.

Administration

9-Hole Pegboard Dexterity has three phases: Instructions, Dominant Hand, and Nondominant Hand.

Instructions

Follow the setup instructions that are presented on the screen (not to be read aloud): *Place the pegboard on the table, positioning it in front and at the center of the participant's body. Place the pegboard so that the cup with the 9 pegs is next to the hand being tested. The hand not being tested can be used to stabilize the board. The hand being tested should be flat on the table (palm down) until the administrator says "Go."* It is suggested that you use a placemat or piece of rubber shelving to keep the pegboard from slipping on the table, but this is not a requirement. When the board is set up, tap the *Next* button in the upper right corner.



The next screen presents instructions. Read the black text aloud and follow the directions that are in blue text. Say: ***In this activity we are going to see how fast you work with your***

hands. You are going to use your RIGHT (or left, if that is dominant) **hand first**. Point to the hand if needed for understanding, then say: **And then you will do it again with your LEFT** (or right, if that is nondominant) **hand**. Point to the hand if needed.

Then gesture to the pegboard and say: **This is a pegboard and these are the pegs. All the pegs are the same. Pick up the pegs one at a time using your RIGHT** (or left, if that is dominant) **hand only**. Point to the hand if needed, then say: **Put them in the holes one at a time until all 9 holes are filled. Then take them all out, one at a time, like this:**

Demonstrate the task by putting all nine pegs in the holes, then take them out and put them back in the cup, one at a time.

Then say: **The pegs can be put in the holes or taken out in any order. I have extra pegs, so if you drop a peg, don't go after it. I will put in another one.** Slide the purple button all the way to the right to move on to the next screen.

Dominant Hand

Practice:

Like before, read the black text aloud and follow the directions that are in blue text. Say: **Let's practice with your RIGHT** (or left, if that is dominant) **hand**. Point to the hand if needed, then say: **You can use your other hand to hold the board in place**. Make sure the hand being tested is flat on the table, then say: **Are you ready? 3, 2, 1, Go!** and tap the *Start* button on the screen to start the timer. As the participant is placing the final peg in the hole, say: **And take them out**. Tap *Stop* when the participant places the final peg in the cup.

There is a *Reset* button to tap if the participant needs to start again. After the timer stops, tap the *Next* button, then tap *OK* in the pop-up window if you are ready to submit the response.

Trial:

Like before, read the black text aloud and follow the directions that are in blue text. Say: **Now I will time how fast you can do this. Pick up the pegs one at a time using only your RIGHT** (or left, if that is dominant) **hand. Put them in the holes, one at a time, until all 9 holes are filled. Then take them all out, one at a time. The pegs can be put in the holes or taken out in any order. Remember to work as fast as you can**. Make sure the hand being tested is flat on the table, then say: **Are you ready? 3, 2, 1, Go!** and tap the *Start* button on the screen to start the timer. As the participant is placing the final peg in the hole, say: **And take them out**. Tap *Stop* when the participant places the final peg in the cup.

There is a *Reset* button if the participant needs to start again. After the timer stops, tap the *Next* button, then tap *OK* in the pop-up window if you are ready to submit the response.

Nondominant Hand

Practice:

Like before, read the black text aloud and follow the directions that are in blue text. Turn the pegboard around, then say: ***Now we are going to do the same thing with your other hand. Again, pick up the pegs one at a time using only your LEFT*** (or right, if that is nondominant) ***hand***. Point to the hand if needed, then say: ***Put them in the holes, one at a time, until all 9 holes are filled. Then take them all out, one at a time. The pegs can be put in the holes or taken out in any order. Let's practice. Remember, you can use your other hand to hold the board in place.*** Make sure the hand being tested is flat on the table, then say: ***Are you ready? 3, 2, 1, Go!*** and tap the *Start* button on the screen to start the timer. As the participant is placing the final peg in the hole, say: ***And take them out.*** Tap *Stop* when the participant places the final peg in the cup.

There is a *Reset* button if the participant needs to start again. After the timer stops, tap the *Next* button, then tap *OK* in the pop-up window if you are ready to submit the response.

Trial:

Like before, read the black text aloud and follow the directions that are in blue text. Say: ***Now I will time how fast you can do this. Pick up the pegs one at a time using only your LEFT*** (or right, if that is nondominant) ***hand. Put them in the holes, one at a time, until all 9 holes are filled. Then take them all out, one at a time. The pegs can be put in the holes or taken out in any order. Remember to work as fast as you can.*** Make sure the hand being tested is flat on the table, then say: ***Are you ready? 3, 2, 1, Go!*** and tap the *Start* button on the screen to start the timer. As the participant is placing the final peg in the hole, say: ***And take them out.*** Tap *Stop* when the participant places the final peg in the cup.

There is a *Reset* button to tap if the participant needs to start again. If starting again, return all the pegs to the cup first. After the timer stops, tap the *Next* button, then tap *OK* in the pop-up window if you are ready to submit the response.

Grip Strength

The Grip Strength test is an assessment of upper extremity strength. Participants ages 3 and older are asked to squeeze a hand dynamometer as hard as they can, one hand at a time. There is one practice trial with each hand, followed by one live trial with each hand. The alteration allows each hand to recover strength between exertions.

For more information about additional equipment and materials needed to administer this test, please refer to Appendix 2.

Handedness: If the participant's dominant hand has not been entered in the demographics, this test cannot be administered. If the participant is unsure which hand is dominant, select *Unknown/Ambidextrous* in the Handedness dropdown in the Participant Demographics section. This will bring up a set of questions to ascertain the dominant hand. Once handedness is entered, it will automatically update the instructions on the test so that "RIGHT" and "LEFT" are displayed where appropriate.

Administration

Grip Strength has three phases: Instructions, Practice, and Live Trials.

Instructions

Follow the setup instructions that are presented on the screen (not to be read aloud):
Before beginning, be sure the dynamometer is turned on. The handle for gripping the dynamometer is adjustable, but should be initially set at the notch second closest to the unit (tap information button for picture).



Before each trial, tap the RESET button and then the TEST button on the dynamometer to record the grip strength (force). Support the dynamometer for the participant and ensure that the participant is holding the arm being tested next to but not touching their side, with the elbow bent at 90 degrees. When the dynamometer is set up, tap the Next button in the upper right corner.



Ensure the participant is seated in a chair so that their feet are on the floor or floor plate of the wheelchair and their knees are bent at a 90-degree angle.

The next screen presents instructions. Read the black text aloud and follow the directions that are in blue text. Show the participant the dynamometer and say: ***We will use this machine to measure how strong your hands are. You will squeeze the handle 2 times (one practice and one test trial) with each hand while your arm is beside you and your elbow is bent like this.*** Demonstrate how the participant should position their arm at their side, but not touching the body, with the elbow bent 90 degrees. Then say: ***The handle won't move but the machine will show how hard you squeezed.*** Tap RESET and TEST on the dynamometer, then squeeze the handle to demonstrate. Then say: ***See?*** Show the force measurement to the participant and say: ***Do you have any questions?*** Answer any questions the participant might have, then tap the *Next* button in the upper right corner to move to the practice.

Practice

Like before, read the black text aloud and follow the directions that are in blue text. Say: ***Let's practice with your RIGHT*** (or left, if that is dominant) ***hand.*** Point to the hand if needed, then say: ***When I say "Squeeze," I want you to squeeze the handle hard, but not as hard as you can.*** Support the dynamometer, then say: ***Ready? 3, 2, 1, Squeeze!*** After 3–4 seconds, say: ***Stop.*** Tap RESET and TEST on the dynamometer, then tap *Next* at the top of the iPad screen.

Say: ***Now we're going to practice with your LEFT*** (or right, if that is nondominant) ***hand.*** Point to the hand if needed, then say: ***When I say "Squeeze," I want you to squeeze the handle hard, but not as hard as you can.*** Support the dynamometer, then say: ***Ready? 3, 2, 1, Squeeze!*** After 3–4 seconds, say: ***Stop.*** Tap RESET and TEST on the dynamometer, then slide the purple button all the way to the right to begin the test.

Live Trials

Like before, read the black text aloud and follow the directions that are in blue text. Say: ***Now we're going to test each hand, beginning with your RIGHT*** (or left, if that is dominant) ***hand. When I say "Squeeze" this time, I want you to squeeze the handle as hard as you can. Ready? 3, 2, 1, Squeeze! Harder, harder, harder!*** After 3–4 seconds, say: ***Stop.*** Enter the force displayed on the dynamometer to the nearest tenth of a pound into the field on

the iPad. Tap RESET and TEST on the dynamometer, then tap *Next* at the top of the iPad screen. A window appears on the screen that says: *Are you sure you want to submit the response?* Tap *OK* if you want to submit the response. Otherwise, tap *Cancel* to re-enter the force; when you are finished, tap *Next*, then *OK*.

Say: ***Now we are going to test your LEFT*** (or right, if that is nondominant) ***hand***. Point to the hand if needed, then say: ***When I say “Squeeze” this time, I want you to squeeze the handle as hard as you can. Ready? 3, 2, 1, Squeeze! Harder, harder, harder!*** After 3–4 seconds, say: ***Stop***. Enter the force displayed on the dynamometer to the nearest tenth of a pound into the field on the iPad. Tap RESET and TEST on the dynamometer, then tap *Next* at the top of the iPad screen. A window appears on the screen that says: *Are you sure you want to submit the response?* Tap *OK* if you want to submit the response. Otherwise, tap *Cancel* to re-enter the force; when you are finished, tap *Next*, then *OK* to end the test.

Standing Balance

The Standing Balance test is an assessment of balance. Participants ages 3 and older are asked to perform a series of poses on the ground and on a foam pad. The participant is asked to wear a gait belt with an iPhone or iPod attached, which measures the participant's postural movement/sway during each pose. This second device—either an iPhone or iPod Touch—must have the “Balance by NIH Toolbox V3” app installed to measure the participant's sway. It is important to install the correct app; the “BalancePod” app that was used to measure balance in NIH Toolbox V2 will not work with the NIH Toolbox V3 Standing Balance test. If possible, use an iPhone or iPod protective case that has a screen cover, as accidental touches to the screen may inadvertently interrupt the test.

For more information about additional equipment and materials needed to administer this test, please refer to Appendix 2.

