Chapter 11

Cognitive Assessment

Goals of Follow-Up Cognitive Assessment

There are five main goals for cognitive assessment at the follow-up visit: 1) To examine cognitive change over time by re-administering the baseline cognitive battery; 2) To accomplish sufficient harmonization with FHS in order to enable direct comparisons across the LLFS and FHS cohorts; 3) To increase the sensitivity of memory assessment by adding a word list learning task; 4) To increase the amount of qualitative information derived from graphomotor tests by implementing an electronic pen; and 5) To evaluate functional cognition (independent activities of daily living) in order to enable a diagnosis of dementia. Each of these five sections is addressed below.

1. **Measuring Cognitive Change**

Cognitive change will be characterized in several ways. First, continuous change scores will be calculated to represent the absolute difference between baseline and follow-up scores. These change scores will be represented in standard deviations (i.e., z-scores) to enable direct comparison of change values across different tests. Cognitive change will also be quantified in terms of ordinal groupings (e.g., quartiles) as a means of examining non-linear relationships between cognitive change and other variables of interest. For primary statistical analyses examining rate of cognitive change in relatives versus spouses, change will be modeled using Generalized Estimating Equations. Finally, longitudinal cluster analyses or similar modeling approaches will be used to examine the extent to which individuals cluster within specific change groups (e.g., relatively stable, mild decliners, and rapid decliners). Change analyses will be adjusted for age, sex, education and baseline cognition.

2. **Harmonizing with the Framingham Heart Study (FHS)**

Three tests have been added to the LLFS follow-up assessment: Trail Making, Digital Clock Drawing, and Letter Fluency. These tests were selected to be brief (under 5 minutes each), to be available in Danish, and to cover areas of cognition not examined by the baseline battery. Specifically, the tasks selected from FHS will provide information about multiple aspects of executive functioning and important qualitative aspects of cognition.

   a. Trail Making Test (TMT): The TMT includes Parts A and B. Part A requires participants to connect a series of circles numbered 1 to 25. It assesses visual scanning, sequencing, and psychomotor speed. Part B adds a set shifting element by requiring the participant to switch between numbers and letters. Comparison of Part B to Part A enables isolate of the executive component of performance.

   b. Digital Clock Drawing (dCDT): The CDT is a multi-dimensional task that evaluates spatial skills, semantic knowledge, planning, and motor functioning. The dCDT was developed to examine subtle aspects of cognitive functioning related to response latency, details of graphomotor markings, as well as organizational features of the response.

   c. Letter Fluency: Letter fluency requires participants to generate as many words as possible that begin with a specific letter across three separate trials. This task is a measure of information organization and generation, and comparison with performance on category fluency provides important information with respect to patterns of cognitive aging.

3. **Improving Sensitivity of Memory Testing**

List learning tasks consistently demonstrate higher sensitivity to early neurodegenerative changes than story memory tasks.

> The Hopkins Verbal Learning Test – Revised (HVLT-R) is a 12 word, three trial list learning task with immediate and delayed recall conditions, as well as a yes-no recognition discrimination task. The HLVT-R is available in both English and Danish and takes approximately 5 to 10 minutes to administer with a 25 minute delay.

4. **Implementing the Electronic Pen**

> A digital pen will be used to record performance on all graphomotor tasks including the CDT, Digit Symbol Test, and Trail Making. This pen offers the ability to analyze qualitative aspects of performance including the nature of graphomotor errors, latency between successive responses within a task, and a participant's organizational approach. All record forms for the digital task will be distributed by CUMC and data from the tasks will be uploaded to software provided by the test developers. Each site must have a windows operating system on which to dock the pen for data transfer.

> The digital pen should be uncapped at the start of the test session, and capped at the completion of the participant's cognitive testing. You do not need to, and should not cap the pen in between each test. There is a set of instructions for how to introduce the digital pen that should be given when the participant first uses the pen on the MMSE. These instructions do not need to be repeated every time the person uses the pen. However, the tester is allowed to repeat them if the person appears to have forgotten them.

> It is very important to write the participant ID, as well as the name of the test at the bottom of each digital page AFTER the completion of each test. (We do not want to invalidate tests by putting visual information on the record forms prior to completion of the tests). Without the ID and the test abbreviation, we will not be able to link the data to the participant and may not be able to determine which test the participant was completing. The test names can be abbreviated as follows:

> MMSE Pentagons: P
> MMSE Sentence: S
> Trails A Practice: PA
> Trail Making Part A: TA
> Trails B Practice: PB
> Trail Making Part B: TB
> Digit Symbol: DS

5. **Evaluating Functional Cognition**

Evaluation of functional cognition is essential for making a diagnosis of dementia. This can be accomplished through a brief evaluation of instrumental activities of daily living (IADLs). The IADL assessment can be mailed to the participant along with other self-report questionnaires in advance of the in- person visit.

Follow-Up Cognitive Battery

Completed By	Completed When	Measure	Source
Participant	In Person (~ 35 minutes)	Folstein Mini-Mental Status Exam	Baseline (NACC)
		HVLT Immediate	New
		Digital Clock Drawing Test	FHS
		Digital Trail Making Test	FHS
		Logical Memory 1A	Baseline (NACC)
		Number Span Test (Digit Span)	Baseline* (NACC)
		Digital Digit Symbol Substitution Task	Baseline (NACC)
		Category Fluency – Animals	Baseline (NACC)
		Letter Fluency	FHS
		HVLT Delay**	New
		Logical Memory IIA***	Baseline (NACC)
		IADL Form (can also be done by mail)	New
		CDR	New
Examiner	Following testing	Cognitive Testing Validity Ratings	New
Informant	By phone or in person	DQ	

* The Number Span test replaces the Digit Span test from baseline. The two tests are highly correlated.
**Administer 20-25 minutes after the completion of the immediate condition of the test. If necessary, administer non-cognitive measures to fill the time and return to the delay condition after you have completed intervening measure(s) and 20 minutes has passed. If necessary, it is preferable to go beyond the delay period rather than to administer the delay portion of the test prior to 20 minutes.
*** Administer 30-40 minutes after the completion of the immediate condition of the test. If necessary, administer following tests to fill the time interval and return to the delay condition after you have completed intervening task(s) and 30 minutes have passed. If necessary, it is preferable to go beyond the delay period rather than to administer the delay portion of the test prior to 30 minutes.

Examiners will encounter situations in which participants are unable to complete portions of the test battery, or are not motivated to complete all of the testing. There are no specific tests that should be prioritized in this situation; the examiner should just move through the battery in the order above.

Certification and Quality Control

Certification to administer all cognitive tests is conducted by Dr. Stephanie Cosentino. New staff members must meet with Dr. Cosentino in person or by skype to complete this certification. Once certified, examiners will send Dr. Cosentino the first five test batteries that they have administered for review. After this, examiners will have one of every five batteries double scored by a second examiner at their site. Scoring discrepancies will be resolved by the two scorers and the final score will be entered into the database. Unresolved scoring issues should be discussed with Dr. Cosentino. When an examiner's batteries are consistently error-free (5 in a row), 1 out of every 10 batteries can be double scored. To maintain certification, examiners must administer the cognitive battery at least twice per month. Examiners should be re-certified by Dr. Cosentino on an annual basis.

General Issues Regarding Cognitive Testing

- Each site will pursue IRB approval to audio record cognitive testing. Audio recordings can be used for later scoring if there is concern that responses were not recorded accurately.

- If a person responds, "I don't know", please cue with, "***Would you like to take a guess***?"

- If a person becomes frustrated or appears to give up on a test, you should say, "***Just try your best***". If additional encouragement is needed, you may also explain to the participant that "***These tests were designed to be challenging, so don't be discouraged if they are difficult***."

- Self-corrections are accepted <u>only if you have not moved onto the next test</u>.

- If the participant asks if they have said a word before on memory testing or fluency tests, you should say, "***I'm sorry, I'm not able to give you feedback on that***").

- If the participant asks you to slow down presentation of stimuli on HVLT, Logical Memory, or Number Span, you should give a polite nonverbal response indicating that you cannot slow down. Once you have finished delivering the information and the person has provided their response, you should say, "***I'm sorry, I have to read the information at that speed***".

