

**DIGIT SYMBOL SUBSTITUTION TEST**

**TABLE OF CONTENTS**

**1. Background and rationale .....2**

**2. Equipment and supplies.....2**

**3. Safety issues and exclusions .....2**

**4. Participant and exam room preparation.....2**

**5. Detailed measurement procedures.....3**

**5.1 General issues/description .....3**

**5.2 Administration.....3**

**5.2.1 Preparation for test .....3**

**5.2.2 Instructions .....3**

**5.2.3 Scoring.....4**

**6. Procedures for performing the measurement at home .....5**

**7. Alert values/follow-up/reporting.....6**

**8. Quality assurance .....6**

**8.1 Training requirements .....6**

**8.2 Certification requirements .....6**

**8.3 Quality assurance checklist .....6**

**9. Reference.....7**

**10. Data collection form .....8**

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## DIGIT SYMBOL SUBSTITUTION TEST

### 1. Background and rationale

The Digit Symbol Substitution Test (DSST) may be a more sensitive measure of dementia than the MMSE. The DSST requires response speed, sustained attention, visual spatial skills and set shifting. It is part of the Wechsler Adult Intelligence Scale, one of the most widely used measures of intelligence. It has been associated with subsequent mortality, independent of comorbidity in the CHS cohort.<sup>1</sup>

The DSST requires that the participant fill in a series of symbols correctly coded within 90 seconds. In this test the higher the score the better the person's performance.

When administered as part of the cognitive vitality substudy, the DSST will be administered as the last test in the cognitive vitality substudy series of measurements.

### 2. Equipment and supplies

- No. 2 pencils with eraser
- Stop watch
- DSS task sheet
- Scoring template for DSST

### 3. Safety issues and exclusions

None

### 4. Participant and exam room preparation

The DSST should be administered in a quiet place with minimal distractions at a desk or table the participant can use to write on. Unless it is policy at the clinic for examiners to never knock or open a closed examination room door, we strongly encourage that a special sign be posted indicating that the DSST is being administered and to please not interrupt the test. If any temporary condition that may detract the participant from their optimal performance cannot be removed, the participant should be moved to another location; if this is not possible, reschedule the exam.

Ask the participant if they are comfortable. Reassure them that this is a routine test of concentration that will be done several times during the course of the study.

## 5. Detailed measurement procedures

### 5.1 General issues/description

This is a standard neuropsychologic test. The participant completes the task of recording the symbols that correspond to a series of digits. The task is timed. This is a pencil and paper task. The participant practices on a sample, copying the correct symbol given for each number. The participant then is timed on the actual task. The score is the number correct in 90 seconds.

- It is imperative to review the instructions very deliberately and to speak **slowly**, and for those participants who are hard of hearing; **speak low, not loudly**.
- Be certain that participants understand the instructions before proceeding with the test.
- Be certain that participants who wear glasses to read are wearing their glasses.
- Read the standardized script **exactly** as it is written.
- Do not offer encouraging words or in any way distract the participant, unless they actually stop and need to be encouraged to continue.

### 5.2 Administration

#### 5.2.1 Preparation for test

Determine if participant wears glasses for reading.

Script: “Do you usually wear glasses to read?”

If the answer is yes, ask the participant to put on their glasses.

Script: “Please put on your glasses.”

#### 5.2.2 Instructions

1) Place the task sheet before the participant and point to the task.

Script: “Look at these boxes across the top of the page. On the top of each box is a number from one through nine. On the bottom part of each box there is a symbol. Each symbol is paired with a number.”

Point to the four rows of boxes.

Script: “Down here are boxes with numbers on the top, but the bottom part is blank. What I want you to do is to put the correct symbol in each box like this.”

Fill in the first three sample boxes.

Script: “Now I want you to fill in all boxes up to this line.”

Point to the line separating the samples from the test proper.

2) Let the participant attempt the sample.

- If the participant has difficulty completing the ten sample items or does not understand the task, help them complete the sample items.

If the participant still has difficulty or does not understand the task, discontinue the task, and indicate on the form that the participant was unable to complete the sample.

- Give participants with physical limitations (e.g., arthritis or visual limitations) an opportunity to complete the sample.

If a visually or physically impaired participant cannot complete the sample:

- Check “unable to test” on the form.
- Do not record scores

3) After the demonstration and practice is complete, point to the first box following the sample items and say:

Script: “When I tell you to begin, start here and fill in the boxes in these four rows. Do them in order and don’t skip any. Please try to work as quickly as possible. Let’s begin.”

4) If the participant stops filling in the boxes before the 90 seconds have passed, give them standard encouragement.

Script: “Can you go further?”

5) If the participant begins to erase filled boxes, tell the participant not to waste time erasing.

6) Stop the participant after 90 seconds. (Note: do not tell them what the time limit is) Say:

Script: “That’s good. That completes this set of tasks.”

### 5.2.3 Scoring

1) Indicate whether or not the participant completed the sample.