We recommend the following exclusion rules for participants:

- Weight over 250 pounds
- Diabetes, depending on comfort
- Joint replacement(s), depending on comfort
- Previous stroke
- Parkinson's disease
- Dizziness/vertigo
- Fallen in the last 6 months more than one time
- Multiple sclerosis
- Macular degeneration
- Glaucoma
- Cataracts
- Pregnancy
- Any participant who does not feel or appear to be safe when performing these tasks

Administration

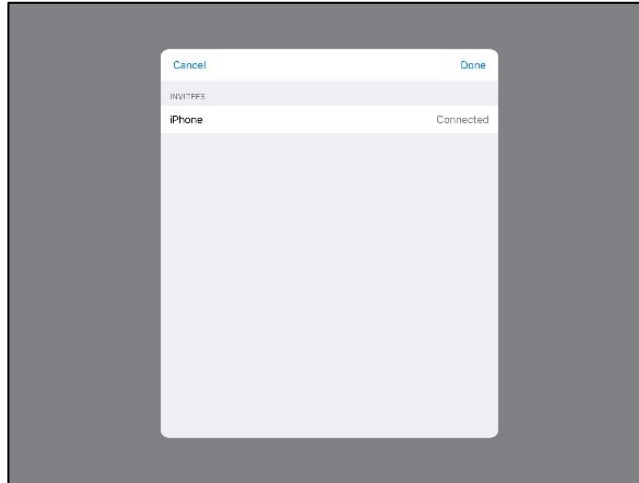
Standing Balance has four phases: Synchronization and Calibration, Preparing the Participant, Instructions, and Live Trials.

Synchronization and Calibration

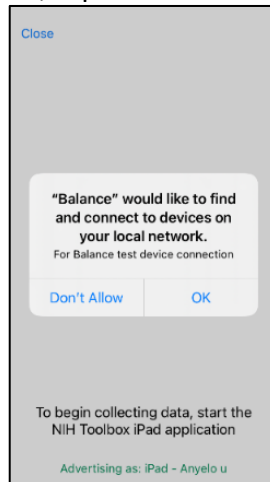
Set up the equipment for this phase before the participant arrives.

Ensure the iPhone or iPod's notifications are turned off and the device is charged. Launch the NIH Toolbox on the iPad, then start the Standing Balance test. A window appears and begins searching for compatible devices. Launch the “Balance by NIH Toolbox V3” app on the iPhone or iPod, then select the *Start a Standing Balance Test* button. This initiates connection to the server that communicates between the iPhone or iPod accelerometer and the NIH Toolbox app on the iPad. When you see the iPhone or iPod device name appear

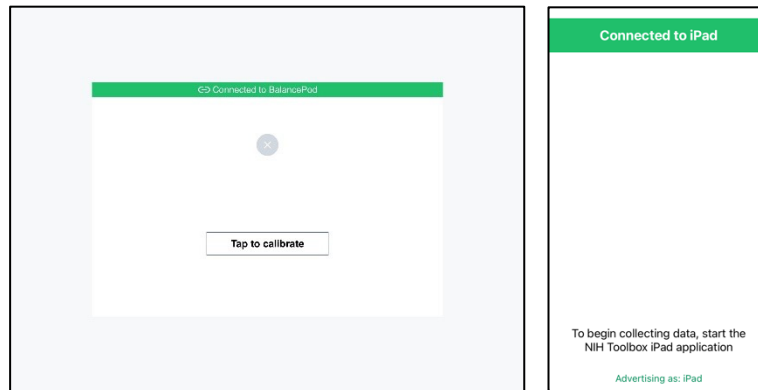
on the iPad, tap it to allow the two devices to connect. When the iPad indicates they are connected, tap *Done*.



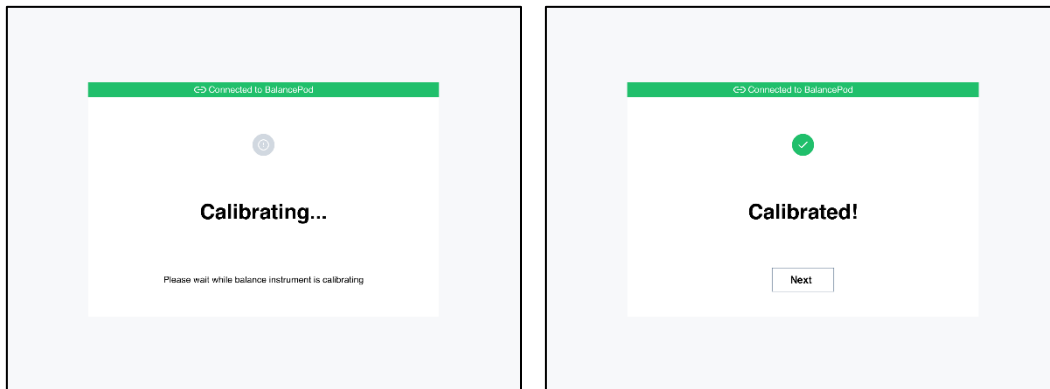
For devices using iOS 14, there is an extra step. These devices require a connection to the local network prior to allowing a pairing/connection between the iPhone or iPod and the iPad. When the screen below appears, tap *OK* to initiate the connection.



As shown below, a green band appears at the top of both the iPhone or iPod and the iPad when they are paired and communicating.



On the iPad, tap the *Tap to calibrate* button. As the devices are calibrating, the iPad will display the word “Calibrating...”; when the two devices have been calibrated, it will display “Calibrated!”



When the devices have been calibrated, tap the *Next* button to start the test.

Though not common, it is possible that the calibration will need to be repeated after the participant is prepared. If this happens, tap the *RE-CONNECT* button until the word “Calibrated!” appears on the iPad screen.

Preparing the Participant

Say to the participant, **“We are going to test your balance.”**

Attach the iPhone or iPod to the gait belt and show it to the participant. Explain that the iPhone or iPod on the belt is used to measure balance, and ask permission to put the belt on the participant or ask the participant to help. The belt should fit tightly around the hips. For participants ages 3–6, the iPhone or iPod should be placed on the back of the belt and when possible, the handles on the belt should be on the participant’s side closest to the examiner.



For participants ages 7 and older, the iPhone or iPod should be placed on the front of the belt, with the handles to the participant's back.



It is critical that the iPhone or iPod be inserted in the protective case and attached to the belt with the home button toward the ground and the green banner at the top.

Ask the participant to remove their shoes so they are either barefoot, in socks or stockings, or wearing paper booties, if offered.

The iPhone or iPod screen may be sensitive to accidental touches, which may cause the Balance app to disconnect and end the Standing Balance test. If possible, use an iPhone or iPod case with a screen cover, such as OtterBox. If the screen is not covered, let the participant know they should avoid touching the screen if possible, but their safety is paramount and not to be concerned with the iPhone or iPod if they lose balance.

Place a sheet of paper with a large X on the wall at the participant's eye level. For Poses 1, 3, and 5, the participant will be asked to focus on the X. The participant should stand 3 feet (1 meter) away from the wall, directly in front of the X. Place a chair close to the participant in case they need to rest between trials.

Instructions

When the participant is ready, read aloud the instructions that are presented on the screen:
This is a test of your balance. There are as many as 5* different poses that you will be asked to do. During each pose, you will be asked to stand as steady as possible for 50

seconds. You will have a second chance if you cannot hold the position for 50 seconds. Between each set of poses, you may rest in the chair if needed. Please try to do your best. I will demonstrate how I want you to stand before each pose. When the participant indicates that they are ready, slide the purple button all the way to the right to begin the test.

*Note: For participants ages 3 to 6, there are only 4 poses.

Remember to stand close to the participant to prevent falls, and remind the participant as needed that they can step out of the pose if they are feeling unsafe or unable to hold the pose. It is crucial that the iPad be less than 15 feet (4.5 meters) away from the iPhone or iPod and placed where you can see it. Although it might be easiest to hold the iPad during testing, in the event that a participant requires help to avoid falling, you might have to drop the iPad and endanger its integrity.

Live Trials

Give the participant up to two trials to be successful on each pose. Use the following guidelines to stop a trial, as any of these are evidence that the participant is no longer holding the pose and has failed the trial:

- If the arms come off of the chest
- If the knees bend
- If the feet move out of the original pose (move, swivel out, or are lifted)
- If the participant bends forward at the waist more than 45 degrees. (If this happens, you will have to support the participant with the belt.)
- If the participant opens their eyes during an eyes-closed pose (Poses 2 and 4)
- If the participant says something like “I cannot do that” or “I do not feel safe trying that.”

After each trial or pose, ask, **“Are you ready for the next one?”** If the participant is not ready or would like to rest, say, **“Please sit in this chair to rest.”** A maximum of 1 minute of rest is permitted, so it is important to note the time. Every 15 seconds or so, ask the participant, **“Are you ready to continue?”** If the participant is ready, proceed with the next trial or pose. If the participant is not ready, ask again in another 15 seconds.

If the participant is not ready by the end of the 1-minute rest period, discontinue the test. In this situation, complete the administrator gesture on the iPad and tell the participant, **“Let’s go on to another activity.”**

Pose 1: Flat Surface, Feet Together, Eyes Open



Trial 1: Read the instructions aloud to the participant: ***Please stand with your feet together (heels and balls of feet touching) and as still as possible with your eyes open and with your arms crossed on your chest, like this.*** Demonstrate the pose and ensure the participant understands. Have the participant stand in front of the X on the wall and assume the pose. Then say: ***Focus on the X shown on the wall in front of you. Ready?*** When the participant indicates that they are ready, say: ***Go*** and slide the purple button all the way to the right to begin the timer.

Place the iPad where you can easily see it and the countdown on the screen, but watch the participant for signs of movement on this and all other trials. If they seem unstable, be ready to reach out and help stabilize the participant.

After 50 seconds, the iPhone or iPod plays a sound to indicate the trial is over. If the participant successfully held the pose for the full 50 seconds, tap the *Pass* button in the upper right corner. If the participant was unable to complete the pose for the full 50 seconds, tap the *Stop/Fail* button in the upper left corner. Regardless of which button is tapped, a pop-up window appears to confirm the selection.

If the participant passed the first trial, the test moves on to the next pose. Ask the participant if they are ready to continue, then either slide the purple button all the way to the right or allow the participant up to 1 minute to rest. If the participant failed the first trial, they are given a second opportunity to complete the pose.

Trial 2: Read the instructions aloud to the participant: ***Let's try that one again. Please stand with your feet together (heels and balls of feet touching) and as still as possible with your eyes open and with your arms crossed on your chest, like this.*** Demonstrate the pose and ensure the participant understands. Have the participant stand in front of the X on the wall and assume the pose. Then say: ***Focus on the X shown on the wall in front of you. Ready?*** When the participant indicates that they are ready, say: ***Go*** and tap the *Start* button to begin the timer.

After 50 seconds, the iPhone or iPod plays a sound to indicate the trial is over. If the participant successfully held the pose for the full 50 seconds, tap the *Pass* button in the upper right corner. If the participant was unable to complete the pose for the full 50

seconds, tap the *Stop/Fail* button in the upper left corner. Regardless of which button is tapped, a pop-up window appears to confirm the selection.

If the participant passed the second trial, the test moves on to the next pose. Ask the participant if they are ready to continue, then either slide the purple button all the way to the right or allow the participant up to 1 minute to rest. If the participant failed both trials of Pose 1, the test ends. In this situation, say, **“Let’s go on to another activity.”**

Pose 2: Flat Surface, Feet Together, Eyes Closed



Trial 1: Read the instructions aloud to the participant: ***Please stand with your feet together (heels and balls of feet touching) and as still as possible with your eyes closed and with your arms crossed on your chest, like this.*** Demonstrate the pose and ensure the participant understands. Have the participant stand in front of the X on the wall and assume the pose. Then say: ***Ready?*** When the participant indicates that they are ready, say: ***Go*** and tap the *Start* button to begin the timer.

Tap the *Pass* button if the participant successfully held the pose for the full 50 seconds, and tap the *Stop/Fail* button if the participant did not hold the pose for the full 50 seconds. Regardless of which button is tapped, a pop-up window appears to confirm the selection.

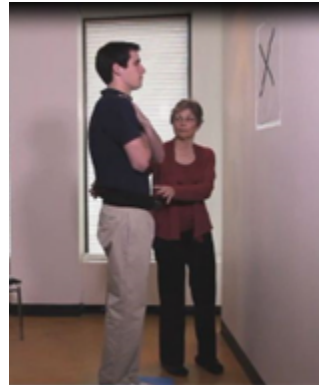
If the participant passed the first trial, the test moves on to the next pose. Ask the participant if they are ready to continue, then either slide the purple button all the way to the right or allow the participant up to 1 minute to rest. If the participant failed the first trial, they are given a second opportunity to complete the pose.

Trial 2: Read the instructions aloud to the participant: ***Let’s try that one again. Please stand with your feet together (heels and balls of feet touching) and as still as possible with your eyes closed and with your arms crossed on your chest, like this.*** Demonstrate the pose and ensure the participant understands. Have the participant stand in front of the X on the wall and assume the pose. Then say: ***Ready?*** When the participant indicates that they are ready, say: ***Go*** and tap the *Start* button to begin the timer.

Tap the *Pass* button if the participant successfully held the pose for the full 50 seconds, and tap the *Stop/Fail* button if the participant did not hold the pose for the full 50 seconds. Regardless of which button is tapped, a pop-up window appears to confirm the selection.

If the participant passed the second trial, the test moves on to the next pose. If the participant failed both trials of Pose 2, they will not be asked to perform any more poses with eyes closed (i.e., will not be administered Pose 4) but will still continue on to Pose 3. Ask the participant if they are ready to continue, then either slide the purple button all the way to the right or allow the participant up to 1 minute to rest.

Pose 3: Foam Surface, Feet Together, Eyes Open



Trial 1: Pick up the blue pad and place it on the floor 3 feet (1 meter) in front of the X on the wall. Read the instructions aloud to the participant: ***Please step onto the foam and put your feet together (heels and balls of feet touching) and stand as still as possible with your eyes open and your arms crossed on your chest, like this.*** Demonstrate the pose and ensure the participant understands. Have the participant stand in front of the X on the wall and assume the pose. Then say: ***Focus on the X shown on the wall in front of you. Ready?*** When the participant indicates that they are ready, say: ***Go*** and tap the *Start* button to begin the timer.

Tap the *Pass* button if the participant successfully held the pose for the full 50 seconds, and tap the *Stop/Fail* button if the participant did not hold the pose for the full 50 seconds. Regardless of which button is tapped, a pop-up window appears to confirm the selection.

If the participant passed the first trial, the test moves on to the next pose. Ask the participant if they are ready to continue, then either slide the purple button all the way to the right or allow the participant up to 1 minute to rest. If the participant failed the first trial, they are given a second opportunity to complete the pose.

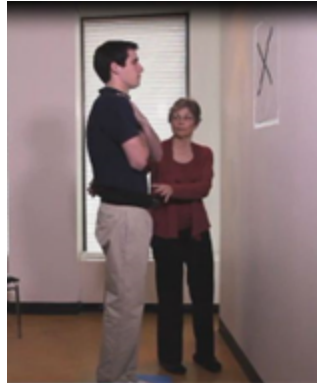
Trial 2: Read the instructions aloud to the participant: ***Let's try that one again. Please step onto the foam and put your feet together (heels and balls of feet touching) and stand as still as possible with your eyes open and your arms crossed on your chest, like***

this. Demonstrate the pose and ensure the participant understands. Have the participant stand in front of the X on the wall and assume the pose. Then say: **Focus on the X shown on the wall in front of you. Ready?** When the participant indicates that they are ready, say: **Go** and tap the *Start* button to begin the timer.

Tap the *Pass* button if the participant successfully held the pose for the full 50 seconds, and tap the *Stop/Fail* button if the participant did not hold the pose for the full 50 seconds. Regardless of which button is tapped, a pop-up window appears to confirm the selection.

If the participant passed the second trial, the test moves on to the next pose. If the participant failed both trials of Pose 3, the test will skip ahead to Pose 5. Ask the participant if they are ready to continue, then either slide the purple button all the way to the right or allow the participant up to 1 minute to rest.

Pose 4: Foam Surface, Feet Together, Eyes Closed



Trial 1: Read the instructions aloud to the participant: ***Please step onto the foam and put your feet together (heels and balls of feet touching) and stand as still as possible with your arms crossed on your chest, and then close your eyes, like this.*** Demonstrate the pose and ensure the participant understands. Have the participant stand in front of the X on the wall and assume the pose. Then say: **Ready?** When the participant indicates that they are ready, say: **Go** and tap the *Start* button to begin the timer.

Tap the *Pass* button if the participant successfully held the pose for the full 50 seconds, and tap the *Stop/Fail* button if the participant did not hold the pose for the full 50 seconds. Regardless of which button is tapped, a pop-up window appears to confirm the selection.

If the participant is younger than age 7 and passed the first trial, say, **“Let’s go on to another activity.”** If the participant is age 7 or older and passed the first trial, the test moves on to the next pose. Ask the participant if they are ready to continue, then either slide the purple button all the way to the right or allow the participant up to 1 minute to rest. If the participant (of any age) failed the first trial, they are given a second opportunity to complete the pose.

Trial 2: Read the instructions aloud to the participant: ***Let's try that one again. Please step onto the foam and put your feet together (heels and balls of feet touching) and stand as still as possible with your arms crossed on your chest, then close your eyes, like this.*** Demonstrate the pose and ensure the participant understands. Have the participant stand in front of the X on the wall and assume the pose. Then say: ***Ready?*** When the participant indicates that they are ready, say: ***Go*** and tap the *Start* button to begin the timer.

Tap the *Pass* button if the participant successfully held the pose for the full 50 seconds, and tap the *Stop/Fail* button if the participant did not hold the pose for the full 50 seconds. Regardless of which button is tapped, a pop-up window appears to confirm the selection.

If the participant is younger than age 7, say, ***Let's go on to another activity.*** If the participant is age 7 or older, regardless of performance on the second trial, the test moves on to the next pose. Ask the participant if they are ready to continue, then either slide the purple button all the way to the right or allow the participant up to 1 minute to rest.

Pose 5: Flat Surface, Tandem Stance, Eyes Open



Trial 1: If the participant is age 7 or older, read the instructions aloud: ***Please stand with the heel of one foot touching the toes of the other foot on the ground. Keep them in a straight line. Stand as still as possible with your eyes open and with your arms crossed on your chest, like this.*** Demonstrate the pose and ensure the participant understands. Then say: ***Before you do this, try each foot in front and decide for yourself which one is more comfortable. Then, focus on the X shown on the wall in front of you.*** When the participant has chosen which is more comfortable, have them stand in front of the X on the wall and assume the pose. Then say: ***Ready?*** When the participant indicates that they are ready, say: ***Go*** and tap the *Start* button to begin the timer.

Tap the *Pass* button if the participant successfully held the pose for the full 50 seconds, and tap the *Stop/Fail* button if the participant did not hold the pose for the full 50

seconds. Regardless of which button is tapped, a pop-up window appears to confirm the selection.

If the participant passed the first trial, the test ends. If the participant failed the first trial, they are given a second opportunity to complete the pose.

Trial 2: Read the instructions aloud to the participant: ***Let's try that one again. Please stand with the heel of one foot touching the toes of the other foot on the ground. Keep them in a straight line. Stand as still as possible with your eyes open and with your arms crossed on your chest, like this.*** Demonstrate the pose and ensure the participant understands. Have the participant stand in front of the X on the wall and assume the pose. Then say: ***Focus on the X shown on the wall in front of you. Ready?*** When the participant indicates that they are ready, say: ***Go*** and tap the *Start* button to begin the timer.

Tap the *Pass* button if the participant successfully held the pose for the full 50 seconds, and tap the *Stop/Fail* button if the participant did not hold the pose for the full 50 seconds. Regardless of which button is tapped, a pop-up window appears to confirm the selection.

Chapter 7: 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, academic and occupational endeavors, and activities of daily living. The following constructs compose the Sensation domain:

Table 7.1
NIH Toolbox V3 Sensation Domain Constructs

<i>Sensation Construct</i>	<i>Definition</i>
Audition	Audition, or hearing, is the processing of sound in the environment. It is assessed by Words-In-Noise.
Olfaction	The human olfactory system allows us to detect odors, to recognize and discriminate odor qualities, and to identify the sources of odors in our world. It is measured by Odor Identification.
Pain	Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. It is measured by Pain Intensity FF and Pain Interference CAT.
Taste	Taste perception, also known as gustation, arises from stimulation of taste receptors, which are composed of epithelial cells, found most frequently on the papillae of the tongue and throughout the oral cavity. It is measured by Regional Taste Intensity.
Vision	Vision is a complex sensation that provides us with a personal, conscious representation of our surrounding environment. Visual impairment can impose various limitations on a person's functional ability including reading, mobility (which includes driving), visual information processing (i.e., seeing), and visually guided motor behavior (i.e., manipulation). It is measured by Visual Acuity.

Sensation tests may be given individually, or in any combination with each other or tests from other domains. There are 8 Sensation tests.

Table 7.2
NIH Toolbox V3 Sensation Test Details

<i>Test Name</i>	<i>Ages</i>	<i>Time to Administer (minutes)</i>
Odor Identification Ages 3-9	3-9	4-5
Odor Identification Ages 10+	10+	4-5
Pain Intensity FF	18+	1
Pain Interference CAT	18+	1
Regional Taste Intensity	12+	6
Visual Acuity Ages 3-7	3-7	3
Visual Acuity Ages 8+	8+	3
Words-In-Noise	6+	6

Note. The “Time to Administer (minutes)” column gives users an idea of how long each test might take. Please note that test times may vary based on how prepared the examiner is going into the session, individual differences among participants, and/or other unplanned activities that may occur during testing.

For more information about additional equipment and materials needed to administer tests in the Sensation domain, please refer to Appendix 2.

Revision Details

The Sensation tests’ user interface (e.g., font, background color) has been updated for consistency with other NIH Toolbox® V3 tests.

Tests

Odor Identification

The Odor Identification tests are an assessment of olfaction. There are two tests: Odor Identification Ages 3–9 and Odor Identification Ages 10+. Younger participants are asked to identify eight pictures, asked if they have smelled the objects or food depicted, and then asked to identify five odors on Odor Identification Cards. Older participants are asked to identify nine odors on Odor Identification Cards.

For more information about additional equipment and materials needed to administer this test, please refer to Appendix 2.

Administration

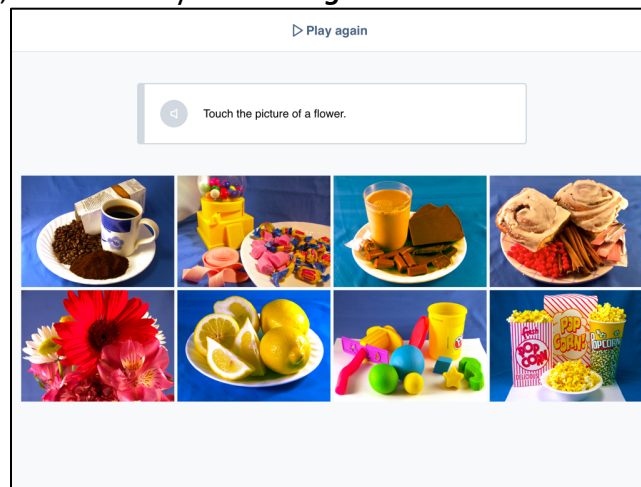
Odor Identification Ages 3–9 has two phases: Picture Identification and Odor Identification. Odor Identification Ages 10+ has one phase: Odor Identification.

Ages 3–9

Picture Identification

Read aloud the instructions that are presented on the screen: ***Now, we are going to look at some pictures. I want to see if you know what they are.*** Slide the purple button all the way to the right to begin the Picture Identification items.

The next screen has eight pictures. Instructions are presented at the top of the screen and via audio: ***Touch the picture of a flower.*** If the participant responds correctly by tapping the picture of the flower, the audio says: ***That's right!***



If the participant responds incorrectly by tapping any of the other pictures, the border around the incorrect picture changes color to red and the audio provides corrective feedback: ***This is a flower.*** The border around the correct picture flashes blue.

Then, the test automatically advances to the next screen, which has a picture of a flower. Text is presented on the screen and via audio: ***Have you ever smelled a flower?*** Tap Yes or

No on the screen to indicate the participant's answer, then tap the *Next* button in the upper right corner. This answer may be changed until the *Next* button is tapped.

The test returns to the screen with eight pictures and follows the same sequence (i.e., ***Touch the picture of ____*** followed by ***Have you ever smelled ____?***) until the participant has responded to all eight objects and foods. The order in which the objects and foods are presented is: flower, popcorn, lemon, Play Doh, cinnamon, coffee, chocolate, bubble gum. Audio feedback when the participant responds correctly alternates throughout this part of the test between ***That's right!*** and ***Great job!***

After all eight items have been presented, the test asks the participant to touch the pictures that were not correctly identified on the first trial. The audio says: ***Touch the picture of ____***, one by one. If the participant responds incorrectly, the border around the incorrect picture changes color to red and the audio provides corrective feedback: ***This is ____.***

Odor Identification

Then, the test advances to the transition screen for the Odor Identification items. Say: ***I am going to give you some stickers to smell. After you smell the sticker, tap the picture that shows what you just smelled. If you want to change your choice, tap the Back button. Let's begin.*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the test.

A screen with four pictures and instructions on top appears. The order in which the five odors are presented is: lemon, Play Doh, bubble gum, chocolate, popcorn. For each odor, scratch the Odor Identification Card and hand it to the participant, saying: ***Tap the picture that shows what you just smelled.***

It is important to note that the odor on the Odor Identification Cards is strongest immediately after the card is scratched. You may need to remind the participant to smell the card as quickly as possible after you hand it to them. If the participant says they do not smell anything, scratch the card one more time and place it directly under the participant's nose, then ask the participant to make their best guess if they are not sure. Encourage the participant to smell the card more than once if needed.

If the participant has difficulty touching the iPad screen, you may tap the screen for them to register their response.

If the participant thinks they made a mistake on the previous item, it is possible to tap the *Back* button in the upper left corner to return to the previous item only. If the participant attempts to go back beyond the previous item, say, ***"You can only go back to the last item you smelled."***

After the last item, the participant is given the opportunity to change their last answer. Say: ***“Are you ready to end this activity? If not, you can tap the Back button to change your most recent answer.”***

When the participant has completed all five cards, say, ***“You have finished this activity.”***

Ages 10+

Odor Identification

Read aloud the instructions that are presented on the screen: ***This task involves smelling various odors, one at a time, and then trying to identify them. The odors that you will smell are chosen from a variety of foods and objects that people experience in everyday life. We are using “scratch and sniff” cards to present the odors. Take the scratcher and scratch the card. Smell it right after you scratch it and then look at the pictures on the screen. Tap the picture that best shows the odor that you smelled on the card. A new set of pictures will then appear on the screen and you will be asked to identify the odor on the next card. If you want to change your last answer, tap the Back button.*** When the participant indicates that they are ready, slide the purple button all the way to the right to begin the test.

A screen with four pictures and instructions on top appears. The order in which the nine odors are presented is: lemon, Play Doh, bubble gum, chocolate, popcorn, coffee, smoke, natural gas, flower. For each odor, hand the appropriate Odor Identification Card to the participant to scratch. As the participant scratches the card and smells it, say: ***Tap the picture that shows what you just smelled.***

It is important to note that the odor on the Odor Identification Cards is strongest immediately after the card is scratched. You may need to remind the participant to smell the card as quickly as possible after scratching it. If the participant says they do not smell anything, scratch the card yourself and place it directly under the participant’s nose, then ask the participant to make their best guess if they are not sure. Encourage the participant to smell the card more than once if needed.

If the participant has difficulty using the scratcher, you may scratch the card and hand it to the participant. If the participant has difficulty touching the iPad screen, you may tap the screen for them to register their response.

If the participant thinks they made a mistake on the previous item, it is possible to tap the *Back* button in the upper left corner to return to the previous item only. If the participant attempts to go back beyond the previous item, say, ***“You can only go back to the last item you smelled.”***

After the last item, the participant is given the opportunity to change their last answer. Say: ***Are you ready to end this activity? If not, you can tap the Back button to change your most recent answer.***

When the participant has completed all nine cards, say, **“You have finished this activity.”**

Pain Intensity & Pain Interference

The Pain Intensity test is an assessment of the participant's pain in the past 7 days. Participants ages 18 and older are asked to rate their pain on a scale of 0 (no pain) to 10 (worst pain imaginable).

The Pain Interference test is an assessment of pain that is administered in a computer-adaptive test (CAT) format. Participants ages 18 and older are asked the extent to which pain has interfered with or affected enjoyment of various activities in the past 7 days. A minimum of four questions and a maximum of twelve questions are presented, depending on the participant's responses. Responses are based on a 5-point scale. Some items are rated *Not at all; A little bit; Somewhat; Quite a bit; Very much*. Other items are rated *Never; Rarely; Sometimes; Often; Always*.

Administration

Since there is no specific introduction to the Pain assessments, "Emotion Instructions (Adult/Child)" should be selected from the test list to introduce them. These instructions read: **On the next screens, we will ask you questions about your thoughts, feelings, and behaviors. Read each question carefully and answer as well as you can. There is no right or wrong answer, only what is true for you and describes your thoughts, feelings, and behaviors. Select an answer by tapping your answer choice on the screen. After you make your choice, the screen will automatically go on to the next question. If you want to change your answer, tap the Back button to return to the question, then tap a different answer choice.**

After this introduction, the tests are automatically presented. Each test is self-administered, and the instructions are presented on the screen. Ensure the participant can respond directly on the iPad, assisting if needed or offering privacy if the participant desires it.

Regional Taste Intensity

The Regional Taste Intensity test is an assessment of taste sensitivity. Participants ages 12 and older are asked to rate the intensity of salty and bitter solutions on the tip of their tongue and in their mouth. Participants should not have had drinks or food in the 30 minutes prior to taking this test.

There are four trials, which are presented in the following order: quinine on the tongue tip, salt on the tongue tip, quinine in the whole mouth, salt in the whole mouth.

This activity requires more preparation and uses more materials than other tests, so you should have everything nearby and ready before beginning the test.

Setup

Prior to administering the Regional Taste Intensity test, you must prepare all the materials. Although the necessary equipment and materials are listed below, more information can be found at NIHToolbox.org.