- Once the delay interval has passed for a memory test, examiners should determine whether it is appropriate to administer the delay. If necessary, examiners should extend administration of the delayed test beyond the recommended window, rather than administering the delay before the necessary time has elapsed. Examiners should never split up related tests to administer a delay condition. This includes:
    - CDT Command & Copy
    - Trail Making A & B
    - Number Span Forward and Backward
    - Animal Fluency and FAS

Missing Data Codes in REDCap

When participants are unable to perform certain test items, or if certain questions are not administered, it may be appropriate to use one of the following missing data codes. Each test item in REDCap has specific missing data codes that are available, therefore the following codes are not applicable to all items. Examiners should use their best judgment to determine which code best describes the reason that data for an item is missing. <mark>When there are missing items within a test, do NOT calculate a total test score.</mark>

Code	Definition	When to Use
N	Not applicable	When the item was not administered and therefore no score is available. Also use for **summary scores** that cannot be computed because individual items are missing.
D	Don't know	When the examiner does not know why the data is missing. This is most applicable when questionnaires are returned via mail and data is missing.
P	Protocol	This is used when the procedure or question is not relevant to the participant. This may apply to DQ items if, for example, a person scores above the MMSE cut-off score for receiving the DQ.
H	Physical or sensory	When participants have a physical or sensory problem such as motor, hearing, or vision impairment that prevents them from completing the test item in a valid manner.
C	Cognitive or behavioral	When participants have a cognitive or behavioral problem that prevents them from **engaging in the test** in a valid manner. This code should not be used if the participant is simply unable to complete the item because they don't know the answer or the task is too difficult.
R	Refused	When participants refuse to respond.
O	Other	When none of the above situations apply.

Instruction Sheet for MINI MENTAL STATE EXAMINATION (MMSE)

Words in boldface type should be read aloud clearly and slowly to the examinee. Item substitutions appear in parentheses. Administration should be conducted privately and in the examinee's primary language. Begin by asking the following two questions:

{SAY]: "Do you have any trouble with your memory? May I ask you some questions about your memory?"

Orientation to Time:
Each question should be asked separately, as specified on the test form.

If the subject gives only the last two digits of the year, prompt by saying, "What is the full year?" When a year or season is near transition <mark>(2 weeks on either side),</mark> the correct answer is prompted with "are you sure?"

If you have to clarify "day of week", please list all days of the week beginning with Sunday (e.g., "Is it Sunday, Monday, Tuesday, etc.....").

If the subjects gives the date when prompted for the day, give credit for date if the response is correct. Conversely, subtract credit for the date if response is incorrect. All other items require exact answers.

Write the subject's response to each question in the space provided. Score one point for each correct response. No partial credit is given.

Orientation to Place:

Each question should be asked separately, as indicated on the test form. Site specific and regionally specific queries are listed below in the table. Please consult this table to determine the appropriate question for your testing location prior to beginning the test.

Table A. County and City Questions

Item	Major City	Suburb	Exceptions
County (City/Town)	Query for City	Query for County	BU scores 2 points for city only and does not query county or part of city
City/town (or part of city/ neighborhood)	Query for Part of City / neighborhood	Query for City	

Table B. Building Questions

Item	House or Apartment Building	Nursing Home / Skilled Nursing Facility	Hotel	Exceptions
Building (name or type)	Query for type of building (answers like "my home", "my sister's home" or the specific type of house (e.g., ranch) are all acceptable)	Query for type of building ("nursing home; hotel")		DK queries for street name
Floor of Building (room number or address)	Query for address	Query for room #	Query for floor	DK queries for house number

For "building", any correct name is acceptable except generic references such as 'hospital' or 'medical center'. All other items require exact answers.

Write the subject's response to each question in the space provided. Score one point for each correct response.

For address, do not record the right or wrong answer verbatim. Just score as 1 or 0. But if it is wrong, record HOW it is wrong (e.g., wrong street number). If participants are seen at a family member's house and do not know the address, the item is scored as incorrect.

Registration:

[SAY]: "Listen carefully. I am going to say three words. You say them back after I stop. Ready? Here they are...APPLE [pause], PENNY [pause], TABLE [pause]. Now repeat those words back to me." Repeat all three words together until the person is able to accurately recall all three (but only up to 5 times). Score only the first trial.

Write the subject's response to each question in the space provided. At the end of the trial, give the following instructions:

[SAY]: "Now keep those words in mind. I am going to ask you to say them again in a few **minutes."**

Write the subject's response to each question in the space provided. Score one point for each correct response.

Following the registration of three items, examiners should administer "WORLD" backwards and then move onto the Pentagon task. Then return to administer the recall portion of the test.

Attention:

[SAY]: "The word WORLD is spelled W-0-R-L-D. Spell WORLD backwards."

Repeat the instructions if the subject asks for a repetition or appears confused. As clarification, the examiner may say "Start from the end and go to the beginning." Allow additional trials if the subject requests them.

If the person spells WORLD forwards, say, "Good – and can you spell it backwards now?" Credit based on the final response.

Record the letters of the subject's final response. One point is given for each correct letter (for example, "D-L-0-W" would receive two points for the correct placement of the "D" and the "L").

Drawing:

Give the subject a pencil or pen and the paper with the overlapping pentagons and say **"Please copy this design."** Do not allow erasures. If the subject appears dissatisfied with his/her drawing or requests a second attempt, allow the subject to re-draw the figures. Clearly label the first and second attempt. The best drawing should be scored.

The pentagon model should be presented flat on the desk in front of the person. ==If a person traces the stimulus when asked to copy the pentagons, re-direct them to the appropriate space on the page.== Introduce the digital pen at this point with the following script:

"This is the pen you'll be using. It's hooked up to our computer system so we can track

how you draw and how you write. It has been known to give a little buzz or vibration at times, and it's usually when participants draw like this [demonstrate horizontal angle]. If it happens, it's not a big deal, nothing to worry about. To stop the buzzing you can just hold it vertically [demonstrate this] or like a normal pen [demonstrate this] and you shouldn't have an issue." In the event that a participant questions why we're using a different pen, try to refrain from answering by saying, "It's just the pen we use for this test." As a last resort to maintain rapport, it is acceptable to tell the participant, "It's a digitized pen."

AFTER the subject completes the drawing, write the participant ID, as well as 'P' for pentagon at the bottom of the digital page.

One point is given if the subject draws two intersecting pentagons (5-sided figures), the intersection results in a 4-sided figure, and all ten angles are present, with two of them intersecting.

Recall:

[SAY]: "What were those three objects I asked you to remember?"

If needed, explain the source of the three objects by saying "I asked you to repeat three words earlier and to remember them. Can you recall them now?

Write the subject's response to each question in the space provided. One point is given for each correct response. If the subject is unable to recall an item, the item should be scored as incorrect.

Naming:

Show the subject a pencil or pen and say, "What is this?" If the subject gives a function (e.g., "You can write with it"), say "Yes, but what is this called?" No other clues should be provided. Repeat for wristwatch.

You must use pen and watch. Please buy a watch for your test kit if you do not wear one.

Write the subject's response to each question in the space provided. One point is given for each correct response.

Repetition:

Engage the subject's attention and clearly say, "Now I am going to ask you to repeat what I say. Ready? 'No ifs, ands, or buts.' Now you say that." Repeat up to 5 times, but score only the first trial.

Write the subject's response in the space provided. One point is given for an exact repetition of the phrase.

For repetition, score only their first attempt (not necessarily your first time saying the phrase, since they might ask for a repetition before responding). You may repeat up to 5 times, only if the person has not attempted to answer. No repetitions are allowed once the participant begins to respond.

Three separate pieces of paper should be used for pentagons, comprehension, and sentence.

Comprehension:

[SAY]: "Listen carefully because **I** am going to ask you to do something." Present the upper portion (blank paper) at the subject's mid-line and say "Take the paper in your right hand, fold it in half and put it on the floor [or table]." One repetition is permitted at the subject's request, but the entire command must be repeated verbatim. The subject is allowed to fold the paper using both hands.

*One repetition of the command is allowed **ONLY** if the person has not yet begun any of the steps.*

If the person does not complete 3-step command and asks what comes next, please encourage them to take their best guess.

If the person takes the paper with their left hand but verbally acknowledges that he or she should have taken it with their right hand, credit can be awarded for that item.

If the person folds the paper more than once (i.e., in fourths or more), credit is not awarded for folding the paper in half.

Record the subject's performance for each of the three separate actions indicated on the form.

Reading:

Show the stimulus card ("CLOSE YOUR EYES") to the subject and say "Read this and do what it says." The subject can be reminded not just to read the sentence, but to perform the action. If the subject is unable to read, read the sentence out loud.

Record the subject's performance. One point is given if the instructions are completely and correctly followed.

Writing:

Give the subject a pencil or pen and the blank piece of paper and say **"Write a sentence."** If needed, prompt the subject by saying **"Write a sentence about the weather."**

Paper should be presented in landscape orientation.

AFTER the subject completes the sentence, write the participant ID, as well as 'S' for sentence at the bottom of the digital page.

One point is given for any complete sentence (even if not about the weather). Grammar, spelling, and punctuation are not scored, but the subject must write a

sensible sentence that contains a subject and a verb. A sentence with an implied subject (e.g., close the door) is acceptable. If the sentence is illegible, ask the subject to read it aloud for scoring.

HVLT-R

Refer to the record form for all instructions and procedures

Additional Administration Considerations:

Prior to reading the list of words, please stick to the script. Do not add, "The words are…".

Repetition of a word at the person's request is provided only on Trial 1. On Trials 2 and 3, please provide a nonverbal response by shaking your head to indicate that you cannot repeat the words any longer.

