

Protocol and instructions for neurodevelopmental testing at 9 years of age

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1. Introduction

We will assess a variety of neurobehavioral outcomes that include several functional domains and clinical phenotypes sensitive to environmental exposures (see Figure 1). These outcomes will be assessed by internationally standardized tests and questionnaires. The cognitive functions assessed will be non-linguistic and culturally blind.

Some tests will be administered through laptops and no more than 1 hour duration will be required. Each nurse can assess a maximum of one child. Ensure that the room used is quiet and the tests are done with minimal interference. Headphones will be used and nurses will be trained to instruct children in a standardized way. The instructions should be followed to start the tests. There will be a record of the general conditions for the administration of the tests.

Additional behavioral questionnaires will be completed by the mothers without any interference from the nurses (except if the mothers require clarification). To increase the robustness of the outcome assessments, it is recommended children be 7 years or older (7 to 10 years).

We intend to assess four main functional domains (by computer tests*) and two clinical phenotypes (by parental questionnaires) as well as subtests from WISC-IV (coding and symbol search) and Semantic verbal fluency:

1) Attention:

- Attention Network Test (ANT) (computer test)
- Symbol Search Subtest from WISC-IV
- Code Subtest from WISC-IV

2) Executive Function (EF): Is an umbrella term for cognitive functions that regulate, control, and manage other cognitive processes, i.e., planning, working memory, attention, problem solving, inhibition, mental flexibility:

- Trail Making Test (computer test)
- N-back test (computer test)
- Symbol Search Subtest from WISC-IV
- Code Subtest from WISC-IV

3) Visual reasoning: As a proxy of perceptive-performance IQ:

- Raven test (computer) (optional)

4) Psychomotor:

- Finger Tapping Test (computer test)
- Trail Making Test (computer test)

5) Child ADHD symptoms:

- Conner's Questionnaire (completed by mothers at home, 5 minutes).

6) Child behavioral and emotional problems:

Child Behavior Checklist (CBCL, completed by mothers at home, 20 minutes). This is one of the most recognized and extended tools to fully assess child behavioral functioning. It includes several sub-scales such as: Aggressive Behavior, Anxious/Depressed, Attention Problems, Delinquent Rule-Breaking Behavior, Social Problems, Somatic Complaints, Thought Problems, Withdrawn, Externalizing, Internalizing, Total Problems, plus DSM-oriented scales.

7) Language and communication:

Semantic verbal fluency test

The sum of time duration for all computer tests will be approximately 50 minutes.

The parental questionnaires are adapted to be self-reported with just a short explanation from the Nurse. There is the option to be completed in the health center or given them in hand and mail returned. It is preferable that mothers complete them.

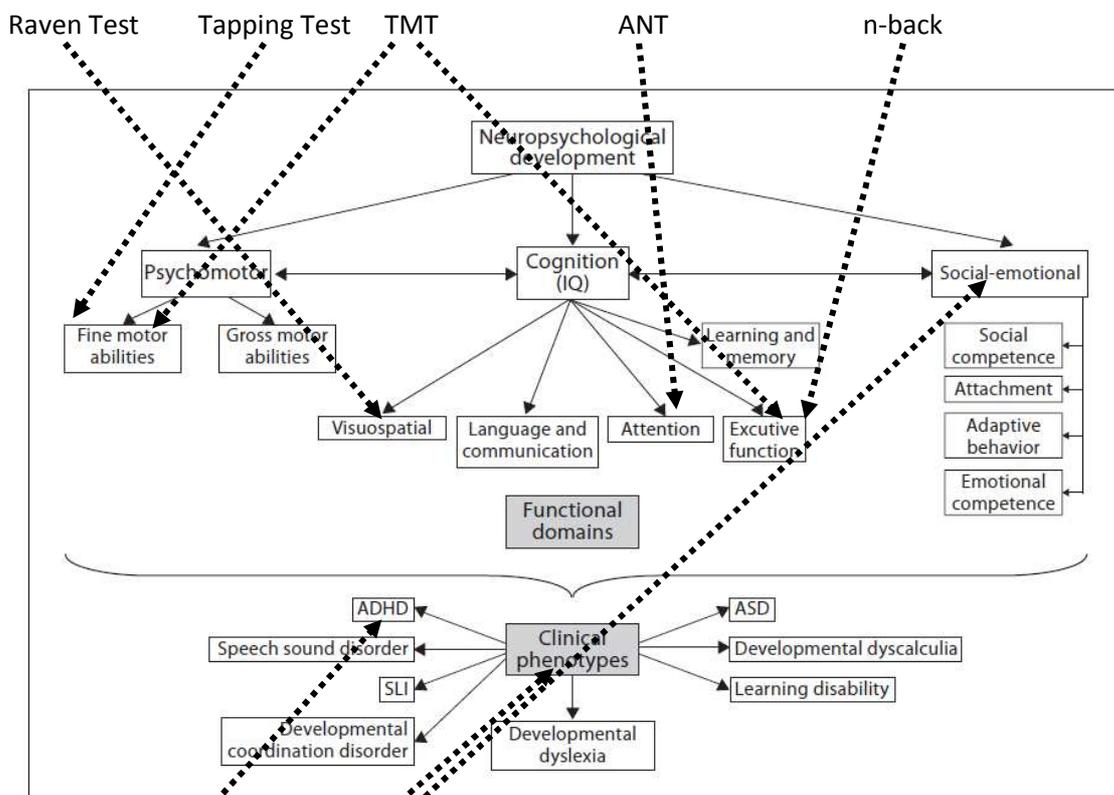


Fig. 1. Conceptual framework of the neuropsychological developmental process. SLI = Specific language impairment; ADHD = attention deficit hyperactivity disorder; ASD = autistic spectrum disorder.

Conner's CBCL
Figure 1: Neurodevelopmental domains to be assessed

A proxy of maternal IQ or cognitive functioning is an important cofactor to be assessed in any study where the neurodevelopment is the main outcome. Therefore a short version of n-back (no more than 6 minutes) adapted to adults, to be completed by the mother (or the father if mother unavailable) after the questionnaire.

2. General steps for computer tests

This set of instructions has the objective of providing uniformity of methodology between different test sites. It also aims to be a reference tool for the application of the tests. Please find some recommendations below:

- It is important to first switch the laptop on and make sure it is plugged in.
- The user is “breathe” and the password, “13breathe20”.
- Activate the game booster icon you will find on the desktop before starting.
- Make sure the sound works (headphones).
- Make sure the Internet connection is OFF.
- Make sure the joystick, mouse, headphones and dongle are plugged in before switching on the laptop.
- The test results should be exported to the corresponding results folder on the desktop at the end of each day for BENCI and Raven CPM. Data for BREATHE tests (first section) and parent test will be exported automatically.
- Please do not delete the results from the laptop at any time.

3. First section

General instructions for tests in the first section (n-back, ANT and Tapping Test):

- To enter this section, please click on the BREATHE icon. Make sure it is the one for children (Breathe kids)
- Enter the ID number
- Select sex
- Verify information and click on Yes to continue
- To run each test (or different levels): Shift+N
- To change the level: shift+s
- To change the test: shift+q
- Between training and tests you must press shift+y for Yes and shift+n for No
- To close the application: Ctrl+Esc

(If the keys do not work, please check that the Caps Lock is not on)

Exception (Tapping test):

Indicate the left or right hand with the arrows on the keyboard.

To run the test: Enter

For next screen: shift+n

Note 1: If the application doesn't work:

1. Click the right button of the mouse.
2. Select "Screen resolution".
3. Advanced settings.
4. Monitor.
5. Screen refresh rate: 60 Hertz.

Note 2: If the application shuts down or stops working appropriately:

1. Close the application: Ctrl+Esc
2. Make sure it is correctly close by clicking on the bottom bar with the right button of the mouse, then click on "Start Task Manager", select "E-Run.exe *32" in "Processes" section and "End Process".
3. