



# **Manual 9**

## **Neurocognitive Function**

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Study website - <http://www.csc.unc.edu/hchs/>

## Neurocognitive Function

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## **1. INTRODUCTION**

Participants 45 years of age and older will be administered a brief battery of neurocognitive tests in the baseline HCHS/SOL examination. These measures will provide new information on cognitive functioning and its association with risk factors (behavioral, biochemical, and genetic) in Hispanics, a population that has been largely under-represented in studies of brain and cognitive aging to date. This first assessment will also establish a baseline for cognitive functioning in HCHS/SOL participants, which with repeated cognitive measurements in subsequent exams, will provide the opportunity to identify risk factors associated with change in cognitive functioning over time.

The baseline cognitive measures were chosen for their broad but efficient coverage of major cognitive domains. Additional factors considered in measurement selection included validation in Hispanic samples, comparability to measures used in previous cohort studies, feasibility with respect to the standardization of administration and scoring procedures, evidence of sensitivity in normal samples including a wide age range, and finally the feasibility of possible administration by phone in subsequent exams.

The measures of cognitive function administered in the HCHS/SOL baseline examination include the six-item screener, the Spanish English Verbal Learning Test, the Word Fluency Test of the Multilingual Aphasia Examination (letters F and A), and the Digit Symbol Substitution Test of the Wechsler Adult Intelligence Scale-Revised (WAIS-R). These measures tap five cognitive domains: global mental status, verbal learning and memory, word fluency, and psychomotor speed, respectively.

## **2. FIELD CENTER PROCEDURES**

A trained examiner administers the cognitive function tests in a fixed order, one right after the other, during a single session in a quiet room. The tests are administered following the instructions printed on the Neurocognitive Assessment paper forms (see Appendix). Test results are tabulated by the interviewer after the participant has completed the tests and left the room. Test results are entered on the Neurocognitive Function DES screen by the examiner.

The order of test administration is as follows: (1) six-item screener, (2) Spanish English Verbal Learning Test, (3) Word Fluency Test, and (4) Digit Symbol Substitution Test. The testing environment and examiner behavior should be geared toward optimizing the participant's performance on each of the cognitive measures. General testing procedures are detailed below.

Testing should be conducted in a quite area free of extraneous background noise and interruptions, as these distractions may affect test results.

Always inquire if the participant uses reading glasses or wears a hearing aid. If so, these items should be worn during testing.

The testing room must have a table with sufficient work space and appropriate lighting for the participant to comfortably complete the Digit Symbol Substitution Test.

A good quality stopwatch is necessary to time components of the cognitive function exam. The stopwatch should be simple to use, easy to read, and preferably one that allows the examiner to begin and end timing silently (some stopwatches produce a sound upon starting and stopping).

Timing should always be as discrete as possible to avoid producing anxiety and affecting test results.

Always read scripts exactly as written.

Each participant should be allowed to attempt every task, unless it is determined that the participant cannot do the task due to an obvious physical impairment.

Although time limits are set for some tests, the participant should never be told of any time limit on any measure.

Participants are often curious as to how well they did. Although scoring does not take place during testing, the interviewer should reassure each participant who asks that he/she did as well as others who have taken the tests. Do not indicate to the participant whether specific responses are correct or incorrect.

Most participants will feel challenged, however, some may feel insecure and others possibly hostile. It is important for the interviewer's attitude to be friendly, non-threatening, reassuring and supportive throughout the testing. Examiners should be sensitive to provide positive reinforcement (e.g., "you're doing fine") after each test if appropriate.

## **2.1 Six-item Screener (Part A)**

The six-item screener, derived from the Mini-Mental Status Examination, is a short measure of global mental status. Following the script on the paper form, the examiner briefly explains the purpose of the cognitive function portion of the HCHS/SOL examination and then proceeds with the instructions for the six-item screener.

Script: "In this part of the exam I will ask you some questions and give you a couple of short tasks that will require memory and concentration. First, I will ask you some questions that ask you to use your memory. I am going to say three words. Please wait until I have said all three words, then repeat them. Remember what they are, because I am going to ask you to name them again in a few minutes. Please repeat these words for me: BLUE - PEAR - SOFA."

Say the words distinctly at the rate of 1.5 seconds per word.

The participant may repeat the words in any order.

If the participant repeats the word after each word is read by the examiner, at the end of the presentation say, "Tell me the three words again" and score according to the response to this request.

Do not repeat the words for the participant until after the first trial (i.e., until after all three words have been presented). If there are errors on the first trial, the examiner may repeat the words two more times.