Responses are not timed and patients should be encouraged to take their time and keep trying if frustrated. Record the patient's responses in order and include any intrusions or perseverations.

<mark>Do not ask the person if they have any more words once they are finished recalling the list.</mark>

The delayed memory trial should be administered after 20 minutes has elapsed. If you are in the middle of another test, complete the test before moving onto the HVLT delay.

Scoring Considerations:

Free Recall. For Trials 1-4, simply count the number of correct words recalled for each learning trial. Total Recall is the summed total for Trials 1, 2, and 3.

If the person is clearly **rehearsing** words that they have already said, do not record or score these as perseverations.

If the person names a word not previously said while **rehearsing**, record and credit.

With regard to **intrusions** and perseverations on the HVLT, if a person repeats an intrusion (e.g., "moon, lion, tiger, moon"), the first instance should be scored as an intrusion, and any further instances would be scored as perseverations. So, for this example, it would be 1 intrusion and 1 repetition.

While administering the HVLT, during the learning trials, a participant may ask the examiner, "You didn't say X, did you?". The table below describes the procedures for responding to this question. Also, if the word is **not from the list**, then explicit rules for scoring this type of intrusion are outlined. See highlighted sections.

 Follow the scoring rules below for **scoring perseverations and intrusions** on the HVLT -

		HVLT		
		Examiner response	Said	Didn't Say
For words from the list	"X" – I already said that.	-	Not Perseveration	Credit
	I already said "X".	-	Not Perseveration	Credit
	Did I say "X"?	*"I'm sorry, I'm not able to give you feedback on that"*	Perseveration	Credit
	You didn't say "X", did you?			
For words NOT from the list	"X" – I already said that.	-	Not Perseveration	Intrusion
	I already said "X".	-	Not Perseveration	Intrusion
	Did I say "X"?	*"I'm sorry, I'm not able to give you feedback on that"*	Perseveration	Intrusion
	You didn't say "X", did you?			

Delayed Memory: If a person does not freely recall any words, or doesn't remember doing a word list but remembers the words once you begin the recognition trial, they do not receive credit for these words on the delay trial.

FHS digital Clock Drawing Protocol

FHS dCDT Administration

The examiner should fold the dCDT form, check *the right **upper** hand box* (carefully remaining inside of the box). The pen should vibrate to indicate that the pen has been activated. Present the command side of the clock form and the dCDT pen to the participant. Read the command instructions. The copy condition should be completed immediately following the command

condition. When you take the paper back, record the ID on the command side below the dotted line and then check the second box to complete the test.

The pen **should not** be capped between the command and copy condition. The lower right hand box **should not** be checked until after the test has been completed and the ID has been recorded.

CLOCK DRAWING TO COMMAND

Place folded paper, blank side up, and pen in front of participant. Say, **"I'd like you to draw a clock, put in all of the numbers, and set the hands to ten after eleven."**

Begin timing as soon as instructions are completed. Tests will be discontinued by the examiner after 5 minutes.

IMPORTANT ADMINISTRATION CONSIDERATIONS

Examinees should not be allowed to rotate the paper PRIOR to beginning their clock.

*However, if examinees rotate their paper once they have started their clock (for example, as they are writing the numbers), **do not stop them**.*

*If the examinee asks if they can use roman numerals, you can tell them that Arabic numbers are preferred. But **do not stop them** if they spontaneously use roman numerals.*

For the FHS question regarding rotation, there is an option to enter "NA". This option is not relevant and should not be selected.

If the examinee finishes their drawing, and quickly fixes an aspect of the clock after you have finished timing, it is not necessary to record additional time.

If the participant asks you to repeat the time, you are allowed to do this. You must provide the entire prompt again. Please note the request on the score form. However, prior to providing the time, you should pause, often times participants ask just to 'double check.' If they ask for a reminder, but then state it themselves WITHOUT asking for clarification, do not respond. For this task, NEVER help the participant unless they look you in the eye and ask for it! Many of my participants will keep their heads down and say "Did you say ten after eleven? Hmmm, yeah that goes like this." Under 'Did participant ask for a reminder of time' circle NO!

If the participant asks for a time reminder but then says the CORRECT time and asks for a clarification, this is not scored as a reminder for time, this is scored as "N/A". However, if the participant says the INCORRECT time, then you should correct them and score this as a request for reminder of time.

CLOCK DRAWING TO COPY

Place pen and folded paper with prepared clock showing in front of participant. Say, **"Please copy this clock."**

If the participant asks, "does it have to be exact?" Respond by saying, **"Just do the best you can."**

Begin timing as soon as instructions are completed. Tests will be discontinued by the examiner after 5 minutes.

SCORING CONSIDERATIONS

1. For the LLFS record form, a "significant error" would be:

Missing numbers
Duplicate numbers
Wrong number of hands
Hands in the wrong place
It DOES NOT include errors in hand length

2. For "Time to Completion" in REDCap
- This value cannot be higher than 5 minutes for either command or copu.
- If the examiner discontinued either test at 5 minutes because the participant "timed out", then enter 5'00 for time to completion, and enter '12' (insufficient time) as the code in the validity section under "Test Not Completed".

<center>**Clocksketch Data Entry and Scoring**</center>

The information here supplements the information contained in the MIT / Lahey Instructions and Manual distributed at the cognitive training meeting and which is available through the clocksketch website.

If any questions arise that are not covered in the clocksketch manual or in the LLFS MOP, please use the group email address to circulate questions and comments: llfs@csail.mit.edu.

One helpful thing may be to establish a master clock scorer at each site, so there is a go-to person if individual scorers have questions. If any clocks are extremely difficult to score, you can upload them to clocksketch unscored and Ansley will be available to assist with scoring.

LLFS examiners will enter the following data into Clocksketch:

1. Demographic and clinical information

   a. Participant ID
   b. MMSE score: Enter 'Unknown' for this variable
   c. Referring Doctor (Enter Cosentino)
   d. Scorer
   e. Site name (Default = LLFS)
   f. Dementia Status (broad impression as to whether the person was Not demented, MCI (for questionable cases), or Mild - Moderate Dementia)
   g. Confidence Level in dementia status (how confident the examiner is in his or her impression)

Some Scoring Notes for Digital Scoring on Clocksketch

Splitting Strokes
Splitting strokes is generally discouraged. One clock we came across contained a center dot drawn in the same stroke as a hand. This should not be split to create a center dot; simply place the stroke in the appropriate hand folder. Splitting strokes creates a problem in reliability as different testers tend to split the same stroke at different places. In the above example there will be no center dot registered by ClockSketch, however, it is rare and reliability is more essential. Another splitting strokes cautionary tale came up with one of the practice tests. The examinee drew a 3 in the 9 place, then self-corrected by placing a "c" on the top loop of the 3; essentially crossing out the 3, but using part of this numeral to create a 9. While it may seem logical to split the stroke to finish the 9 and designate part of the 3 as crossed out digit, this is in fact incorrect.

Placing the "c-shaped" stroke in the nine folder, and the 3 should go into the xoutdig folder. Splitting strokes is encouraged for dividing a stroke that makes up both clock hands. It's important to indicate that there is both a minute hand and an hour hand by splitting in this case. It's also encouraged when a participant corrects hand length by placing an arrowhead lower on the shaft. The portion above the arrowhead should be clipped and placed into xouthand folder.

Original versus Prime

Generally, if there is a significant amount of time between a participant drawing a hand and overwriting it, this should be categorized as a prime. If a participant overdraws the hour hand without changing the length or any element of it, this would be considered HH'. In other cases, participants will return to previously drawn clock elements and add a novel feature to the element. Not infrequently, participants add "hats" to the 11 on copy clock or will add a line segment to better connect a hand to the center dot. This should classified as part of the original as it adds to the original without over-drawing.

Noise

When deciding if a stroke is noise or part of another clock component, the time and the order in which the stroke was made can be useful. If the stroke, no matter the size, was created very close in time (less than 0.5 seconds) and in consecutive order to a stroke that makes up the majority of e.g. the 2, then it would be considered part of the 2. If the stroke was created several seconds from the stroke composing the 2 or if there is another stroke in between that stroke, then this stroke is likely noise. A useful tool in making this determination has been created for the newest version of ClockSketch. If you press Ctrl-Y, the program will display the latency for each stroke i.e. the time from the end of the last stroke and the beginning of the one you're examining. It's important to remember that you must consider the pre- and post-stroke latency for each item. Location of the noise stroke is also important to consider. If a stroke does not lie on or very close to another stroke that composes a component of the clock, it is likely belongs in the noise folder.

Clocks Drawn Under the Line

It sometimes happens that a cognitively impaired participant will draw under the line on command condition. In these situations, **DO NOT** re-direct the participant to draw above the line as this could affect their clock drawing and this is something we try our hardest to prevent. When this happens, the clock cannot be scored by Clocksketch because this space is purged from the file before being transmitted to Dana and Randall. Instead, this clock should be hand scored using our old CDT scoring forms. Mark the appropriate factor affecting testing, and make a note in the Clocksketch file that the participant drew below the line. Finally, inform Dana and Randall (via e-mail) of the date and time of the participant who drew below the line.

