

# INSTRUCTIONS FOR THE PACED AUDITORY SERIAL ADDITION TEST

## DESCRIPTION

The Paced Auditory Serial Addition Test (PASAT) is a measure of cognitive function that specifically assesses auditory information processing speed and flexibility, as well as calculation ability. It was initially developed by Gronwall in 1977 (1) to monitor the recovery of patients who had sustained mild head injuries. Stimulus presentation rates were adapted for use with MS patients by Rao and colleagues in 1989 (2), and the measure has been widely used in MS studies during the last decade. The PASAT is presented on audiocassette tape or compact disk to control the rate of stimulus presentation. Single digits are presented either every 3" (3" PASAT) or every 2" (2" PASAT) and the patient must add each new digit to the one immediately prior to it. The test result is the number of correct sums given (out of 60 possible). To minimize familiarity with stimulus items in clinical trials and other serial studies, two alternate forms have been developed; the order of these should be counterbalanced across testing sessions.

## MATERIALS NEEDED

An audiocassette tape or CD player, audiocassette tape or CD with PASAT stimuli, clipboard, PASAT Record Forms to administer the test. **Note:** audiocassette tapes stretch after 50-75 presentations and should be replaced with new tapes.

## DISCONTINUE RULES

1. If the patient cannot get at least two answers correct (consecutive or not) on any one of the three 3" practice sequences.
2. If the patient cannot get at least one answer correct on PASAT-3" test, do not administer the 2" test. This patient is considered unable to perform the test.

## ADMINISTRATION

Verify that you have the correct Record Form (Form A or B) *before* you start reading the instructions for the 3" Practice Trial to the patient.

### ***PASAT-3" Practice Trials***

For Part 1 (stimuli every 3") say, ***"On this tape you are going to hear a series of single digit numbers that will be presented at the rate of one every 3 seconds. Listen for the first two numbers, add them up, and tell me your answer. When you hear the next number, add it to the one you heard on the tape right before it. Continue to add the next number to each preceding one. Remember, you are not being asked to give me a running total, but rather the sum of the last two numbers that were spoken on the tape."***

Then give the following example: *“For example, if the first two numbers were ‘5’ and ‘7,’ you would say ‘12.’ If the next number were ‘3,’ you would say ‘10.’ Then if the next number were ‘2,’ you would say ‘5.’* If the patient is having difficulty understanding these instructions, write 5, 7, 3, and 2 on a sheet of paper and repeat the instructions, demonstrating how the task is done.

Then say, *“This is a challenging task. If you lose your place, just jump right back in - listen for two numbers in a row and add them up and keep going. There are some practice items at the beginning of the tape. Let’s try those first.”* Play the sample items, stopping the tape after the last practice item. Repeat the practice items, if necessary, until the subject understands the instructions (up to three times). You should always administer *at least one* practice trial before administering the actual test. If the patient begins to give you a running total, stop the practice immediately and explain the task again, emphasizing that he/she is not to give you a running total. Then start the practice items again from the beginning. If the patient begins adding each number to the number two previous to it, again stop the practice immediately, explain the correct way to do the task, and start the practice items from the beginning. If the patient merely makes a math error, do not stop the tape; continue with the practice items. After two consecutive ‘no responses,’ prompt him/her to resume by saying, *“Jump back in with the next two numbers you hear.”*

Administer the practice sequence a *maximum of three times*. Record answers in the space provided on the back of the PASAT Record Form.

### **PASAT-3”**

Once it is clear that the patient possesses sufficient understanding of the task, begin Part 1. Before starting Part 1, remind him/her: *“Remember, if you get lost, just jump back in because I can’t stop the test once it has begun.”* Discourage talking and oral calculations during the test; only the patient’s answers should be spoken out loud. The patient may need prompting to continue the test if she/he gets lost. After five consecutive ‘no responses’ redirect the patient quickly by saying, *“Jump back in,”* but do not stop the tape.

### **PASAT-2” Practice Trials**

Before Part 2 (stimuli every 2”) say, *“There is a second part to this test, identical to the first, except that the numbers will come a little faster, one every 2 seconds. Let’s try some practice items.”* Emphasize that the patient’s task is the same, but that it is important to try to get his/her answer out as quickly as possible so as to hear the next number spoken on the tape. Every visit, *at least one 2”* practice trial must be administered before administering the 2” test. Allow *up to three* practice trials.

### **PASAT-2”**

After the practice items, proceed directly with the 2” administration. If the patient completed the 3” PASAT, the 2” version is to be administered regardless of the patient’s performance on the 2” practice items.