Equipment and Materials Needed

- Electronic balance (scale) readable to at least 0.01 grams, and preferably 0.001 grams
- Magnetic stirrer
- Stir bar (1 or 1.5 inches in length)
- Plastic-coated magnetic retrieving rod
- 1-liter graduated cylinder
- Solution storage bottles (light-occluding are required for quinine)
- Lab spoon
- Plastic weigh boats
- Food, Kosher, or USP grade quinine monohydrochloride dihydrate
 - Note: NIH Toolbox norms were collected using Kosher grade quinine monohydrochloride dihydrate (formula weight 396.9).
- USP grade sodium chloride (NaCl; salt)
 - Note: NIH Toolbox norms were collected using USP grade NaCl (formula weight 58.44).
- Distilled or deionized water for mixing solutions
- Labelled medicine cups
- Sterile cotton swabs
- Distilled, deionized, or other purified water for rinsing
 - Note: Dasani is NOT recommended because minerals are added back in after the purification process.
- Disposable cups
- Latex-free gloves
- Spittoon
- iPad stand

Mixing Instructions

Mixing the NaCl Solution:

Ensure the balance is on a level surface. Add the weigh boat to the balance pan, and carefully zero the balance. Then add 58.44 grams of NaCl to the weigh boat. Then, empty all the premeasured NaCl crystals from the weigh boat into the 1-liter graduated cylinder. Slowly add distilled or deionized water to the 1-liter mark by bringing the meniscus (bottom) of the solution to the 1000 ml mark. Gently add the stir bar and then stir on the magnetic stirrer until the NaCl is completely dissolved (approximately 5 to 10 minutes). Once the NaCl is fully dissolved, turn off the stirrer, and use the retrieving rod to remove the stir bar from the solution. Transfer the solution to labeled storage bottles. Wash and rinse the graduated cylinder, stir bar, and retrieving rod thoroughly before reusing.

Mixing the Quinine Solution:

Ensure the balance is on a level surface. Add the weigh boat to the balance pan, and carefully zero the balance. Then weigh out 0.397 grams of quinine hydrochloride dihydrate. If you do not have access to an analytical balance that goes to three decimal points, weigh out 0.40 grams of quinine HCl on a standard top-loading electronic balance. Do not use a triple-beam balance for quinine. Empty the pre-measured quinine into a 1-liter cylinder and add distilled or deionized water to the 1000 milliliter mark. Gently add the stir bar and then stir on a magnetic stirrer until the quinine is completely dissolved, and no visible crystals can be seen (at least 15 to 20 minutes). Transfer the solution to labeled storage bottles. Wash and rinse the graduated cylinder, stir bar, and retrieving rod thoroughly before reusing.

Solution Storage Requirements

Taste solutions should be made fresh each week, stored under refrigeration when not in use, and warmed to room temperature prior to use for testing. A period of 3 to 4 hours is generally required for solutions to warm to room temperature. Do not freeze the solutions because the container may crack.

Taste solutions should be stored in glass bottles with a nonreactive lid. Quinine is light-sensitive, so quinine should be stored in a light-occluding glass bottle or a bottle wrapped in aluminum foil to minimize light exposure.

Use of Solutions for Taste Testing

Each participant will be tested with 10 ml of quinine solution and 10 ml of NaCl solution. Solutions should be at room temperature for testing. Use two labeled medicine cups to hold the solutions for testing each participant. Pour 10 ml of quinine solution into one cup and 10 ml of NaCl solution into the second cup.

For tongue tip testing, a sterile cotton swab will be dipped once in the quinine solution and then used to paint the solution across the anterior tongue. After the participant rinses their mouth, a second sterile cotton swab will be dipped once in the NaCl solution and used to

paint the solution across the anterior tongue. The solution remaining in each of the two cups will then be used for whole-mouth testing, first with quinine and then with NaCl.

Administration

Regional Taste Intensity has three phases: Instructions, Practice, and Live Trials.

Instructions

Position the iPad so that both you and the participant can see the screen. Read aloud the instructions that are presented on the screen: ***Now I am going to test your sense of taste. To do this we will be using a salty flavor and a flavor found in tonic water.*** To move to the next screen, tap the *Next* button in the upper right corner.

Read the second instruction screen aloud: ***Before the tasting, I am going to ask you to use this scale to rate how weak or strong some sensations are to you. Some of these sensations are things that you will experience. Some of these sensations are what you will recall experiencing in the past.***

This scale ranges from 'No Sensation At All' at the bottom to the 'Strongest Sensation of Any Kind' at the top. The top of the scale (Strongest Sensation of Any Kind) refers to any kind of experience; for example, sound, brightness of light, and even those sensations that might be painful. Slide the purple button all the way to the right to continue with the instructions.

Read the third instruction screen aloud: ***This is how you use this scale. You can use your finger to choose a word on the scale that describes what you experience or what you remember. You can tap anywhere on the line. For example, if the sensation you experience is more than 'Moderate' but not quite 'Strong', you can use your finger to touch a spot between Moderate and Strong.*** Demonstrate by tapping on the scale and moving your finger up and down, then say: ***Move your finger until you think it best represents how you feel, and then remove your finger. If you would like, you can fine-tune your rating by using the up and down arrows to the right of the scale. When you are happy with the position of the mark, tap the Next button.***

Allow the participant to interact with the scale and tap the *Next* button.

Practice

After the instructions are presented, the test advances to a transition screen to begin the practice items. Say: ***Let's try some for practice.*** When the participant indicates that they are ready, tap the *Next* button.

The first practice item appears on the screen. Say: ***Use this scale to rate the brightness of a well-lit room. How strong or intense is the brightness to you? When you are finished, tap the Next button.***

After the participant taps the *Next* button, the second practice item appears. Say: ***Please think about the brightness of a dimly lit restaurant, where the only light is from candles on the table. Would you say the strength or intensity of a dimly lit restaurant is less bright than the light in a well-lit room? Use the scale to rate the brightness of a dimly lit restaurant. When you are finished, tap the Next button.***

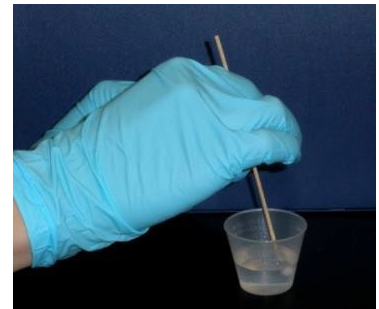
After the participant taps the *Next* button, the third practice item appears. Say: ***Now think about the brightest light you have ever seen. Use the scale to rate the intensity or strength of the brightest light you have ever seen. When you are finished, tap the Next button.***

If the participant has difficulty tapping the screen, they may point and you may interact with the screen. You can say something like ***“You can point to your choice and then I can tap the screen for you.”***

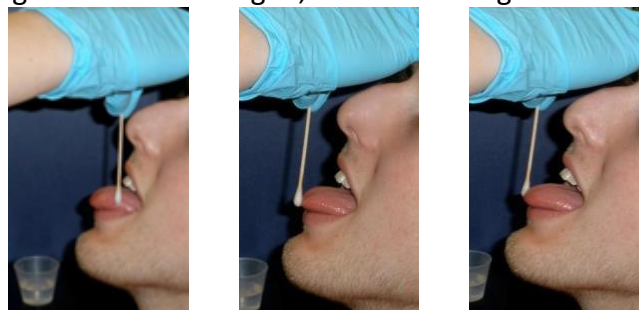
Live Trials

Trial 1:

After the practice items are presented, the test advances to a screen to present the first trial item. Say: ***Now we are going to do the taste test. Before we begin, please rinse out your mouth two times with bottled water and then spit the rinse water into this container.*** Show the participant the spittoon, have them rinse twice, then say: ***Now I am going to ask you to rate the strength of these tastes. First, I will put some of the solution across the tip of your tongue and ask for a rating. To begin I will put on these gloves.*** Put on latex-free gloves for the remainder of this test. Then say: ***Then, I will put this sterile cotton swab into the solution.*** Put a swab into the cup of solution, like in the image to the right. Then, tap the *Next* button.



Say: ***Now hold your tongue out.*** If the participant has difficulty doing this, show them the picture or demonstrate. Say: ***I am going to start on your left side and gently put some solution across the tip of your tongue.*** Carefully and gently apply the quinine solution with the cotton swab in a slow, continuous motion from the left side of the tongue across the tip and finishing on the right side of the tongue, like in the images below.



Then say: ***Now, show me the strength or intensity of the taste on the scale you used before. Keep your tongue out while you make the rating on the scale. Tap the Next button when you are finished. If you should accidentally swallow any, it will not hurt you.***

Between items, the test advances to a transition screen. Say: ***Please rinse your mouth two times with the bottled water and spit the rinse water into the container.*** When the participant is ready, tap the Next button.

Trial 2:

Say: ***Now hold your tongue out again. I am going to gently put some solution across the tip of your tongue.*** Put a cotton swab into the salt solution (NaCl). Carefully and gently apply the solution in a slow, continuous motion from the left side of the tongue across the tip and finishing on the right side of the tongue, like before.

Then say: ***Now, show me the strength or intensity of the taste on the scale you used before. Keep your tongue out while you make the rating on the scale. Tap the Next button when you are finished. If you should accidentally swallow any, it will not hurt you.***

Between trials, the test advances to a transition screen. Say: ***Please rinse your mouth two times with the bottled water and spit the rinse water into the container.*** When the participant is ready, tap the Next button.

Trial 3:

Hand the participant a medicine cup with quinine and say: ***Next, I would like you to sip all of the solution in this cup. Try not to drink the solution, but hold it and gently move it around in your mouth until I tell you to spit it out in this container. If you should accidentally swallow any, it will not hurt you.***

After the participant sips the solution, count for 3 seconds (one-thousand-one, one-thousand-two, one-thousand-three), then say: ***Spit out the solution in your mouth and swallow whatever remains. Then, rate the strength or intensity of the taste on the same scale you used before. Tap the Next button when you are finished.***

Between trials, the test advances to a transition screen. Say: ***Please rinse your mouth two times with the bottled water and spit the rinse water into the container.*** When the participant has rinsed their mouth twice, tap the Next button.

Trial 4:

Hand the participant a medicine cup with salt solution (NaCl) and say: ***Next, I would like you to sip all of the solution in this cup. Try not to drink the solution, but hold it and gently move it around in your mouth until I tell you to spit it out in this container. If you should accidentally swallow any, it will not hurt you.***

After the participant sips the solution, count for 3 seconds (one-thousand-one, one-thousand-two, one-thousand-three), then say: ***Spit out the solution in your mouth and swallow whatever remains. Then, rate the strength or intensity of the taste on the same scale you used before. Tap the Next button when you are finished.***

Give the participant the bottle of water and encourage them to drink it. Say: ***Now that we have finished, you might want to drink some more water to clean out your mouth.*** When the participant has rinsed their mouth and is ready to continue, tap the *Next* button.