A Third Hand Pointing to the 12

When a participant draws a third hand pointing to the 12, we give benefit of the doubt and assume this is a second hand. To classify consistently and without throwing off the clock computations, classify this as a MH or MH' depending on whether the MH or second hand was drawn first, and designate which hand should be used for the length comparison by right clocking on the appropriate MH folder.

Targeting the 11 or 2 without a Hand

If a participant targets the 11 or 2 without using a hand (e.g. by circling or underlining it), the strokes composing the targeting object should be placed in the Noise folder.

Hour hand vs. Minute Hand

If hand length is reversed (i.e. one hand points to the 11 and one to the 2, but the one pointing to the 11 is longer), you can assume the 11-targeting hand is the hour hand and the 2-targeting hand

is the minute hand. If the hands do not point to 2, 11, or 10, then

1. If a hand points to the upper left quadrant it is considered an "hour hand"
2. If a hand points to the upper right quadrant it is considered a "minute hand"
3. Otherwise, defer to hand length in determining hour hand versus minute hand. The longer hand then would be the minute hand.

Complex Numeral Self-Corrections

Recently a participant drew a 1 in the 12 location, then subsequently added a 2 to correct this so that a 12 was in the 12 location. After a bit more thinking, the participant drew a 1 over the 2 indicating that it should be a 1 at the top of the clock. This left two 1's on the page. Scoring these can be difficult as we want to capture as much as we can about what happened. In this case, we decided to score the 1's as 1 and 1', indicating that the participant left to 1's on the page. Then we placed the 2 in the xoutdigit folder to indicate that the participant made some attempt to self-correct despite eventually coming to the wrong decision.

Xoutpersevdig Clarification

If the person draws a 2 followed by another 2, then crosses out the first number the first 2 is still considered an xoutpersevdig rather than an xoutdig. Despite the strict definition of a perseverated digit which pops up when you try to save a stroke in the xoutpersevdig folder.

Tick Marks

A tick mark is a tick mark is a tick mark. Whether a person crosses out a tick mark as a correction or perseverates on a tick mark, each of these strokes should be placed in Tick Mark folder.

Center Dot Primes

Unless the center dot stroke are in different positions, all center dot strokes should be classified as the same center dot regardless of time or whether the participant overdraws this. This is simply to keep scoring consistent longitudinally.

Do-Overs

In Framingham, we always allow participants to start over no matter how much they have drawn. If a participant draws more than just an outline, place all of this data in the Not Clock Data folder. If a participant draws only an outline then starts over, the clock outline should be scored as CF and the actually outline as CF'.

Were Any Non-standardized Cues given (e.g. numerals, hands, etc.)?

This question is meant to capture whether the tester gave non-standardized cues to demented participants who can complete the CDT Command with prompting.

Scoring Guidelines for the FHS Clock Drawing Questions in Clocksketch

Quick Definition -

Extraneous Marks: any mark that does not represent a hand, number, numeral substitute, or outline of the clock. Extraneous marks include bisecting lines, crisscrossing, radiating lines, etc. Be careful not to confuse numeral substitutes with extraneous marks.

Variable	Scoring Instruction
Rotated paper while placing numbers	**No:** The participant did not rotate the paper when placing numbers. **Yes:** The participant turned the paper while inserting numbers. If the examiner did not record this data, observe the numbers. Select yes if it appears that the angle of the hand or wrist would have been uncomfortable and would have caused the participant to either rotate the paper (or write upside down, which is highly unusual). **N/A:** Numbers were not placed along the circle, which may have precluded the impulse to rotate the paper. **Unknown:** Examiner did not record this data. Note: you should consult with the Clinical Supervisor, but it is typically assumed that the participant did NOT rotate the paper unless you can see otherwise.
Attempt to self-correct any error	**No:** Errors are made, but the participant makes no effort to correct them. Please note: this option should NOT be circled if the participant self-corrects incorrectly (in this case, circle "yes" to acknowledge the attempt) **Yes** (result is correct): participant makes a successful effort (crossing out, overwriting, etc) to correct his/her drawing. Clock must be error-free. .**** This is a revision to previous scoring rules on 8/5/15. **Yes** (result is incorrect): the participant makes any effort (crossing out, overwriting, etc) to correct his/her drawing. The "correction" itself need not be an improvement over what was initially drawn. This also includes a self-correction of an originally CORRECT variable. NOTE: this applies if a participant successfully corrects SOME BUT NOT ALL errors.**** This is a revision to previous scoring rules on 8/5/15. **No errors/N/A:** If there are NO errors present **Unknown:** Examiner did not record this data.
Needed reminder of time for hand-setting (*in clock to command only*)	**No** **Yes:** The participant asks, any time after beginning the drawing, that the time be repeated and the examiner provided the time again. **N/A:** Participant did not represent the time in any manner AND did not ask that the time be repeated. If a person writes time down as a way of remembering, this counts as "N/A". If the participant asks for a time reminder but then says the CORRECT time and asks for a clarification, this is not scored as a reminder for time, this is scored as "N/A". **Unknown:** Examiner did not record this data.

Clock outline is <u>clearly</u> irregular, angular, lumpy, or has indentations	**No:** the outline of the clock is neatly drawn and has no obvious lumps, indentations, or angles. Please note that the elongation of the outline as an oval should not be considered irregular. **Yes:** the circle is not symmetrical, and/or it has noticeable irregularities, lumps, indentations, angles, etc. Again, an oval outline is not irregular. Tremor N/A: if the participant has a marked tremor that has affected his/her ability to write neatly throughout the test, do not penalize them for having a "lumpy" or "irregularly shaped" clock. Instead, Mark N/A **Hint:** If unsure, use Template #1 to evaluate how symmetrical the outline is. Compare the four quadrants of the outline, are they significantly different?
Clock outline perseveratively overdrawn (more than two times around)	**No:** the outline is drawn once or twice around, stopping short of beginning a third pass. **Yes:** the participant did not stop drawing the outline after second pass, but continued to draw the same outline on top of the previously drawn outline. NOTE: multiple circles drawn in different locations on the page are not coded here (see next variable; "perseveration of clock outline")
Perseveration of clock outline (do NOT include self-correction)	**No:** only one outline is drawn, or any multiple outlines are unambiguously self-corrections. **Yes:** Multiple clock outlines are drawn, with no obvious report by participant that these outlines are self-corrections.
Numerals	
Numerals or numeral substitutes are: (**circle all that apply**) (If Absent: Leave the rest of <u>Numerals</u> section blank; skip ahead to <u>Time Setting</u>)	**Absent**: there are no numerals or numeral substitutes drawn. **No numerals present; only substitutes:** although there are no numbers present, the participant produced marks ("numeral substitutes" such as ticks, lines, circles, etc.) in number locations to represent clock numerals. **Written Out:** the participant spelled out one or more numbers (e.g., in order to represent the number "1" the participant spelled out "O-N-E") **Arabic:** the participant used some/all Arabic numerals (1, 2, 3, 4, etc.) to number the clock. **Roman:** the participant used some/all Roman numerals (I, II, III, IV(IIII), V, etc,) to number the clock . Note: when Roman numerals are used on a standard clock, the 4 is represented by "IIII" rather than "IV." Also, on a standard clock with Roman numerals, the numerals all face the center of the clock (e.g., the VI will be upside down when you view it).

Dots, words, symbols, or other marks substituted for one or more numerals	**No:** Only numerals are used; if some numerals are missing, there is NO mark in the place of the missing numeral. If a mark is made as a place-maker, a number was subsequently written to replace it. **Yes:** the participant used numeral substitutes in the place of one or more numerals Unknown: A determination cannot be made about whether marks are meant to be a numeral substitution. NOTE: If a clock has BOTH marks substituted for numerals and missing numerals, BOTH variables should be scored as "yes" *SEE EX BELOW If numerals or substitutes are present, but unintelligible, mark N/A for these variables.
Time Setting	
Is one *hand* correctly pointing to "11" **AND** the 11 is approximately in the correct location	**No:** There is **NOT** a distinguishable line pointing purposefully to the "11," **OR** the "11" is **NOT** approximately in the *correct* location on the clock **Yes**: There **IS** a distinguishable line pointing purposefully to the "11," **AND** the "11" is approximately in the *correct* location on the clock (NOTE: *both* conditions must be met).
If no, is the eleven ("11") location **OR** numeral "11" (not in correct location) indicated correctly in some manner.	**No: Neither** the eleven location **NOR** the number "11"is indicated by a hand or mark. **Yes:** The eleven location **OR** the number "11" is indicated in some manner (a hand, circling, marking, putting a line, placing an x next to or at the location, etc.)
Is one hand correctly pointing to the "2" **AND** the 2 is approximately in the correct location?	**No:** There is **NOT** a distinguishable line pointing purposefully to the "2," OR the "2" is NOT approximately in the correct location on the clock **Yes:** There is a distinguishable line pointing purposefully to the "2," **AND** the "2" is approximately in the correct location on the clock (NOTE: *both* conditions must be met).
If no, is the two ("2") location **OR** numeral "2" (not in correct location) indicated correctly in some manner?	**No:** NEITHER the two location NOR the number "2"is indicated by a hand or mark. **Yes:** The two location **OR** the number "2" is indicated in some manner (a hand, circling, marking, putting a line, placing an x next to or at the location, etc.)