### **Completing the PASAT Record Form**

Place a check next to all correct answers. Write in any incorrect responses in the space provided. Place a dash when no response was given. If the patient corrects him/herself after giving a response, count

the amended answer as the response. The *amended* response is the one that will be used in determining total correct, regardless of whether it was the correct or incorrect response. *Slash through the old response and write in 'SC' with a circle around it to indicate that the patient self-corrected.*

Each section of the PASAT has a maximum of 60 correct answers (i.e. 61 digits are presented for each part). Count the total number correct (number of circled answers) for PASAT-3” and record on the PASAT Record Form. Repeat the same scoring procedure for PASAT-2”. (Additional scores can also be computed to examine patterns of responses on the PASAT, but these are beyond the scope of this manual.)

Finally, record any circumstances that you believe may have affected the patient’s performance. These are factors that may have affected the trial, but were not severe enough to necessitate repetition of the trial. Examples include, but are not limited to, the following:

- Subtle noises outside of the testing room
- Patient reports frustration or mild distress
- Patient talked during test (other than to give answers)

If a trial must be repeated, indicate this and specify the reason why it had to be repeated. Examples of reasons to repeat a trial include, but are not limited to the following:

- Test interrupted (e.g. someone walked into the room or other major disturbance)
- Examiner error, such as starting the tape in the wrong place or using the wrong form.

Record only totals for the **successfully completed** PASAT-3” and PASAT-2”.

If the patient is unable to perform the PASAT (i.e., cannot get at least two correct on any 3” practice and at least one correct on the test portion), the examiner should indicate “Unable to complete due to cognitive limitations” and record any specific observations. If the patient did not complete a trial for any other reason, record the reasons for this as well (e.g., patient refused to complete test, examiner forgot to administer PASAT2”, etc.).

# FREQUENTLY ASKED QUESTIONS ABOUT THE PACED AUDITORY SERIAL ADDITION TEST

*Q. Can I operate the audiocassette tape or CD players on batteries when administering the PASAT?*

A. No. You should always run the tape/CD players on electric power to ensure that the rate of stimulus presentation is standardized.

*Q. What should I do if the patient does not respond at all on the PASAT practice?*

A. If the patient has not made a response to any of the first five stimulus items, stop the practice trial and explain the task again. Remind the patient to state his/her answers aloud. Do not count the five “no responses” as one of the three practice trials. (This situation is likely to occur only on the patient’s first visit, when the patient is not familiar with the task.)

*Q. If the patient has performed well on the PASAT in past visits, do I still have to administer the PASAT practice sequence?*

A. Yes. At least one practice trial for both the 3” and 2” PASAT must be administered at every study visit. Failure to administer the practice trial will invalidate the test administration.

*Q. What should I do if the patient refuses to do the PASAT practice sequence?*

A. The PASAT practice is an important part of the PASAT. The practice sequence is *not* optional and should not be presented as such. Explain to the patient that he or she must be given at least one 3” and 2” practice every study visit to maintain consistency. Emphasize the benefits that the practice trial will have on preparing him/her for the task.

*Q. Am I allowed to provide the patient with helpful strategies for the PASAT?*

A. No. You are allowed to give the patient only the standard instructions. Further explanations are allowed if the patient is having difficulty understanding the test, but these should be general instructions, not specific strategies to improve the patient’s score.

*Q. Is the patient allowed to perform the calculations out loud, for example, to say “3 + 9 is 12”, etc.?*

A. All calculations are to be done silently. Indicate to the patient that oral calculations could interfere with his or her performance. Discourage the patient from talking, except to provide his or her answer. Watch for this behavior during practice trials and correct it before proceeding to the actual test.

*Q. Is the patient allowed to “write” on the table with his or her finger during the PASAT?*

A. No. Observe the patient during the practice trials for this behavior. Instruct the patient that all calculations are to be done in his or her head and that “writing down” the numbers is not permitted.

*Q. Is the patient allowed to count on his or her fingers?*

A. No. Again, if this behavior is exhibited by the patient during the practice, explain that is not allowed and that all calculations must be done in the patient’s head.

*Q. I had already started the PASAT test and the patient asked to start over. Is this OK?*

A. No. As the instructions indicate, once the PASAT test has begun, you cannot stop it even if the patient requests to do so. The only reasons that you would stop the PASAT test would be because of a major external disturbance, equipment failure/malfunction, or something of this nature.

*Q. Is the patient allowed to rest in between the PASAT 3" and the PASAT 2"?*

A. No. You should proceed, directly from the end of the PASAT 3" test into the two second sequence (i.e., 2" instructions, 2" practice, then 2" test).