Visual Acuity

The Visual Acuity test is an assessment of distance vision. There are two tests: Visual Acuity Ages 3–7 and Visual Acuity Ages 8+. Participants are asked to sit 3 meters (9.8 feet) from the iPad and verbally identify the letters that appear on the screen. Younger participants may choose to point to the same letter on a card in front of them instead of saying the letters verbally. Different sets of optotypes (letters) are used for children and adults.

For more information about additional equipment and materials needed to administer this test, please refer to Appendix 2.

Setting up Bluetooth Wireless Keyboard

- Go to the Settings app of the iPad and enable Bluetooth.
- Make sure the keyboard is in discovery mode. A small light on the keyboard starts to blink on many keyboards when discovery mode is enacted.
- Select the keyboard when it appears on the My Devices list on the iPad.
- If a pop-up window appears on the iPad screen, follow the instructions, and enter the required code on the keyboard.
- The onboard/on-screen keyboard that normally appears on the iPad screen will not work when the external keyboard is working.

Using the Keyboard

- After the participant responds to each item, type the letter recalled into the keyboard. Then press the spacebar to move to the next letter.
- Once the spacebar is pressed, you cannot change the answer to the previous item.
- Control + Command + L on the keyboard is equivalent to the NIH Toolbox administrator gesture used in other tests to pause or stop an administration. Like the NIH Toolbox administrator gesture, when Control + Command + L is entered on the keyboard, a passcode screen will appear and ask for the passcode of the user who started the assessment. Select from among the options: Add/Edit Test Notes, Stop Assessment, Skip Test, Delay Test, Resume Test.

Setup

- Place the iPad on a portable stand that sits on a table, and, using measuring tape, ensure that the iPad is 3 meters from the participant and at eye level (which may necessitate adjusting the participant's chair height).
- Pair the wireless keyboard by Bluetooth with the iPad if it has not already been paired. It is important to pair the wireless keyboard to the iPad before beginning this test, as the wireless keyboard is used to record the participant's responses.
- It is recommended that you have a printed copy of all instructions (e.g., this manual) close at hand before beginning the test. This is important because it may be necessary to provide extra instruction, particularly for young children and older adults.
 - Alternatively, you may hold the iPad and read the initial instruction screens to the participant, after which the iPad should be placed on the stand. If you are using this procedure, try to stay close to the participant while reading from the

iPad, and then place the iPad on the stand 3 meters away before starting the items.



iPad on stand



Visual Acuity setup showing 3 meters distance

If the participant wears corrective lenses for distance, ensure they are wearing them. If the participant wears corrective lenses but does not have them for any reason, you may choose to continue testing or not at your discretion. However, if the participant requires a very strong correction, testing without corrective lenses will likely not be valid. Note any such irregularities and, if testing is completed, interpret results with caution.

Administration

Visual Acuity has three phases for participants ages 3–7: Instructions, Practice, and Live Items. For participants ages 8+, there are two phases: Instructions and Live Items.

Ages 3–7

Instructions

When the participant is seated in a chair that is 3 meters away from the iPad, say: ***Now we are going to do an activity that shows us how well you can see pictures on the iPad screen.*** When the participant indicates that they are ready, press the spacebar on the keyboard.

The instructions are presented on the screen. Read the black text aloud and demonstrate the motions that are in blue text. Hand the participant the laminated card and point to each letter accordingly as you say: ***Everything you will see is shown on this card. This is a picture of an H, this is a picture of an O, this is a picture of a T, and this is a picture of a V. Now, you try to name the pictures.*** Because letter naming is not required to complete the test, it is OK if the participant does not correctly name each letter; they can point to the letter on the card on the table. Sit beside the participant so you can see what letter the participant chooses. Encourage the participant to name the letters the best they can without providing negative feedback. If the participant names all four letters correctly, say, ***“Good job!”*** Then press the spacebar on the keyboard.

If the participant responds incorrectly, point to each letter and say only one time, ***“This is a picture of an H, this is a picture of an O, this is a picture of a T, and this is a picture of a V.”*** Encourage the participant’s efforts without providing negative feedback. Then say, ***“Let’s do some more.”*** Then press the spacebar on the keyboard.

Say: ***You are going to look on this screen; then, you will see a picture or letter. Each time, I want you to tell me or point on this card to what you see on the screen. If you are not sure, it is OK to guess. Are you ready to start?*** When the participant is ready to start, press the spacebar on the keyboard.

Practice

Trial 1:

One trial set of practice letters (H, O, T, and V) is presented in a large size. After the participant responds to each item, type the letter they named into the keyboard. Then press the spacebar to move to the next letter. If the participant gets three or more correct, the program automatically advances to the live items.

If the participant gets two or more of four letters incorrect, review the laminated card with the participant and ask them to identify the four letters either orally or by pointing. If they correctly identify all four letters, proceed to the second practice trial set. If the participant does not correctly identify all four letters on the card, repeat the training one more time before moving on to Trial 2.

Trial 2:

For a seamless participant experience, the trials are not marked. When the participant is ready for the second trial (i.e., second set of four letters), continue entering the responses on the keyboard. If the participant gets three or more letters correct, the program automatically advances to the live items. If the participant gets two or more of the four letters incorrect, proceed by administering a third trial set without reviewing the letters again.

Trial 3:

If the participant gets three or more letters correct, the program automatically advances to the live items. If the participant gets two or more of the four letters incorrect, the test ends.

Live Items

There is no transition between the practice items and the live items, but the first letter of the test is smaller than the practice letters. When you see this first test letter, say, **“You did great. Now, the letters will get smaller and smaller until you cannot really see them. That is OK. We want to know how small they can get before you cannot see them.”**

Each time a letter is displayed, say, **“Tell me what you see.”** This can be replaced by, **“Go ahead”** after a few letters have been displayed.

If the participant is struggling to verbalize the letters, remind them that pointing is OK. Say, **“You can show me what you see.”**

Continue recording responses. The next item will not appear until you have recorded the participant’s response to the item currently on screen and then pressed the spacebar. The test will progressively present smaller letters if the participant answers correctly or larger ones if the participant answers incorrectly. The test automatically ends when the program has calculated the acuity score.

It is possible to go back one previous item to change an answer—before pressing the spacebar—if the participant self-corrects or if you made an error while entering that response. To do this, press the left arrow on the keyboard, then type the correct response for that previous item, then press the spacebar to move to the next item. The next item may or may not be the same letter that was presented before going back to a previous item or changing an answer.

Ages 8+

Instructions

When the participant is seated in a chair that is 3 meters away from the iPad, read aloud the instructions presented on the screen: ***Now we are going to do an activity where you will tell me what letters you see on the screen. You are going to look on this screen (point to the iPad) and you will see a letter. Each time, I want you to tell me the letter you see on the screen. If you are not sure, it is OK to guess. The letters will get smaller and smaller until you cannot really see them. That is OK. We are trying to determine how small they can get before you cannot see them. Are you ready to start?*** When the participant indicates that they are ready, press the spacebar on the keyboard.

Live Items

Each time a letter is displayed, say, **“Tell me what you see.”** This can be replaced by **“Go ahead”** after a few letters have been displayed.

Record the participant's responses by pressing the letter they name on the keyboard and then pressing the spacebar. The next item will not appear until you have recorded the participant's response to the item currently on screen and then pressing the spacebar. The test will progressively present smaller letters if the participant answers correctly or larger ones if the participant answers incorrectly. The test automatically ends when the program has calculated the acuity score.

It is possible to go back one previous item to change an answer—before pressing the spacebar—if the participant self-corrects or if you made an error while entering that response. To do this, press the left arrow on the keyboard, then type the correct response for that previous item, then press the spacebar to move to the next item. The next item may or may not be the same letter that was presented before going back to a previous item or changing an answer.

Words-In-Noise

The Words-In-Noise test is an assessment of the ability to recognize single words amid varying levels of background noise. Participants ages 6 and older are asked to repeat the words presented by the audio. As the test progresses, the speaker's voice gradually becomes softer until eventually it is the same level as the background noise.

For more information about additional equipment and materials needed to administer this test, please refer to Appendix 2.

There are seven levels of word/noise ratios and five words at each level. The participant wears headphones, and each ear is tested separately, one ear at a time. The test is concluded either when the participant cannot repeat any of the five words at a given level in each ear or, if the participant repeats one word correctly from each of the seven levels, after all levels have been presented.

If the participant wears hearing aids, they should be removed for the duration of this test.

Before the test begins, ensure the iPad volume is turned on and is set to a mid-range level (i.e., a comfortable listening level).

Administration

Words-In-Noise has two phases: Instructions and Live Trials.

Instructions

Before placing the headphones on the participant's head, make sure that you can see the participant's face and hear their responses. The participant should not be able to read the iPad screen. Since the headphones will block communication between you and the participant, tell the participant that if they do not hear anything in the headphones, they should take them off and you will try to rectify the situation.

Introduce the task by reading aloud the instructions presented on the screen: ***You will hear a woman asking you to repeat various words. Repeat the words she asks out loud so that I can hear you. For example, if you hear her say, "Say the word dog," you would say, "dog." If you are not sure what she said, just say what you think you heard. You will also hear people talking in the background. Do your best to ignore them and to focus on the woman's voice asking you to repeat the words. You will hear words in only one ear and then in the other. Do you have any questions?*** Answer any questions the participant might have, then say: ***Let's begin.***

Place the headphones on the participant's head, making sure that the right headphone is over the right ear and the left headphone is over the left ear.

Live Trials

A list of five words appears on the screen, along with the ear being tested and the current decibel (dB) level. The associated audio files play in the participant's headphones. Listen carefully to the participant's responses and tap any word that they say correctly. Incorrect words should not be selected/scored.

Each screen represents a different background noise level and has a different set of words. If the participant correctly repeats at least one word at a level, that ear will continue to be tested. If all five words at a given level are incorrect, the second ear will be tested.

The second ear is tested like before. Listen carefully to the participant's responses and tap any word that they say correctly. Incorrect words should not be selected/scored. If the participant correctly repeats at least one word at a level, that ear will continue to be tested. If the participant repeats at least one word correctly from each of the seven levels, or if all five words at a given level are incorrect, the test ends.