Other Observations	
Extraneous marks in clock	**No**: The clock is free from any *extraneous* marks (NOTE: this does NOT include marks that are clearly numeral substitutions or those that were used as place markers.) **Yes**: The clock has extraneous marks. Examples include: • Bisecting, crisscrossing, or radiating lines • Tick marks (*not* used as number place markers)
Other observations: (please describe below)	No: nothing to add Yes: Describe anything significant in interpreting/understanding data that was not be captured by any of the variables above. You should avoid redundancy when using the "other observations" box. It is not necessary to use this box to state things that are reflected elsewhere in the scoring pages. Examples to avoid: • "one hand points to the 10" • "drew outline in a clockwise motion" Examples include: • placement of numbers in counterclockwise order (i.e., "1" in "11" position; "2" in "10" position) • human hands are drawn • smiley face is drawn • blatant difference in size of numerals NOTE: Keep in mind that the "other observations" box does not result in a point deduction in the algorithm. When it is appropriate, mark "yes" to "extraneous marks" instead of as an "other observation", as the "extraneous marks" box does result in a point deduction in the algorithm.
Tester's clinical assessment of clock drawing	Enter "Cannot Determine"

TRAILMAKING TESTS- Trails A

<u>Sample</u>

Place sample in front of participant, give participant a pen, and say,

"On this page (point) are some numbers. Begin at number 1 (point to "1") **and draw a line from one to two,** (point to "2"), **two to three** (point to "3"), **three to four** (point to "4"), **and so in, in order, until you reach the end** (point to the circle marked "END"). **Draw the lines as fast as you can. Do not lift the pen from the paper. Ready, Begin!"**

If the participant makes a mistake on Sample A, point it out and explain it. The following explanations of mistakes are acceptable:

1. **"You started with the wrong circle. This is where you start"** (point to "1").
2. **"You skipped this circle"** (point to the one omitted). **You should go from number one** (point) **to two** (point), **two to three** (point) **and so on until you reach the circle marked END** (point).**"** If it is clear that the participant intended to touch the circle but missed it, do not count it as an omission, but caution him/her to touch the circle.
3. **"You only went as far as this circle** (point). **You should have gone to this circle marked END** (point).**"**
4. **"Please keep the pen on the paper, and continue right on to the next circle."**

After the mistake has been explained, mark out the wrong part and say, "**Go on from here"**, pointing to the last correct circle. If the participant still cannot complete Sample A, take the participant's hand and guide the pen through the trail. Then say:

"Now you try it. Put your pen, point down. Remember, begin at number one (point) **and draw a line from one to two** (point to "2"), **two to three** (point to "3"), **three to four** (point to "4"), **and so on, in order until you reach the circle marked END** (point). **Do not skip around but go from one number to the next in the proper order. If you make a mistake, mark it out. Remember, work as fast as you can. Ready, Begin!"**

If the participant succeeds, say, "**Good! Let's try the next one."** If the participant still cannot do it, discontinue the test.
   Participants are not permitted to start over on a new "practice" sheet if they make errors on the sample.

> AFTER the subject completes the practice, write the participant ID, as well as 'PA' for Practice Trails A at the bottom of the digital page.

<u>Test</u>

"On this page are numbers from 1 to 25. Do this the same way. Begin at number 1 (point to "1") **and draw a line from one to two**, (point to "2"), **two to three** (point to "3"), **three to four** (point to "4"), **and so in, in order, until you reach the end** (point to the circle marked "END"). **Remember, work as fast as you can and do not lift the pen from the paper. Ready, Begin!"**

ADMINISTRATION

1. Start timing. If the participant makes an error, call it to his or her attention immediately, by following the steps below, and have the participant proceed from the point where the mistake occurred. Do not stop timing. The assistance given when an error is made should proceed along a continuum as follows:
   a. Cross out line, point to last correct circle, and say, **"This is a mistake. Start again from here."**
   b. If participant does not start, ask, **"What should come next?"**
   c. If unable to proceed, ask, **"Do you remember the sequence?"**
   d. If participant still cannot proceed, go back three circles and say, **"You were at X** [number] (point), **what should come next?"**

When Part A is finished, stop timing, take the paper and say, "**That's fine. Now we'll try another one."**

AFTER the subject completes the test, write the participant ID, as well as 'TA' for Test Trails A at the bottom of the digital page.

Data Collection: Record the time to completion. AND number of pen lifts/corrected errors. It is important to continue this test to the extent that the participant is willing and able. If the participant struggles, but is able to maintain set with some cuing, it is important to continue the test for as long as necessary. If you find that the participant loses set with each circle, it may be discontinued.

If the tester has provided all allowable prompts and the person simply can't continue / doesn't know what to do, it is appropriate to discontinue. If they can continue with prompting, cycle through the prompts as necessary for each of the remaining errors until 5 minutes is reached. Trails A and B will each be discontinued at 5 minutes.

IMPORTANT ADMINISTRATION CONSIDERATIONS

1. If the participant starts before the instructions are done in the sample, say, **"I'm sorry, but I have to read through all of the instructions."**

2. If the participant starts before the instructions are done in the test, say, **"please don't start until I say *begin*".**

3. If the participant says the next number loud, questioning you regarding whether it is correct, you need to say: **"I can't say anything until you draw the line."**

4. If the person **starts trails early**, stop them by providing the appropriate cue. This does not present a problem for the electronic pen.   There should also be a place in the scoring section that says "Participant started test early?" - be sure to circle 'yes'!

5. General rule of thumb is to **give person the benefit of the doubt**. If they pass through an incorrect circle but it's clearly on their way to the correct circle, do not stop them. Similarly, if they nearly miss a correct circle but it is clear that they intended to pass through it, do not stop them.

6. If participants lose their place on either Trails A or B, they are **allowed to retrace lines**.

TRAILMAKING TESTS- Trails B

<u>Sample</u>

Place paper in front of participant.

"On this page are some numbers and letters.   Begin at number one (point) **and draw a line from one to A** (point to "A"), **A to two** (point to "2"), **two to B** (point to "B"), **B to three** (point to "3"), **three to C** (point to "C"), **and so on, in order, until you reach the end** (point to the circle marked END). **Remember, first you have a number** (point to "1"), **then a letter** (point to "A"), **then a number** (point to "2"), **then a letter** (point to "B"), **and so on. Draw the lines as fast as you can and do not lift the pen from the paper. Begin!"**

If the participant succeeds, say, "**Good! Let's try the next one."**

If the person makes an error, explain the error according to the error guidelines for the sample. Use additional instruction as necessary to explain the test instructions to the participant. If the person is clearly unable to get through the sample or understand the instructions, you do not need to administer the test. Record "inability to establish set" as the reason the test was not administered. However, if you are unsure of their ability, proceed to the test.

> AFTER the subject completes the practice, write the participant ID, as well as 'PB' for Practice Trails B at the bottom of the digital page.

<u>Test</u>

"On this page are some numbers and letters. Do this one the same way. Begin at number one (point) **and draw a line from one to A** (point to "A"), **A to two** (point to "2"), **two to B** (point to "B"), **B to three** (point to "3"), **three to C** (point to "C"), **and so on, in order, until you reach the end** (point to the circle marked END). **Remember, first you have a number** (point to "1"), **then a letter** (point to "A"), **and so on. Do not skip around, but go from one circle to the next in the proper order. Draw the lines as fast as you can and do not lift the pen from the paper. Ready, Begin!"**

Start timing. If the participant makes an error, immediately put a dash through the incorrect line and have the participant proceed from the point at which the mistake occurred. Follow error correction guidelines outlined on the record form in the Error Corrections for TEST. Do not stop timing. Each time you have to use an error correction, this is counted as a CUE. Administer all error corrections, one at a time, in order, without skipping any, until the person can continue.

> AFTER the subject completes the test, write the participant ID, as well as 'TB' for Test Trails B at the bottom of the digital page.

IMPORTANT ADMINISTRATION CONSIDERATIONS FOR TRAILS B

1. *If the person stops at 'L' and thinks that's the end of the test, the prompt is, "what comes next". If they still think that they are at the end, continue to queue them until they catch on. Record the number of queues in the scoring section. If the participant cannot continue, mark that the test was not completed and make a note in the back of the battery documenting what happened.