If the participant fails to repeat all three words correctly after three attempts, this portion of the testing (i.e., recall of the three words) is discontinued. In this case, the examiner should mark the appropriate box next to item 1: either "Incorrect," or if the failed response is due to a physical limitation (e.g., hearing loss) mark "Not Attempted/Disability," or if the participant refuses to complete the task mark "Not Attempted/Refusal." If the participant fails to repeat all three words correctly after three attempts, items 5, 6, and 7 will not be testable and should be marked as "Not Attempted/Disability." In the event that a participant refuses to complete the task (i.e., item 1 is marked as Not Attempted/Refusal), then items 5, 6, and 7 should be marked as "Not Attempted/Refusal."

Record the number of presentations necessary for the participant to repeat all three words correctly.

Next, the examiner asks the orientation items and records the appropriate response.

Script: "What year is this?"

Script: "What month is this?"

Script: "What is the day of the week?"

Record the appropriate response next to each item.

Do not offer extra help or provide any feedback as to whether a response is correct or incorrect.

Do not wait too long for a response (~ 15 seconds) before prompting for a response by repeating the question. After the question is repeated wait ~ 10 seconds for a response before moving on to the next item. The lack of a response after a reasonable period is marked as "Not Attempted/Refusal."

Ask the participant to recall the three words presented earlier.

Script: "Now, what were those three words I asked you to remember?"

Record the appropriate response next to each item.

The words may be repeated in any order.

Recalled words are considered correct whether stated in Spanish or English regardless of the language in which the original words were provided.

### **2.1.1 Six-item Screener (Scoring and Discontinuation)**

Items 1-6 on the six-item screener are scored as correct, incorrect, not attempted/disability, or not attempted/refusal. An incorrect response includes a response of "I don't know" or "I can't remember." When no response is received after a reasonable amount of time check "Not Attempted/Refusal." If an item is not attempted due to a physical impairment (such as hearing loss) check "Not Attempted/Disability" for each item affected. In this instance, continue on to the next question without delay.

## **2.2 Spanish English Verbal Learning Test (Part B)**

The Spanish English Verbal Learning Test (SEVLT) is a measure of new learning and verbal memory. The participant is asked to recall a list of 15 common words over three trials. Recall of the words are requested again following a short delay, during which a new (distracter) list of words is presented.

The first 15-item word list is presented in three learning trials.

Script: "Next, I am going to read a list of words. I want you to listen carefully and try to remember the words as I read them. When I stop, I would like you to recall as many of the words as you can. You may know some of the words by a different name, but I want you to try to remember the exact words I say. You will not be able to remember all of the words so just do the best you can. You do not have to recall the words in the same order that I read them. The words are..."

Say each word distinctly at the rate of ~ 1.5 seconds per word.

Script: "Now tell me all of the words you can remember."

Following these instructions, start the stopwatch. Timing should be discrete to avoid creating anxiety or a sense of time pressure.

Check off all the words recalled.

The participant may repeat the words in any order.

Recalled words are considered correct only when stated in the language in which the examiner provided the words. If the participant begins to produce the recalled word in another language say "Please tell me the word in \_\_\_\_\_ (Spanish or English)."

Once the participant has produced as many words as he/she appears able to recall, provide one prompt for additional items before going on to Trial 2.

Do not allow more than 60 seconds for recall for any trial.

The word list is repeated for Trial 2.

Script: "I am going to read the same list of words to you again. I want you to try to remember as many of the words as you can, including those you have recalled before. When I stop I want you to tell me as many of the words as you can remember."

Present the 15-item word list.

Script: "Now tell me all of the words you can remember."

Discretely start the stopwatch.

Check off all the words recalled.

Once the participant has produced as many words as he/she appears able to recall, provide one prompt for additional items before going on to Trial 3.

Do not allow more than 60 seconds for recall of Trial 2.

The word list is repeated for a final time in Trial 3.

Script: "I will read the same words once more. Listen carefully and when I finish tell me as many of the words as you can remember."

Present the word list.

Script: "Now tell me all of the words you can remember."

Discretely start the stopwatch.

Check off all the words recalled.

Once the participant has produced as many words as he/she appears able to recall, provide one prompt for additional items before presenting the Distracter list.

Do not allow more than 60 seconds for recall of Trial 3.

Next, the new (Distracter) list of 15 shopping items is presented.

Script: "I am going to read you a different list of words. This time, I want you to repeat each word out loud after I read it.