- If they were not able to complete the sample (not due to a physical limitation, such as poor vision), check off “unable to complete sample,” and record “00” for “number completed” and “00” for “number incorrect.”
  - If they refused to complete the sample, check off “refused,” and do not attempt or score the test.
  - If they are unable to complete the sample due to a physical limitation such as poor vision, do not attempt or score the test.
- 2) If they completed the sample, check “sample completed,” and go on to the timed test.
  - 3) When it is known that a participant is dyslexic and will therefore draw some types of symbols backward, those symbols which are drawn exactly backward are scored as being correct.
  - 4) Single blank spaces between two completed items are not considered incorrectly coded symbols.
  - 5) Two or more blanks which occur consecutively signal the end of the task. Symbols coded after two or more blanks are not included in totals recorded.
  - 6) Enter the number completed.
  - 7) Enter the number of symbols incorrectly coded.
  - 8) One blank space does not count as completed or as incorrect.
  - 9) Additional Scoring Notes
    - An “A” is not acceptable for the carat “^” sign (symbol for number 7).
    - A “U” with a tail is acceptable for the “U” symbol (symbol for number 5).
    - A flat-bottomed “U” is also acceptable for the round-bottomed “U” (symbol for number 5).

## 6. Procedures for performing the measurement at home

No modifications required.

## 7. Alert values/follow-up/reporting

When testing is completed, thank the participant without offering specific feedback on their performance.

## 8. Quality assurance

### 8.1 Training requirements

The examiner requires no special qualifications or prior experience for performing this assessment. Training should include:

- Read and study manual
- Attend training session on techniques (or observe administration by experienced examiner)
- Practice on volunteers
- Discuss problems and questions with local expert or QC officer

### 8.2 Certification requirements

- Complete training requirements
- Conducts exam on two participants while being observed by QC officer
  - According to protocol, as demonstrated by completed QC checklist
- Correctly scores sample forms

### 8.3 Quality assurance checklist

- Exam performed in quiet, private area without interruptions
- Participant asked if they wear glasses to read

Explanation of test:

- instructions given clearly, concisely and slowly
- participant asked if they understand testing procedure

Test demonstration and practice:

- script read exactly as written (no omission, deletions or substitutions) - subtle changes allowed only if instructions need to be repeated.
- demonstrated in first 3 sample boxes
- participant completes 10 sample items - proper aid is given if participant has difficulty completing items.
- proper coding of answers for difficulty in completing or visual impairment

Test administration:


- script read exactly as written
- participant instructed to begin and asked to stop after 90 seconds
- scores are coded properly (# completed, # incorrect); symbols not counted after two blanks.

- Reviews form for completeness
- Correctly completes form

## 9. Reference

1. Fried LP, Kronmal RA, Newman AB, et al: Risk factors for 5-year mortality in older adults: the Cardiovascular Health Study. JAMA 1998 Feb 25;279(8): 585-592.

10. Data collection form



HABC Enrollment ID#	Acrostic										
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Year of Visit:  Year 9

**COGNITIVE VITALITY SUBSTUDY DIGIT SYMBOL SUBSTITUTION**

- 1 Place the task sheet before the participant and point to the task.  
*Script:* "Look at these boxes across the top of the page. On the top of each box is a number from one through nine. On the bottom part of each box there is a symbol. Each symbol is paired with a number."
- 2 Point to the four rows of boxes.  
*Script:* "Down here are boxes with numbers on the top, but the bottom part is blank. What I want you to do is to put the correct symbol in each box like this."
- 3 Fill in the first three sample boxes.  
*Script:* "Now I want you to fill in all boxes up to this line."
- 4 Point to the line separating the samples from the test proper.

5  Sample completed

Go on to timed test.

Unable to complete sample

Do NOT go on to timed test. Write in "00" below for Number Completed and "00" for Number Incorrect.

Refused

Do NOT go on to timed test. Do not score.

Unable to test (arthritis, poor vision, etc.)

*Script:* "When I tell you to begin, start here and fill in the boxes in these four rows. Do them in order and don't skip any. Please try to work as quickly as possible. Let's begin."

*Stop the participant after 90 seconds. Say:*

*Script:* "That's good. That completes this set of tasks."

**Score:** (Examiner Note: Use Card #22 to score test. DO NOT COUNT ANY SYMBOLS AFTER TWO BLANKS IN A ROW).

Number Completed:        Number Incorrect:





DIGIT	1	2	3	4	5	6	7	8	9
SYMBOL	—	L	7	L	U	0	Λ	X	=

SCORE

SAMPLES

2	1	3	7	2	4	8	1	5	4	2	1	3	2	1	4	2	3	5	2	3	1	4	6	3
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

1	5	4	2	7	6	3	5	7	2	8	5	4	6	3	7	2	8	1	9	5	8	4	7	3
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

6	2	5	1	9	2	8	3	7	4	6	5	9	4	8	3	7	2	6	1	5	4	6	3	7
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

9	2	8	1	7	9	4	6	8	5	9	7	1	8	5	2	9	4	8	6	3	7	9	8	6
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