SCORING GUIDELINES

1. "Check here if test NOT completed":
   a. Answer 'YES' if test was administered and participant completed all circles within 5 minutes.

   b. Answer 'No' if the test was not administered, or if the test was discontinued at any time, including if the participant "timed out" at the 5 minute mark.

2. "Time to Completion"
   c. This value cannot be higher than 5 minutes.
   d. If the examiner discontinued the test at 5 minutes because the participant "timed out", then enter 5'00 for time to completion, and enter '12' (insufficient time) as the code in the validity section under "Test Not Completed".

3. **Error Definitions**

Loss of Set Error = Person fails to alternate between numbers and letters.

Sequencing Error = Person alternates between numbers and letters but goes in wrong order.

Perceptual Errors = Confusion between I and 1 or B and 8.

4. **Pen lifts** during error corrections are not counted as errors. (Revised per FHS on 12/15/14).

5. **A "cue"** is defined by any comment provided by the examiner as listed in the error correction box.

LOGICAL MEMORY IMMEDIATE and DELAYED

Please see record form for all instructions and procedures.

Regarding administration of the Logical Memory Test, prior to reading the story provided, interviewers should emphasize to the participants that no repetitions will be permitted during the administration of this measurement. Following the instructions for Logical Memory I, please state, **"*Please listen carefully, because I am not allowed to repeat any portions of the story*".**

The length of time to read the story should be approximately 30 seconds.

No credit is given for "employed" if the participant responds: "Anna Thompson, a cook in a school".

On Logical Memory I, the cue is to say "Anything else?" after the person has recounted the story. In cases where a participant says "I don't remember", the tester can say: "Anything at all?"

The LM II form says: "If the 30-40 minute delay period has elapsed and another test is being administered, interrupt the other test and administer this test". **Please disregard this and do NOT interrupt another test. LM II should be completed as soon as possible after finishing the ongoing test according to the rules in the "General Issues" section at the beginning of this chapter.**

Record time LMI is completed, or start a separate timer to begin the delay period.

Logical Memory Scoring

Scoring is deferred until after the examination and is done from the written record, which must be written in a legible, decipherable manner_ The story consists of 25 units. On the *Worksheet for Logical Memory IA-Immediate,* underline each unit that is successfully recalled. Then total the units recalled and enter that number (00-25) in the space provided. This is the number to be entered on NACC UDS Form Cl, item 3c. Scoring criteria for each unit are given below.

STORY A SCORING CRITERIA			
Text	General Rule	Examples of 1-point Responses	Examples of 0-Point Responses
Anna	Anna" or variant of the name	Ann; Annie; Annette	Angela; Allison
Thompson	"Thompson" is required	——	Thompkins; Thomas of
South	"South" (in any context)	from South; who lived in South; who came from South	——
Boston	"Boston" (in any context)	who worked in Boston; on a trip to Boston	——
employed	An indication that she held a job	worked; had a job as; who was; who earned a living as	who wanted to be; employed a cook
as a cook	"Cook" or some form of word is required	who cooked	as a waitress; in the kitchen the
in a school	"School" is required	at a high school; by a school	in a hospital; at a company
cafeteria	"Cafeteria" is required	——	lunchroom; dining hall; diner; restaurant; kitchen
reported	Indication that a formal statement was made to someone in authority (in any context)	filed a complaint; said to police; made a statement; notified the police; called the police; told the police	said; told how
at the City Hall	"City Hall" (in any context)	went to City Hall; called City Hall	——
Station	"Station" in any context, or a word, or a word phrase denoting a police station	police station; train station; station house; police headquarters; precinct house; police department	office; building
that she had held up	An indication that she had been held up (i.e., gun point or knife)	that someone held her up; that she was in a stick-up	that she was beaten; she was been attacked; that she was robbed; she got mugged
on State Street	"State Street" (in any context)	she lived on State Street; on her way to State Street	on some street; State Avenue
the night before	Indication that the hold-up occurred the previous night	last night; the previous night	at night; one night; yesterday; the day before
and robbed	Indication that a robbery took place	was robbed; her money was stolen; they took her money; someone took her purse	lost her money; somebody took her things

	STORY A SCORING CRITERIA (continued)		
Text	General Rule	Examples of 1-point Responses	Examples of 0-Point Responses
of fifty-six dollars.	Indication that an amount of money greater than $49 but less than $60 was taken from her	fifty-some dollars; fifty-five dollars; about fifty dollars	sixty-five dollars; a lot of money; the police collected fifty-six dollars for her
She had four	"Four" is required together with an indication that the children were hers	she was the mother of four	she had two; she had some; there were some
small children,	"Children" or a synonym is required	little children; kids; small kids; young children	babies; girls; sons; small boys
the rent was due,	A phrase indicating that the rent was due	she had not paid the rent; she owed for the rent; the landlord had to be paid; she needed money for the rent	she owed money; she needed money; there was no money
and they had not eaten	Indication that her children, or the family, were without food	they had gone without food; they were hungry; there was no food; her kids had nothing to eat; she couldn't feed her family	there wasn't much food they had only a little food; she had not eaten; didn't have money to buy food
for two days.	"Two days" is required, or a phrase meaning about two days	for a couple of days; for one or two days; for two or three days	for days; for several days; for a day; for three days
The police,	A word or phrase signifying one or more members of the police department (in any context)	the cops; the policeman; the detectives; the police officer; they (where police is clearly meant)	they (unspecified); some people; her neighbors; somebody
touched by the woman's story	An indication that her story evoked sympathy	were touched; felt sorry for the woman; wanted to help her; were sympathetic; were impressed by her story (implying emotional reaction)	listened to her story; helped her; believed her
took up a collection	A phrase indicating that money was collected	chipped in; collected money; donated; collected some food	gave her some money; found some money
for her.	An indication that the money collected was for her or her children	and gave it to her for her children; for her family; for them; to help her out; ==gave her money==	as a gift; to make things better; for food

Number Span Test

Description

This is a test of working memory and it taps two different working memory constructs. The first, Forward Number Span, measures the capacity for holding information very briefly for the purpose of repeating it exactly. The second, Backward Number Span, measures the ability not only to hold the information but also to manipulate the numbers and reverse the sequence. This test is also referred to as Digit Span.

Numbers for both forward and backward span tests are presented, with sequences ranging from 2 to 9 numbers. Two trials are administered at each sequence length. There are two scores: total number of correct trials; longest sequence repeated correctly prior to failing two consecutive trials of the same length.

Source
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Administration and Scoring — Forward Number Span

[Say]: **"I am going to ask you to repeat some numbers for me. Wait until I finish saying the numbers and then repeat them in the same order. For example, if I say 1-8-7, you would say 1-8-7. If I say 2-9-8, what would you say? If the subject gives the wrong answer, say, "Actually you would say 2-9-8."**

[Say]: "**Repeat only the numbers I say each time**". Then start with the test items. Before each of the first two items, say, **"Ready?" If the subject is clearly attentive and ready for the next item, it is not necessary to continue to use this prompt beyond the second item. However, if you feel it is necessary to re-direct attention, this prompt may be used as often as necessary.**

Administer the items in the order indicated on form. Write subject's response on the answer sheet. Continue testing until two number strings at the same length are failed. Record total number of trials correct and longest number sequence repeated correctly.

Administration and Scoring — Backward Number Span

[Say]: **"I am now going to ask you to repeat some numbers for me but to reverse them from the way I say them. Wait until I finish saying the numbers and then repeat them in reverse order, or backward. For example, if I say 3-7-4, you would say 4-7-3. If I say 7-3-6, what would you say?"** If the subject gives the wrong answer, say, **"Actually, you would say 6-3-7."**

[Say]: **"Repeat only the numbers I say each time, backward, in reverse order."** Then start with the test items. Before each item, say, **"Ready?"**

Do not correct the subject if they repeat the numbers in a forward order. Stop testing after two consecutive failures of the same span length. Administer the items in the order indicated on the test form. Write the subject's response on the answer sheet. Continue testing until two number strings at the same length are failed. Record total number of trials correct and longest number sequence repeated correctly prior to the two failed trials. Responses that are "chunked" (e.g., "18" "95" for 1895) are given credit.

WAIS-R DIGIT SYMBOL

Place the test form on table in front of subject (form follows this page). Read aloud the following instructions:

[SAY]: "Look at these boxes. Notice that each has a number in the upper part and a special mark in the lower part. Each number has its own mark. Now look down here where the boxes have numbers in the top part but the squares at the bottom are empty." *[Point to the sample items.]*

[SAY]: "You are to put in each of the empty squares the mark should go there, like this: Here is a 2; the 2 has this mark, so I put it in this square like this. Here is a 1; the 1 has this mark, so I put it in this square. This number is 3; the 3 has this mark, so I put it in this square." *[Examiner fills in the first three boxes to demonstrate. The examiner should use both the sample items and the key at the top of the page during the instructions to clearly indicate how subjects should use the key to find the appropriate numbers].*

[SAY]: "**Now you fill in the squares up to this heavy line**." *[if subject makes errors, continue to help until all sample items are filled in correctly.]* "**Yes, now you know how to do them**."