Present each word and pause for the participant to repeat it. If the participant does not repeat a word, prompt for the correct response.

Following the presentation and repetition of the distracter items immediately ask the participant to recall the 15 items from the first list presented.

Script: "Now, I want you to tell me as many of the words from the first list that I read to you as you can remember."

Discretely start the stopwatch.

Do not repeat the first list.

Check off all the words recalled.

Once the participant has produced as many words as he/she can recall, provide one prompt for additional items.

Do not allow more than 60 seconds for recall.

### **2.2.1 Spanish English Verbal Learning Test (Scoring and Discontinuation)**

The number of correctly recalled words for each of the three learning trials (Trials 1-3) and the recall trial (Trial 5) is recorded on the Neurocognitive Summary Scoring Form by the examiner after the participant has left the exam area.

Words may be recalled in any order.

Recalled words are considered correct only when stated in the language in which the words were provided by the examiner.

The SEVLT may be discontinued due to participant refusal or if the examiner determines that the participant is unable to perform the task due to a physical impairment such as hearing loss. If discontinued, the reason is recorded on the Neurocognitive Scoring Summary Form.

### **2.3 Word Fluency Test (Part C)**

The Word Fluency Test is a measure of verbal functioning. In this task, participants are asked to produce as many words as possible that begin with the letters F and A within a time limit of 60 seconds for each letter, avoiding proper nouns, variations, plurals, and repetitions.

Explain the task to the participant.

Script: "On this next task, I will say a letter. Then I want you to tell me as many different words as you can think of, as fast as you can, that begin with that letter. You may tell me words in English or Spanish so long as they are different words. Leave out names of people, names of places, and numbers. So, if I were to say "T," you would not say words like 'Thomas,' 'Texas,' or the number 'Ten.' But you could say words like 'table,' 'take,' or 'turtle.'

Pause.

Script: "Also, do not use the same word again with a different ending. For example, if you said 'take,' then you could not say 'takes,' or 'taking.' These would all be considered the same word. Are you ready?"

Pause.

Script: "Tell me as many words as you can that start with the letter F. I will tell you when to stop. Ready, go."

Discretely start the stopwatch and record the participant's responses verbatim.

If the participant cannot think of any more words, wait quietly for ~ 15 seconds. After 15 seconds of silence prompt for more words, saying: "Can you think of any other words that that begin with the letter F?"

Do not stop the test until the entire 60 seconds is over.

A participant may stop producing words because he/she feels he/she made an error (e.g., repeated a word or said a proper name). In this instance, prompt the participant to continue, saying: "that's okay; just go on."

The examiner should never interrupt the exam to correct sporadic errors.

The examiner may clarify the instructions only when the participant has clearly misunderstood the instructions and is only providing inadmissible words such as only stating proper names or only listing numbers. In the case of three or more consecutive inadmissible words, the examiner should clarify the instructions, saying: "Tell me words that start with F but do not include names of people" (or names of places or numbers depending on the error).

While recording the words, if the examiner cannot keep up with the words produced and misses a word, but is certain that the participant produced an admissible word, place an x on the line to indicate the participant should receive credit for the word.

After 60 seconds has passed, the examiner stops the test, provides encouragement, and states the next letter.

Script: "That was great. Now, tell me as many words as you can that start with the letter A. I will tell you when to stop. Ready, go."

Discretely start the stopwatch and record the participant's responses verbatim.

After 60 seconds has passed, the examiner stops the test.

### **2.3.1 Word Fluency Test (Scoring and Discontinuation)**

After the participant has left the room, the examiner must proof all the responses for admissibility. The examiner should finish writing out any words that were not completely written out during the exam. Clarify any words that may have been unclear during the time the test was given. If unable to spell the word, write it out phonetically. Check any ambiguous words in the dictionary (only after the participant has left the room).

Draw a single straight line through any inadmissible words, i.e., proper nouns, variations (e.g., change in suffix such as "ed"), plurals, and repetitions. Record the number of admissible words for each letter on the Neurocognitive Scoring Summary Form.

Words like anyone, anything, and anybody are counted as separate words. Homonyms like "ant" and "aunt" may be counted if given consecutively otherwise it is considered a repetition and only counted as one word.

Homophones (i.e., words that sound like they are spelled with F or A but actually begin with another letter) are inadmissible.