# NORMS FOR THE PACED AUDITORY SERIAL ADDITION TEST

Normative data have been reported on 101 healthy adults (3). No significant age differences were observed in test performance within the range of 25 to 65 years; however, there were significant educational differences. The following table provides means and standard deviations for the total number of correct responses (maximum = 60) by education level, as well as the 5<sup>th</sup> percentile cutoff. Scores less than the 5<sup>th</sup> percentile of the normal population are generally considered to be in the impaired range.

|                                    | PASAT 3" |      | PASAT 2" |      |
|------------------------------------|----------|------|----------|------|
|                                    | ≤ 12     | > 12 | ≤ 12     | >12  |
| Yrs. of Education:                 |          |      |          |      |
| Number of Subjects:                | 54       | 47   | 54       | 47   |
| Total Mean Correct:                | 46.7     | 50.4 | 35.1     | 39.4 |
| Standard Deviation:                | 9.1      | 9.7  | 9.6      | 10.2 |
| 5 <sup>th</sup> Percentile Cutoff: | < 32     | < 35 | < 20     | < 23 |

## REFERENCES

1. Gronwall, D. M. A. (1977). Paced auditory serial-addition task: A measure of recovery from concussion. Perceptual and Motor Skills, *44*, 367-373.
2. Rao, S. M., Leo, G. J., Haughton, V. M., St. Aubin-Faubert, P., & Bernardin, L. (1989). Correlation of magnetic resonance imaging with neuropsychological testing in multiple sclerosis. Neurology, *39*, 161-166.
3. Rao, S. M., Leo, G. J., Bernardin, L., & Unverzagt, F. (1991). Cognitive dysfunction in multiple sclerosis: I. Frequency, patterns, and prediction. Neurology, *41*, 685-691.

# PASAT - Form A

Name \_\_\_\_\_

Date \_\_\_\_\_

PRACTICE

|      |     |     |     |     |      |      |      |     |     |
|------|-----|-----|-----|-----|------|------|------|-----|-----|
| 9+1  | 3   | 5   | 2   | 6   | 4    | 9    | 7    | 1   | 4   |
| 10__ | 4__ | 8__ | 7__ | 8__ | 10__ | 13__ | 16__ | 8__ | 5__ |

RATE #1

(3")

|      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|
| 1+4  | 8    | 1    | 5    | 1    | 3    | 7    | 2    | 6    | 9    |
| 5__  | 12__ | 9__  | 6__  | 6__  | 4__  | 10__ | 9__  | 8__  | 15__ |
| 4    | 7    | 3    | 5    | 3    | 6    | 8    | 2    | 5    | 1    |
| 13__ | 11__ | 10__ | 8__  | 8__  | 9__  | 14__ | 10__ | 7__  | 6__  |
| 5    | 4    | 6    | 3    | 8    | 1    | 7    | 4    | 9    | 3    |
| 6__  | 9__  | 10__ | 9__  | 11__ | 9__  | 8__  | 11__ | 13__ | 12__ |
| 7    | 2    | 6    | 9    | 5    | 2    | 4    | 8    | 3    | 1    |
| 10__ | 9__  | 8__  | 15__ | 14__ | 7__  | 6__  | 12__ | 11__ | 4__  |
| 8    | 5    | 7    | 1    | 8    | 2    | 4    | 9    | 7    | 9    |
| 9__  | 13__ | 12__ | 8__  | 9__  | 10__ | 6__  | 13__ | 16__ | 16__ |
| 3    | 1    | 5    | 7    | 4    | 8    | 1    | 3    | 8    | 2    |
| 12__ | 4__  | 6__  | 12__ | 11__ | 12__ | 9__  | 4__  | 11__ | 10__ |

Total Correct (raw) = \_\_\_\_\_ Percent Correct = \_\_\_\_\_

PRACTICE

|      |      |     |      |      |     |      |     |     |      |
|------|------|-----|------|------|-----|------|-----|-----|------|
| 3+8  | 2    | 7   | 9    | 1    | 8   | 5    | 2   | 6   | 4    |
| 11__ | 10__ | 9__ | 16__ | 10__ | 9__ | 13__ | 7__ | 8__ | 10__ |

RATE #2

(2")

|      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|
| 4+3  | 7    | 2    | 5    | 1    | 8    | 6    | 9    | 1    | 7    |
| 7__  | 10__ | 9__  | 7__  | 6__  | 9__  | 14__ | 15__ | 10__ | 8__  |
| 9    | 4    | 6    | 3    | 5    | 8    | 1    | 6    | 2    | 7    |
| 16__ | 13__ | 10__ | 9__  | 8__  | 13__ | 9__  | 7__  | 8__  | 9__  |
| 5    | 9    | 4    | 5    | 2    | 6    | 4    | 8    | 3    | 5    |
| 12__ | 14__ | 13__ | 9__  | 7__  | 8__  | 10__ | 12__ | 11__ | 8__  |
| 9    | 7    | 4    | 2    | 8    | 5    | 2    | 1    | 6    | 4    |
| 14__ | 16__ | 11__ | 6__  | 10__ | 13__ | 7__  | 3__  | 7__  | 10__ |
| 7    | 3    | 5    | 9    | 6    | 4    | 5    | 3    | 9    | 4    |
| 11__ | 10__ | 8__  | 14__ | 15__ | 10__ | 9__  | 8__  | 12__ | 13__ |
| 1    | 8    | 3    | 1    | 6    | 8    | 5    | 4    | 2    | 6    |
| 5__  | 9__  | 11__ | 4__  | 7__  | 14__ | 13__ | 9__  | 6__  | 8__  |