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Appendix 1: Pausing, Stopping, Delaying, and Resuming Rules

An assessment can be paused any time after it is started. To pause the assessment, perform the admin gesture: place three fingers on the screen and slide from right to left. This will give you the following options:

- **Add/Edit Test Notes:** This allows you to add or edit notes for any test within the current assessment (e.g., ‘Participant refused’ or ‘Car alarm distracted participant’). You can view, add, or edit these notes after the assessment by navigating to the participant’s Assessments tab, tapping on the assessment card, and tapping the “Add Note” or “Edit Note” button. Entered notes will also appear in the Score Report and Scores Export. If a note is added or edited and then the test is resumed, please refer to the *Pause* sections in the tables below to determine what the next screen will be.
 - For example, if a note is added during the Dimensional Change Card Sort instructions, you will resume on the same screen you paused the test.
- **Stop Assessment:** Stopping the assessment ends the active testing session and brings you back to the participant’s screen. To resume the assessment after stopping, navigate back to the participant and the assessment, then tap *Resume Test*. To determine where the stopped test will resume once you have returned to it, please refer to the *Stop/Delay* sections in tables below. Please note that after certain points (e.g., beginning live test items) stopped tests cannot be resumed. If the app is backgrounded (e.g., pressing the iPad’s Home button) during an assessment, the test will behave as if it had been stopped. To stop a test, you must select one of the following reasons:
 - Environmental Issues
 - Testing was interrupted due to the environment (e.g., loud noise, fire alarm, participant needed to leave/out of time)
 - Cognitive Problems
 - Participant did not understand the task for cognitive reasons (not due to the language of the test/language barrier)
 - Physical Limitations
 - Participant could not physically respond to the test, could not meet the physical requirements of the test, had a physical illness, or could not safely complete the test
 - Language Barrier
 - Participant did not understand the language in which the test was presented
 - Participant Refused
 - No apparent cognitive or physical reasons the participant could not complete the test or assessment
 - Other
- **Skip Test:** Skipping a test means the current test will be skipped and the next test in the assessment will be presented (or the assessment will end if that was the last test). A skipped test is marked as “completed” and cannot be resumed or restarted in that

assessment. You will be asked to select the reason that best describes why the test is being skipped (same options as ‘Stop Assessment’ above).

- **Delay Test:** Delaying a test allows you to stop the test and move it to a later spot in the assessment. You will see a list of tests remaining in the assessment; these can be reordered by tapping and dragging the three horizontal lines to the right of the test up or down. After a test is delayed, the next test in the assessment will begin. Delaying a test behaves as if the test was stopped; to determine where the delayed test will resume once you have returned to it, please refer to the *Stop/Delay* sections in tables below. Please note that after certain points (e.g., beginning live test items) delayed tests cannot be resumed.
 - For example, if you delay Dimensional Change Card Sort during the practice items, you will continue with the other tests in the assessment. When you return to DCCS, the first screen you will see will be the first practice item.
- **Resume Test:** Resuming the test means the popup window will disappear and the test will continue. You can resume stopped assessments until a certain point in each test, after which that test may not be resumed; if “Resume Test” is selected at or beyond that point, the assessment will resume on the next test. For details, refer to the *Pause* sections in tables below.

The screen on which a test will resume after pausing, stopping, or delaying will depend on where the assessment was interrupted. These resume points are detailed in the tables below.

Cognition

Dimensional Change Card Sort		
Pause	Instructions	Return to active screen
	Practice	Return to active screen
	Trial	Return to active screen
	Transition	Return to active screen
	Live Items	Test ends
Stop / Delay	Instructions	During 1st set of instruction screens, returns to start of test; during all other instruction screens, test ends
	Practice	Return to start of test
	Trial	Test ends
	Transition	During first transition, returns to start of test; during all other transition screens, test ends
	Live Items	Test ends

Face Name Associative Memory Exam		
Pause	Instructions	Return to active screen
	Practice	Return to active screen
	Live Items	Test ends
Stop / Delay	Instructions	Return to start of test
	Practice	Return to start of test
	Live Items	Test ends
Face Name Associative Memory Exam Delay		
Pause	Instructions	Return to active screen
	Practice	Return to active screen
	Live Items	Test ends
Stop / Delay	Instructions	Test ends
	Practice	Test ends
	Live Items	Test ends
Flanker		
Pause	Instructions	Return to active screen
	Practice	Return to active screen
	Transition	Return to active screen
	Live Items	Test ends
Stop / Delay	Instructions	Return to active screen
	Practice	Return to first practice item
	Transition	During first transition, returns to start of test; during second transition screens, returns to first practice item
	Live Items	Test ends
List Sorting Working Memory		
Pause	Instructions	Return to active screen
	Practice	Return to active screen
	Transition	Return to active screen
	Live Items	Return to active screen
Stop / Delay	Instructions	Return to active screen
	Practice	Return to instructions
	Transition	Return to active screen
	Live Items	Test ends
Oral Reading Recognition		
Pause	Instructions	Return to active screen
	Live Items	Return to active screen
Stop / Delay	Instructions	Return to active screen
	Live Items	Return to active screen

Oral Symbol Digit		
Pause	Practice	Return to active screen
	Live Items	If <i>Start Test</i> has not been pressed, return to active screen; if <i>Start Test</i> has been pressed, test ends
Stop / Delay	Practice	Return to start of test
	Live Items	If <i>Start Test</i> has not been pressed, return to active screen; if <i>Start Test</i> has been pressed, test ends
Pattern Comparison Processing Speed		
Pause	Instructions	Return to active screen
	Practice	Return to active screen
	Transition	Return to active screen
	Live Items	Test ends
Stop / Delay	Instructions	Return to active screen
	Practice	Return to start of test
	Transition	Return to start of test
	Live Items	Test ends
Picture Sequence Memory		
Pause	Instructions	Return to active screen
	Training	Return to start of test
	Practice	Return to active screen
	Transition	Return to active screen
	Live Items	Test ends
Stop / Delay	Instructions	Return to active screen
	Training	Return to start of test
	Practice	Return to start of test
	Transition	Return to start of test
	Live Items	Test ends
Picture Vocabulary		
Pause	Instructions	Return to active screen
	Practice	Return to active screen
	Transition	Return to active screen
	Live Items	Return to an unadministered live item
Stop / Delay	Instructions	Return to active screen
	Practice	Return to first practice item
	Transition	Return to first practice item
	Live Items	Return to an unadministered live item

Rey Auditory Verbal Learning		
Pause	Instructions	Return to active screen
	Live Items	If <i>Play</i> has not been pressed, return to active screen; if <i>Play</i> has been pressed, test ends
Stop / Delay	Instructions	Return to start of test
	Live Items	If <i>Play</i> has not been pressed, return to start of test; if <i>Play</i> has been pressed, test ends
Rey Auditory Verbal Learning Delay		
Pause	Instructions	Return to active screen
	Live Items	Test ends
Stop / Delay	Instructions	Return to start of test
	Live Items	Test ends
Speeded Matching		
Pause	Instructions	Return to active screen
	Practice	Return to active screen
	Transition	Return to active screen
	Live Items	Test ends
Stop / Delay	Instructions	Return to start of test
	Practice	Return to start of test
	Transition	Return to start of test
	Live Items	Test ends
Visual Reasoning		
Pause	Instructions	Return to active screen
	Practice	Return to active screen
	Transition	Return to active screen
	Live Items	Return to active screen
Stop / Delay	Instructions	Return to active screen
	Practice	Return to start of test
	Transition	Return to start of test
	Live Items	Return to an unadministered live item

Emotion

Emotion CAT		
Pause	Instructions	Return to active screen
	Live Items	Return to active screen
Stop / Delay	Instructions	Return to active screen
	Live Items	Return to an item equivalent of last item shown
Emotion Fixed Form		
Pause	Instructions	Return to active screen
	Live Items	Return to active screen
Stop / Delay	Instructions	Return to start of test
	Live Items	Return to active screen

Motor

2-Minute Walk Endurance		
Pause	Instructions	Return to active screen
	Practice	Return to active screen
	Live Trial	Test ends
Stop / Delay	Instructions	Return to start of test
	Practice	Return to start of test
	Live Trial	Test ends
4-Meter Walk Gait Speed		
Pause	Instructions	Return to active screen
	Practice	Return to active screen
	Live Trials	Test ends
Stop / Delay	Instructions	Return to start of test
	Practice	Return to start of test
	Live Trials	Test ends
9-Hole Pegboard Dexterity		
Pause	Instructions	Return to active screen
	Live Trials	Return to active screen
Stop / Delay	Instructions	Return to start of test
	Live Trials	Return to start of test
Grip Strength		
Pause	Instructions	Return to active screen
	Practice	Return to active screen
	Live Trials	Test ends

Stop / Delay	Instructions	Return to start of test
	Practice	Return to start of test
	Live Trials	Test ends
Standing Balance		
Pause	Instructions	Return to active screen
	Live Trials	Return to active screen
Stop / Delay	Instructions	Return to start of test
	Live Trials	Return to start of test

Sensation

Odor Identification		
Pause	Instructions	Return to active screen
	Transition	Return to active screen
	Picture Identification	Return to start of test
	Odor Identification	Return to active screen
Stop / Delay	Instructions	Return to active screen
	Transition	Return to active screen
	Picture Identification	Return to start of test
	Odor Identification	Return to active screen
Pain Intensity FF		
Pause	Live Item	Return to active screen
Stop / Delay	Live Item	Return to active screen
Pain Interference CAT		
Pause	Live Items	Return to active screen
Stop / Delay	Live Items	Return to an item equivalent of last item shown
Regional Taste Intensity		
Pause	Instructions	Return to active screen
	Practice	Return to active screen
	Live Trials	Return to active screen
Stop / Delay	Instructions	Return to start of test
	Practice	Return to start of test
	Live Trials	Return to active screen

Visual Acuity		
Pause	Instructions	Return to active screen
	Live Items	Return to active screen
Stop / Delay	Instructions	Return to start of test
	Live Items	Return to an item equivalent of last item shown
Words-In-Noise		
Pause	Instructions	Return to active screen
	Live Trials	Return to active screen
Stop / Delay	Instructions	Test ends
	Live Trials	Test ends

Appendix 2: NIH Toolbox® Equipment and Materials

In most cases when using the NIH Toolbox® app, an iPad is all that is needed to administer the tests. However, there are some additional supplies needed for the Cognition, Motor, and Sensation tests as outlined below. More detail, including suggested vendors, can be found at NIHToolbox.org/test-finder. When purchasing additional supplies, keep the following in mind:

- Unless recommended otherwise, all materials and equipment can be purchased from any vendor of your choosing.
- Adhere to the minimum requirements for the materials and equipment where applicable.
- Some materials and equipment can be reused for multiple tests (e.g., Bluetooth wireless keyboard).
- Vendors may provide discounts for educational institutions, non-profits, etc.