Admissible words may be produced in Spanish or English regardless of the language in which the instructions were provided. Words from other languages (e.g., *apropos*) are also counted, however it up to the examiner to verify the word in cases where the examiner is not familiar with a given word. Each field center should refer to the same standard dictionary in clinic. Cases where the examiner is unclear about scoring should be referred to the Neurocognitive Reading Center for clarification.

The Word Fluency Test may be discontinued due to participant refusal, task difficulty (i.e., meaning the participant never understood the instructions), or if the examiner determines that the participant is unable to perform the task due to a physical impairment such as hearing loss. If discontinued, the reason is recorded on the Neurocognitive Scoring Summary Form.

## **2.4 Digit Symbol Substitution Test (Part D)**

The Digit Symbol Substitution Test (DSST) is a measure of psychomotor speed and sustained attention. In this task, the participant is asked to translate numbers (1-9) to symbols using a key provided at the top of the test form.

Present the instructions deliberately and at a slow pace.

Hand the participant a pencil without an eraser. Place the digit symbol form in front of the participant, point to the key above the test items and read the script

Script: "This last task is the digit-symbol task. Look at these boxes. Notice that each box has a number in the upper part and a special mark in the lower part. Each number has its own mark."

Point to 1 and its mark, then to 2 and its mark.

Script: "Now, look down here to where the boxes have numbers in the top part, but the squares at the bottom are empty."

Point to the sample items.

Script: "I want you to put in each of the empty squares the mark that should go there, like this."

Point to the first sample item, then to the mark below the 2 in the key.

Script: "Here is a 2; the 2 has this mark. So I put it in this square, like this."

Write in the symbol in the first sample square. Then say:

Script: "Here is a 1; the 1 has this mark."

Point to the second sample item, then to the mark below the 1 in the key.

Script: "So I put it in this square."

Write in the symbol in the second sample square. Then say:

Script: "This number is 3; the 3 has this mark."

Point to the third sample item, then to the mark below the 3 in the key.

Script: "So I put it in this square."

Write in the symbol in the third sample square.

After marking the first three samples items, say:

Script: "Now, you fill in the squares up to this heavy line."

If the participant makes an error on a sample item, correct the error immediately and review the use of the key. Continue to help (if necessary) until the seven sample items have been filled in correctly. Do not proceed with the test until the participant clearly understands the task. When the participant fills in a sample item correctly, offer encouragement by saying: "yes" or "right."

When the sample items have been completed successfully, say:

Script: "Yes, now you know how to do them."

During the sample exercise, look to see if a left-handed participant blocks or partially blocks the key when filling in the marks. If this occurs, fold a separate template so that only the key is exposed and place it next to the participant's worksheet on the participant's right-hand side so that the extra key is aligned with the one blocked by the participant's left hand. Have the participant use the separate key to complete the sample items and to take the actual test.

To begin the formal test, say:

Script: "When I tell you to start, you do the rest of them."

Point to the first test item and say:

Script: "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 mistakes."

Sweep across the first row with your finger and say,

Script: "When you finish this line, go on to this one."

And point to the first item in row 2.

Script: "Ready? Go ahead."

Discretely begin timing.

If the participant omits an item or starts to do only one type (e.g., only the "1"s) say:,

Script: "Do them in order. Don't skip any."

Point to the first item omitted and say:

Script: "Do this one next."

If the participant gets to the end of a line and stops, say:

Script: "Please go on to the next line."

Give no further assistance except (if necessary) to remind the participant to continue until instructed to stop.

The examiner must sit quietly and minimize movements to avoid distracting the participant during this test.

Timing must be precise. At the end of 90 seconds, say:

Script: "Stop. That's good, thank you. That completes this set of tasks."

#### **2.4.1 Digit Symbol Substitution Test (Scoring and Discontinuation)**

After the participant has left the room, the examiner scores the DSST. Using the DSST scoring template, record 1 point for each correctly drawn symbol completed within the 90-second time limit and record this number on the Neurocognitive Scoring Summary Form.

A response is scored as correct if it is clearly identifiable as the keyed symbol, even if it is drawn imperfectly (e.g., "v" instead of "u") or if it is a spontaneous correction of an incorrect symbol.

Credit is not given for items completed out of sequence (e.g., doing all the 1's). Blank spaces between two completed items receive no credit.

If there is more than one symbol in the box, and one is correct, give the participant credit. The seven sample items are not included in the participant's score.

The DSST may be discontinued due to participant refusal, task difficulty (e.g., the participant never fully understood the instructions), or if the examiner determines that the participant is unable to perform the task due to a physical impairment such as a motor or visual problem. If discontinued, the reason is recorded on the Neurocognitive Scoring Summary Form.