Total Correct (raw) = \_\_\_\_\_ Percent Correct = \_\_\_\_\_

## PASAT - Form B

Name \_\_\_\_\_

Date \_\_\_\_\_

PRACTICE

|      |     |     |     |     |      |      |      |     |     |
|------|-----|-----|-----|-----|------|------|------|-----|-----|
| 9+1  | 3   | 5   | 2   | 6   | 4    | 9    | 7    | 1   | 4   |
| 10__ | 4__ | 8__ | 7__ | 8__ | 10__ | 13__ | 16__ | 8__ | 5__ |

RATE #1

(3")

|      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|
| 2+7  | 5    | 8    | 2    | 9    | 6    | 4    | 1    | 3    | 6    |
| 9__  | 12__ | 13__ | 10__ | 11__ | 15__ | 10__ | 5__  | 4__  | 9__  |
| 3    | 6    | 2    | 8    | 4    | 9    | 1    | 6    | 7    | 2    |
| 9__  | 9__  | 8__  | 10__ | 12__ | 13__ | 10__ | 7__  | 13__ | 9__  |
| 4    | 1    | 5    | 7    | 3    | 9    | 7    | 2    | 6    | 8    |
| 6__  | 5__  | 6__  | 12__ | 10__ | 12__ | 16__ | 9__  | 8__  | 14__ |
| 4    | 2    | 5    | 8    | 5    | 9    | 3    | 7    | 1    | 4    |
| 12__ | 6__  | 7__  | 13__ | 13__ | 14__ | 12__ | 10__ | 8__  | 5__  |
| 2    | 4    | 3    | 6    | 1    | 7    | 3    | 8    | 3    | 9    |
| 6__  | 6__  | 7__  | 9__  | 7__  | 8__  | 10__ | 11__ | 11__ | 12__ |
| 1    | 3    | 5    | 2    | 6    | 4    | 9    | 7    | 1    | 4    |
| 10__ | 4__  | 8__  | 7__  | 8__  | 10__ | 13__ | 16__ | 8__  | 5__  |

Total Correct (raw) = \_\_\_\_\_ Percent Correct = \_\_\_\_\_

PRACTICE

|      |      |     |      |      |     |      |     |     |      |
|------|------|-----|------|------|-----|------|-----|-----|------|
| 3+8  | 2    | 7   | 9    | 1    | 8   | 5    | 2   | 6   | 4    |
| 11__ | 10__ | 9__ | 16__ | 10__ | 9__ | 13__ | 7__ | 8__ | 10__ |

RATE #2

(2")

|      |      |     |      |      |      |      |      |      |      |
|------|------|-----|------|------|------|------|------|------|------|
| 7+8  | 6    | 3   | 7    | 5    | 9    | 1    | 2    | 6    | 8    |
| 15__ | 14__ | 9__ | 10__ | 12__ | 14__ | 10__ | 3__  | 8__  | 14__ |
| 3    | 6    | 2   | 5    | 9    | 7    | 1    | 8    | 3    | 6    |
| 11__ | 9__  | 8__ | 7__  | 14__ | 16__ | 8__  | 9__  | 11__ | 9__  |
| 7    | 4    | 2   | 5    | 3    | 8    | 6    | 2    | 3    | 7    |
| 13__ | 11__ | 6__ | 7__  | 8__  | 11__ | 14__ | 8__  | 5__  | 10__ |
| 3    | 5    | 2   | 8    | 5    | 3    | 7    | 4    | 1    | 5    |
| 10__ | 8__  | 7__ | 10__ | 13__ | 8__  | 10__ | 11__ | 5__  | 6__  |
| 2    | 4    | 1   | 6    | 3    | 9    | 7    | 1    | 8    | 4    |
| 7__  | 6__  | 5__ | 7__  | 9__  | 12__ | 16__ | 8__  | 9__  | 12__ |
| 6    | 2    | 5   | 8    | 1    | 9    | 7    | 2    | 8    | 3    |
| 10__ | 8__  | 7__ | 13__ | 9__  | 10__ | 16__ | 9__  | 10__ | 11__ |

Total Correct (raw) = \_\_\_\_\_ Percent Correct = \_\_\_\_\_