General: Additional Recommended Equipment and Materials

It is recommended that the NIH Toolbox is only used on the supported 9.7” through 11” iPad models running the current version of iOS.

An iPad case that allows for different viewing angles and provides protection is recommended (e.g., Otterbox, Logitech) for use with all tests.

Cognition: Additional Recommended Equipment and Materials

Test	Equipment and Materials
Dimensional Change Card Sort	None
Flanker Inhibitory Control and Attention	None
Face Name Associative Memory Exam	None
Face Name Associative Memory Exam Delay	None
List Sorting Working Memory	Bluetooth wireless keyboard (fully charged)
	List Sorting Working Memory Answer Sheet*
Oral Reading Recognition	Bluetooth wireless keyboard (fully charged)
	Oral Reading Recognition Pronunciation Guide*
Oral Symbol Digit	Oral Symbol Digit Examination Sheet*
Pattern Comparison Processing Speed	None
Picture Sequence Memory (Forms A & B)	None
Picture Vocabulary	None
Rey Auditory Verbal Learning	None
Rey Auditory Verbal Learning Delay	None
Speeded Matching	None
Visual Reasoning	None

*Available on NIHToolbox.org to registered and approved Cognition users

Emotion: Additional Recommended Equipment and Materials

None

Motor: Additional Recommended Equipment and Materials

Test	Equipment and Materials
2-Minute Walk Endurance and 4-Meter Walk Gait Speed	Chair
	Masking tape
	Measuring tape with meters and feet
	Set of two cones
	Walking course set up diagram (in Chapter 6 above)
9-Hole Pegboard Dexterity	Jamar® 9-Hole Peg Test Kit or Rolyan® 9-Hole Peg Test Kit
	Jamar® 9-Hole Peg Test Kit Replacement Pegs or Rolyan® 9-Hole Peg Test Kit Replacement Pegs
Grip Strength	Jamar® Plus+ Digital Hand Dynamometer or Rolyan® Digital Hand Dynamometer
Standing Balance	iPhone or iPod iPhone or iPod protective case Balance Pad Gait Belt

*If collecting data for a study, it is strongly recommended to use the same iPod or iPhone device for the duration of the study.

Sensation: Additional Recommended Equipment and Materials

Test	Equipment and Materials
Hearing Threshold	Sennheiser HD280 Pro Headphones or Sennheiser HD 25 Headphones
Near Visual Acuity	Bluetooth wireless keyboard (fully charged)
	Measuring tape
Odor Identification	Odor Identification Cards*
	Scratcher (e.g., guitar pick)
Pain Intensity FF	None
Pain Interference CAT	None
Regional Taste Intensity	Disposable cup
	Gloves (latex-free)
	iPad stand
	Purified water
	Quinine solution
	Spittoon (or cup, basin, sink, etc.)

	Salt Solution
	Sterile cotton swabs
	Electronic balance (scale) readable to at least 0.01 grams, and preferably 0.001 grams
	Magnetic stirrer
	Stir bar (1 or 1.5 inches in length)
	Plastic-coated magnetic retrieving rod
	1-liter graduated cylinder
	Solution storage bottles (light-occluding are required for quinine)
	Lab spoon
	Plastic weigh boats
	Distilled or deionized water for mixing solutions
	Labelled medicine cups and storage bottles
Visual Acuity	Bluetooth wireless keyboard (fully charged)
	iPad stand
	Laminated HOTV letters card
	Measuring tape
	Table
Words-In-Noise	Sennheiser HD280 Pro Headphones or
	Sennheiser HD 25 Headphones

*Refer to NIHToolbox.org for ordering details.

Appendix 3: Understanding Exports and Reports

Exports

As detailed in the 'Export File Formats' section in Chapter 2, data for each assessment is spread across three kinds of exports: Registration, Item, and Scores. There are two export structures: Wide/Default and Narrow. In total, there are six export files (i.e., Wide/Default and Narrow versions of the Registration, Scores, and Item exports). Narrow exports are modeled on key-value tables and pivot the data so there are many more rows than columns. *While we attempt to minimize changes to all export formats, the format of the Narrow exports is least likely to change over time.*

The Participant ID (PID) should be used to link demographic information to assessment scores and item-level data.

Registration Export

The Registration Export contains participant demographic information as well as details about the app version and iPad version. The following fields are coded numerically:

- Education, MothersEducation, FathersEducation, GuardiansEducation
 - 1 = None
 - 2 = Preschool
 - 3 = Kindergarten
 - 4 = 1st grade
 - 5 = 2nd grade
 - 6 = 3rd grade
 - 7 = 4th grade
 - 8 = 5th grade
 - 9 = 6th grade
 - 10 = 7th grade
 - 11 = 8th grade
 - 12 = 9th grade
 - 13 = 10th grade
 - 14 = 11th grade
 - 16 = High School Graduate
 - 18 = Some college credit but less than 1 year
 - 20 = Associate degree (e.g., AA, AS)
 - 21 = Bachelor's degree (e.g., BA, BS)
 - 22 = Master's degree (e.g., MA, MS)
 - 23 = Professional degree (e.g., MD, DDS)
 - 24 = Doctorate degree (e.g., PhD, EdD)
 - 25 = 1+ years of college at a 2-year program, no degree
 - 26 = 1 year of college at a 4-year program, no degree
 - 27 = 2 years of college at a 4-year program, no degree
 - 28 = 3 years of college at a 4-year program, no degree

- 999 = Unknown
- Note: If “GED” is selected, the app will ask how many years were successfully completed without graduating; that selection will be shown in the export.
- SexAssignedAtBirth
 - 1 = Male
 - 2 = Female
 - 3 = Decline to Answer
- Handedness
 - 1 = Right
 - 2 = Left
- Race
 - 0 = Field left blank/no response
 - 1 = White
 - 2 = Black or African American
 - 4 = Asian
 - 8 = American Indian or Alaska Native
 - 16 = Native Hawaiian or Other Pacific Islanders
 - 32 = Other
 - 64 = Not Provided
 - Note: Race is in bitwise values. Each response is assigned a numeric value (i.e., 1, 2, 4, 8, 16, 32, 64). These values are summed, and the total is stored in the *Race* field. For example, if there is a 9 in the *Race* field, you know that the participant endorsed the first and fourth responses (scores 1 and 8 summed).
- Ethnicity
 - 2 = Hispanic or Latino
 - 1 = Not Hispanic or Latino
 - -1 = Not Provided

Scores Export

The Scores Export contains test-level scores and information (e.g., assessment paused during Grip Strength). For more information about the scores provided in the scores export, please refer to the NIH Toolbox V3 Technical Manual. The following fields are coded numerically:

- StartPointOverride
 - 3 = Age 3
 - 4 = Age 4
 - 5 = Age 5
 - 6 = Age 6
 - 7 = Age 7
 - 8 = Age 8
 - 9 = Age 9
 - 10 = Age 10
 - 11 = Age 11

- 12 = Age 12
- 13 = Age 13
- 14 = Age 14
- 15 = Age 15
- 16 = Age 16
- 17 = Age 17
- 18 = Age 18
- 101 = Ages 19+: Less than HS Graduate
- 102 = Ages 19+: HS Graduate
- 103 = Ages 19+: Some College
- 104 = Ages 19+: College Graduate
- InstrumentBreakoff indicates if a test was interrupted.
 - 1 = Yes
 - 2 = No
- InstrumentStatus2 indicates whether a test has been administered.
 - 1 = Not Started
 - 2 = Partially Complete (i.e., test was stopped and can still be resumed)
 - 3 = Complete
 - 4 = Not Complete (i.e., test was interrupted or stopped by the examiner at a point where the test cannot be resumed)
- InstrumentSandSReason shows which code the examiner selected as the reason for skipping or stopping the assessment. For more information about how to use these codes, please refer to the *Pausing an Assessment* section in Chapter 3.
 - 1 = Environmental Issues
 - 2 = Cognitive Problems
 - 3 = Physical Limitations
 - 4 = Language Barrier
 - 5 = Participant Refused
 - -5 = Other
- InstrumentRCReasonOther can contain any system messages listed below (e.g., “App interruption” if the assessment was interrupted by pressing the iPad’s Home button). This column also contains user-entered text after selecting “Other” when stopping or skipping a test.
 - All items were skipped
 - Relevant to Emotion and PROMIS tests
 - App interruption
 - Assessment was interrupted due to backgrounding (e.g., pressing the iPad’s Home button)
 - Began FNAME Delay without FNAME
 - Began RAVLT Delay without RAVLT
 - Delayed
 - Delay ended test
 - FNAME Delay already taken
 - FNAME Delay started after maximum time

- FNAME Delay started before minimum time
- Manually entered text
 - When a test was stopped or skipped and 'Other' is selected
- RAVLT Delay already taken
- RAVLT Delay started after maximum time
- RAVLT Delay started before minimum time
- Repeated FNAME
- Repeated FNAME Delay
- Repeated RAVLT Delay
- Repeated RAVLT
- Rescored
 - Test has been rescored due to updates to demographic information
- Skipped test
 - Relevant to FNAME, FNAME Delay, RAVLT, and RAVLT Delay
- Start Point Override was used. Test started at [selected override level]
- Stopped assessment
- Test ended due to system error
- Test interrupted by examiner, unable to resume
- Test stopped by examiner

Item Export

The Item Export contains item-level information such as scores, responses, and response time. For more information about the scores provided in the item export, please refer to the NIH Toolbox V3 Technical Manual.

Reports

Score reports are available in PDF format and contain information about a single assessment. The participant's demographic information at the time of testing is displayed at the beginning of the report. However, if the demographics are edited later (e.g., due to an examiner data entry error), the updated Age at Time of Assessment, Sex Assigned at Birth, Ethnicity, and Race will be reflected in any newly generated reports. Handedness and education levels remain the same as they were at the time of testing, as these fields impact where a test begins. Although Age also impacts start points in some tests, an updated age will be displayed in newly generated reports because age-adjusted scores will be recalculated with the updated age.

Scores for each administered test (and composite scores, if applicable) appear in tables by domain. Age-adjusted standard scores for Cognition tests are also presented in a profile format with 90% confidence interval ranges. For more information about specific scores, scoring, or normative data, please refer to the NIH Toolbox V3 Technical Manual.

Administration notes will appear by test if there was a non-standard administration (e.g., if a test was stopped, then later resumed).