## **2.5 Neurocognitive Scoring Summary Form**

The Neurocognitive Scoring Summary Form (Appendix XX) is completed after the participant has completed the cognitive tests and left the exam area.

Item 0a: Record the date of data collection.

Item 0b: Record the code number of the interviewer completing this form.

Questions 1-7 (Part A: Six Item Screener) have already been recorded by the examiner on Page 1 of the Neurocognitive Assessment booklet and are entered into the DES as they appear on Page 1.

The SEVLT (Part B), Word Fluency Test (Part C), and Digit Symbol Substitution Test (Part D) are each scored after the participant has left the exam area and are recorded by the examiner on the Neurocognitive Scoring Summary Form.

If any test scores are permanently missing because part of the battery was skipped or discontinued, enter "=" in those fields. Further details regarding discontinued tests are recorded in Item 16 (a-c).

Items 8-11: Record the number of correct words recalled (checked off by column on the SEVLT form) for each of the three learning trials (Trials 1-3) and the recall trial (Trial 5). Refer to section 2.2.1 for scoring instructions.

Items 12-13: Record the number of acceptable words produced for each letter, F and A. Refer to section 2.3.1 for detailed scoring instructions.

Item 14: Apply the DSST scoring template to the response form and record the number of correct symbols. Refer to section 2.4.1 for detailed scoring instructions.

Item 15: Record the language in which the tests were administered. If parts were given in both English and Spanish, record the predominant language used.

Item 16 (a): Record whether cognitive tests parts B, C, or D were discontinued. If none was discontinued, the Neurocognitive Summary Form is complete. If any tests were discontinued,

note which tests (Item 16b) and the reason(s) (Item 16c) as either refusal, task difficulty, or physical impairment (e.g., visual loss, hearing loss, limb or motor problem). Task difficulty is appropriately marked in cases where the examiner feels compelled to discontinue a test, for example if a participant appears particularly frustrated by a test or does not appear to comprehend the instructions to a test, but where no obvious physical limitation can otherwise explain the participant's poor performance.

### **3 QUALITY CONTROL ISSUES AND PROCEDURES**

#### **3.1 Training and Certification**

Prior to the first HCHS/SOL examination, examiners will be trained centrally to a common level of proficiency in the administration and scoring of the neurocognitive measures. Following central training, examiners will obtain approval from the field center lead examiner or study coordinator and submit five audio-taped neurocognitive assessments along with copies of the associated paper protocols to the Neurocognitive Reading Center at the University of Mississippi Medical Center for review. Certification assessments should not be performed on HCHS participants. Examiner certification for the neurocognitive portion of the HCHS/SOL exam is achieved by the successful administration and scoring of the five certification assessments reviewed and approved by the Neurocognitive Reading Center.

The field center lead examiner or study coordinator is responsible for the basic training of all new field center examiners. Following basic training and approval by the field center study coordinator, new examiners will submit five audio-taped neurocognitive assessments for review and approval by the Neurocognitive Reading Center for certification.

Maintaining proficiency in the administration of the neurocognitive measures requires regular exposure to the protocol. In order to maintain certification, examiners will administer the neurocognitive measures at least twice per month.

Recertification will be performed annually and requires the successful administration and scoring of one audio-taped neurocognitive examination reviewed and approved by the Neurocognitive Reading Center. An actual participant assessment may be submitted for recertification purposes.

#### **3.2 Quality Assurance**

Several procedures are in place to monitor data quality.

With participant approval, all assessments are routinely audio-taped for quality control. During the first six months of the study, two audio-taped exams and associated paper protocols for each examiner will be reviewed by the Neurocognitive Reading Center to ensure appropriate pacing and technique, adherence to protocol, and accuracy of recorded responses and scoring. Notes about any inconsistencies and deviations from the established protocol will be sent to the field center lead examiner or study coordinator. After the initial 6 month period, one audio-taped exam and associated paper protocol for each examiner will be reviewed for accuracy and adherence to protocol by the Neurocognitive Reading Center.

General feedback pertaining to all examiners is provided on monthly conference calls involving field center study coordinators. These calls also provide an opportunity to discuss and problem-solve any exam issues that arise.

The Neurocognitive Reading Center will conduct an annual site visit to the field centers to observe examiner performance and ensure an optimal testing environment.

Test score means and standard deviations are regularly tracked and reported for each examiner by the Data Coordinating Center allowing detection of outliers and investigation of possible systematic differences by examiner.