[SAY]: "**When I tell you to start, you do the rest of them. Begin here and fill in as many squares as you can, one after the other, without skipping any. Keep working until I tell you to stop. Work as quickly as you can without making any mistakes. When you finish this line, go on to this one. Ready? Begin**." *[Allow 90 seconds.]*

- If the subject skips an item, immediately give a reminder to go in order and not skip over any; point out the skipped item and direct the subject to continue from the last item completed successfully in order.

- Do not intervene if the subject fills in a wrong symbol, but if the subject has clearly lost focus as to what to do (e.g., starts filling in something other than symbols), you may give the following reminder: "**Remember, you are to fill in the symbol that goes below each number, as indicated in the key up above**."

- If the subject pauses at the end of a row, say "**Good, keep going**." *[Point to the beginning of the next row, if necessary.]*

- *If the subject starts at the right side of the row, redirect him or her to begin at the left side by pointing to the appropriate square sand saying, "**Please continue over here**". Any symbols filled in from the right side should receive credit.*

- *Subjects should be given the benefit of the doubt if the symbols closely resemble the correct symbols (i.e., rounded edges). However, if the errors to the symbols clearly change the meaning of the symbol (i.e., changing the symbol for #2 to a 't' or changing the symbol for #5 to a 'u' with a tail) then credit should not be awarded.*

AFTER the subject completes the test, write the participant ID, as well as 'DS' for Digit Symbol at the bottom of the digital page.

CATEGORY FLUENCY

[SAY]: "**I am going to give you a category and I want you to name, as fast as you can, all of the things that belong in that category. For example, if I say 'articles of clothing', you could say 'shirt', 'tie', or 'hat'. Can you think of other articles of clothing**?"

Allow up to 20 seconds for the subject to produce two responses. **Circle the number response type, and read the associated instruction from the table below**.

Participant Response to Sample		Examiner Response
Correct	≥ 2 correct responses	*That's right.*
Partially Correct	1 correct response only	*That's right. You also could have said 'shoes' or 'coat'.*
	≥ 1 incorrect **AND** ≥ 1 correct responses	*_____is (are) correct, but is (are) not an article of clothing. You also could have said 'shoes' or 'coat'.*
Incorrect	No response	*You could have said 'shoes' or 'coat' since they are articles of clothing.*
	≥ 1 incorrect responses only	*No, _____is (are) not an article (s) of clothing. You could have said 'shoes' or 'coat' since they are articles of clothing."*

✍ Next, read the instructions for the <u>Animals</u> category (worksheet follows this instruction page):

[SAY] "**Now I want you to name things that belong to another category: Animals. You will have one minute. I want you to tell me all the animals you can think of in one minute. Ready? Begin."**

Start timer as you say "Begin". Write actual responses as legibly as possible on the *Worksheet for Category Fluency-Animals*. Stop the procedure at 60 seconds. One prompt ("Tell me all the animals you can think of.") is permitted if the participant makes no response for 15 seconds or expresses incapacity (e.g., "I can't think of any more."). It is also permissible to repeat the instruction or category if the subject specifically requests it.

If the person asks if something is an animal and they are correct (i.e., "Are birds animals?), you can say yes and provide credit.

*To be consistent with baseline, we **will not** redirect people after set loss errors.*

Mythical/ fictional creatures (such as unicorns) do NOT receive credit on the Animals test and should be scored as an OTHER error. The one exception is "dragon", which will always receive credit because a Komodo dragon is an animal

If a pt. said mice after giving mouse as an answer, it IS a perseveration.

In a "thinking aloud" response such as, "Fish are reptiles", both fish and reptiles would get credit.

Infant names of species are given credit, such as "cow, calf" (2 points) or "dog, puppy" (2 points).

VERBAL FLUENCY (FAS)

"I will say a letter of the alphabet. Then I want you to give me as many words that begin with that letter as quickly as you can. For instance, if I say *B*, you might give me bad, bottle, bed. However, I do not want you to use words that are proper names such as Boston or Bob. Also, I do not want you to use the same word again with a different ending, such as bake, baking, baked. Any questions? The first letter is *F*. Give me as many words as you can that begin with *F*."

Begin timing. Record each verbalization in the appropriate space depending on the time frame (15 second intervals) in which it was said. Time for one minute.

"The next letter is *A*. Begin."

Record as above.

"The next letter is *S*. Begin."

Record as above. It is often helpful to maintain the "sss" sound for 1 second, because it makes it more obvious that the letter is "S" not "F" or "X").

If the person loses set (i.e., forgets the task instructions) and provides incorrect words, you can cue him/her back to set AFTER THE 2ⁿᵈ ERROR IN A ROW.

Specific Error Corrections after TWO errors:

1. Wrong first letter: "Remember please use words that start with the letter (insert)".
2. Proper nouns: "Remember, please don't use proper nouns".
3. Different form of same word: "Remember, please don't use the same word with different endings"

IMPORTANT ADMINISTRATION CONSIDERATIONS

1. If the person says, "that's it!" or has a very long pause that indicates they are finished, you may say **"you have more time..."** or **"keep going!"**

2. If the person says, "No, I already said that," after a perseveration, it IS included as a perseveration in scoring. Similarly if, they say a proper noun and then self-correct with a statement like, "No, that is a proper noun," it IS counted as a loss of set error.

3. Neologisms (made-up words) and phonemic errors (e.g., "photo" for "F") are NOT loss of set errors. Words in foreign languages are permitted but not encouraged. They need to be verified later if you do not know the word to be real.

4. Any proper nouns are considered errors (e.g., names of months, days of week, etc.). In other words, any noun that is capitalized when spelled is an error.

5. If the participant says a word unfamiliar to you, wait until after the test is completed, and ask about it. Have the participant spell the word and/or give a definition. This will allow you to later look in the dictionary to see whether the word was, in fact, a valid response.

6. Always verify words you do not know by looking them up in the dictionary. Make sure they are spelled correctly.

Never provide a word from a test category to the participant. If they have difficulty hearing the specific letter (for example differentiating 'F' from 'S', please say these letters as many times as necessary, slowly and clearly so that they can see the placement of your lips and teeth when saying these letters).

If a person provides an ambiguous word like "frank", always give credit.

Follow the scoring rules below for rehearsals versus perseverations on fluency tasks

	FAS		*Animals*	
	Said	*Didn't Say*	*Said*	*Didn't Say*
Did I say "x"?	*P*	*No credit*	*P*	*No credit*
"X" – I already said that.	*P, SC*	*No credit*	*P, SC*	*No credit*
I already said X.	*P, SC*	*No credit*	*P, SC*	*No credit*
Response said as if person was rehearsing previously said words	*Not a P*	*Credit*	*Not a P*	*Credit*

P = Perseveration; SC = Self-Correction

FHS SCORING RULES FOR FAS

1.   Record all responses in the cells provided for each 15 second time interval. Be sure that the words are written clearly and that the order in which the responses were given is obvious. If your writing is not neat enough for someone else to read, you need to go back after testing and write the ambiguous words clearly. The best strategy to represent order is to write the words in columns, with ample space separating the columns. For example, in the following example the participant would have said, "ant, aardvark, alien, away, apple, ample, astronaut."

Ant	**Apple**
Aardvark	**Ample**
Alien	**Astronaut**
away	

2. In the box located within each cell, write the total number of words produced during that time interval that "pass." A word "passes" if it meets the following conditions:

a. It is a valid dictionary word

b. It begins with the appropriate letter (e.g., "F")

c. It is NOT a proper noun (e.g., if a participant says, "France, oh, I can't use that, it's a proper noun," it IS counted as an error and a self-correction.

d. It is NOT the same word that was given earlier in the trial with a different ending. Interpret this rule concretely. That is, a word does NOT pass only if it literally has a different ending, NOT if it is only a different tense of a word (e.g., If a participant says "run," then "running" does NOT pass, but "run" DOES pass).

e. It is the first occurrence of the word (If a participant says, "I already said friend" or "friend, I said that," it DOES count as a perseveration and a self-correction.

f. Foreign words are accepted, but you need to confirm that they meet the above criteria.

3. Fill in all of the error boxes, with zeros if necessary. ALL of the variables MUST be filled in.

4. **Wrong First Letter**: For each letter condition, and following the guideline described above, count the total number of errors, produced during that allotted minute, that do NOT begin with the correct letter. Place this total in the column marked "Wrong First Letter." If a participant loses set, then gives additional consecutive answers making the same error (prior to being corrected after 2 errors), only the first error is scored.

5. **Broken Rule**: For each letter condition, and following the guideline described above, count the total number of errors, produced during the allotted minute, which reflect a "broken rule" (i.e., proper noun or same word with a different ending). Place this total in the column marked "Broken Rules." If a participant loses set, then gives additional consecutive answers making the same error (prior to being corrected after 2 errors), only the first error is scored.

6. **Perseverations**: For each letter condition, count the total number of words, produced during the allotted minute, that are repetitions of a previously given word. If the same word is given several times during the allotted minutes, each instance of the word (except the first one) should be counted. Perseverations, unlike the other two error types, are counted as errors, even if they are said consecutively. Place this total in the column marked "Perseverations."

MISCELLANEOUS SCORING CONSIDERATIONS

1. If a participant loses set, then gives additional consecutive answers making the same error, only the first error is scored. For example, if the participant says, "friend, foe, folly, shop, stop, furniture, ship...," this would count as TWO "Non-F" words; "shop" is a loss of set (1), "stop" is NOT a loss of set because it follows another "s" word (participant STAYED OUT OF SET, rather than LOSING set a second time), and "ship" is a loss of set (2), for a total of two (2) "non-F" words.
   a. Other examples: if the participant loses set but the error is a broken rule or wrong first letter, the same scoring rules apply. BROKEN RULE example - if the participant says "Alabama, Alaska..." Only the first error ("Alabama") is scored as a broken rule error. WRONG FIRST LETTER example - If during the A trial the participant says "apple, anteater, oath, found, did I say found?, fix fake...[examiner cue after fix]..." "Oath" would be scored as a wrong first letter, "found" would be scored as a 2nd wrong first letter error and the 2nd instance of "found" would be scored as a perseveration.
2. If the person says, "that's it!" or has a very long pause that indicates that they are finished, you may say "you have more time..." or "keep going!".

3. If the person says, "No, I already said that," after a perseveration, it is counted as a self-correction but also counted as a perseveration. Similarly if, they say a proper noun and then self-correct with a statement like, "No, that is a proper noun," it IS counted as a loss of set error.

4. Words in foreign languages are permitted but not encouraged. They need to be verified later if you do not know the word to be real. If they are not real, they fall into the "other category" and are treated as neologisms (#5).

5. Neologisms (made-up words) and phonemic errors (e.g., "photo" for "F") are NOT loss of set errors. They are scored as "other" errors.

6. Any proper nouns are considered errors (e.g., names of months, days of week, etc.). In other words, any noun that is capitalized when spelled is an error.

7. If the participant says a word unfamiliar to you, wait until after the test is completed, and ask about it. Have the participant spell the word and/or give a definition. This will allow you to later look in the dictionary to see whether the word was, in fact, a valid response.

8. If the participant asks "Did I say ___?" and the word is a perseveration, this is scored as a perseveration ONLY.

9. Different numbers that begin with the same letter (six, seven, etc.) are acceptable. Numbers in the same category (six, sixteen, sixty, etc.) are also acceptable because the ending changes the meaning of the word.

10. The words "south, southwest, southeast, southern" counts as 4 points because the ending changes the meaning.

11. Phrases given that begin with the appropriate letter should be counted as 1 point per phrase, no error, unless the first word of the phrase is given again, in which case the 2nd incidence of the word is scored a perseveration. (e.g. "stop sign" = 1 point. "stop sign, stop, sign" = 2 points, 1 perseveration. "an hour" = 1 point. "french fry" = 1 point.)

12. Abbreviations (ASAP, SOS, etc.) are fine.

14. Situations similar to if someone said "frustration" and "frustrating" would both get credit because they are different words, rather than the same word with a different ending. The parts of speech (i.e. noun, verb, adjective, etc.) are important here. If the words were "frustrates" and "frustrated," the second word would be coded as a "broken rule"

15. The following are examples of how to score perseverations with self-corrections. (1). "Friend. I said friend" (having already said friend): would be scored as "1" perseveration and "1" self-correction. (2). "I already said friend" (having already said friend): would be scored as "1" perseveration and 1" self-correction. (3). "I already said friend" (having not previously said friend): would be scored as "0" credit and "0" self-corrections.

16. If a participant starts to say a word but stops in the middle of saying it because they have already said the word, and if it is clear what that word was going to be, then score it as a perseveration and self-correction. For example if on animals, the participant says "ze...", it can be inferred that they were going to say zebra and if they previously said zebra it will be scored as perseveration and self-correction.

17. Self-correction/perseveration examples: "Frank," then, "no, can't do that... oh wait, okay," gets 1 pt., 1 broken rule error & 1 SC. "Frank," then, "no, can't do that... oh wait, okay, frank:" the first mention gets a broken rule error and no SC, and the second gets 1 pt. & 1 SC. "Fair" and, then later, said "fair, I said that. Oh, different kind," gets 1 pt. and no errors for the first 'fair, and 1 pt., 1 SC and 1 psv. for the second 'fair.'"Fair"; and, then later said "fair, I said that. Oh, different kind, fare," gets 1 pt and no errors or SCs for the first 'fair,' 1 psv and 1 SC for the second, and 1 pt and no errors for the third.

18. If a word applies to multiple scoring types, ONLY score it as one error type and the error should be applied in the following order: (1) Wrong 1st letter (2) Perseveration (3)Broken Rule (4) Other Error.

19. If a person says a word that has two different meanings (i.e., foul/fowl) and later says "the same" word again, assume person is offering the other meaning of the word. Other examples are (for/four, sun/son, ale/ail, etc.)

Validity Ratings

At the completion of cognitive testing, please indicate if any tests were not administered or discontinued, and the corresponding reasons. If a test was considered to be valid without any issues affecting performance, assign a score of 0 for the individual validity ratings in the "Test WAS completed" column. Do not enter anything in the "Test was NOT completed" column. Additionally, please assign an overall validity rating to the test session as indicated on the validity rating panel.

The validity ratings regarding **establishing and maintain mental set** should be used as indicated below.

	Use 'Failure to Establish Set' if:	Use 'Failure to Maintain Set' if:
Test was NOT administered or completed	Person could not understand instructions	NA
Test administered but NOT completed	NA	Person had difficulty remembering instructions
Test completed	NA	

IADL Scale Administration Guidelines

The ADL scale can be given to the participant to complete in person, by mail, or by phone. The examiner states:

For these next questions, please select the statement that best describes your ability to complete the task. If you do not perform the task for reasons other than your health, please choose the answer that best estimates your abilities if you had to carry out the task.

This form should be completed by proxy when the participant demonstrates cognitive impairment.

Dementia Questionnaire (DQ) Administration Guidelines

The DQ should be given to an informant that is identified by the participant. As of January 2019, the DQ will be administered on a limited basis as follows:

1) The DQ will be NOT be administered when participants are considered to be cognitively normal. It will only be administered when participants score <27 on the MMSE for in person visits, (or TICS Total Score (not including Q12) < 31 on phone follow ups) OR when the examiner is concerned about the participant's level of cognitive functioning.

2) The DQ will NOT be collected in individuals who have previously endorsed "Yes" to at least 3 of the first 6 DQ items o*n two consecutive* DQ assessments.

3) The DQ should not be administered more than once every 6 months.
   Please refer to Chapter 18 for detailed administration guidelines.

   It should be noted that the collection of informant data for the DQ does not necessitate use of a proxy for other LLFS instruments. Use of a proxy is determined by the criteria described in Chapter 4.

Appendix: Digital Data

Sites will receive paper for digital tests from CUMC. All written data will be collected on the digital paper including:

MMSE Pentagons
MMSE Sentence
Trail Making Practice and Test for A & B
Digit Symbol

IDS must be written on the bottom of each piece of paper AFTER the participant completes the test. We may move to a system that will not require this, but it is not in place yet.

Workflow of Data from Digital Pens

Field center computers to do this must be PCs (no Macs) and running Windows 7 or XP, not 8

Clock Drawing

- Administer test during home visit
- Return to field center and download data from epen (saving locally)
- Store this data locally
- Score test using ClockSketch software locally.
- Once a week upload anonymized clock files to clocksketch website, by uploading the "UploadMe.csk" file.

- Lahey/MIT does QC, sending a spreadsheet with a list of scoring errors back to the person identified as the site liason. Site liason reviews the scoring errors and communicates with scorers as needed.

- Once a month Lahey/MIT will create and send to DMCC a csv file that contains the FHS clock variables for each test done by each site during the preceding month. This will be one csv file with the data for all clocks for all sites for that month. The data in the csv file will have in it the subject IDs assigned by each site. (The clock tests are anonymized while being uploaded to MIT, but the IDs can be decrypted and reinserted into the files before the csv file is created. This saves the step previously mentioned about creating a table matching MIT-generated patient IDs with LLFS-generated IDs.)

- When requested by the DMCC, Lahey/MIT will provide the full set of dCDT variables. This is easier and more efficient than sending this information on a regular basis, given the large number of variables (~2000) and the fact that there may be variables that are added or eliminated over the next couple of years as more dCDT data gets analyzed.

- Final analysis variables will be made available by DMCC as sas and csv files for investigators

Trail Making and Digit Symbol with epen

- Store raw pen data locally at each field center

. Processing stream still in development (by Ben Wasserman at FHS)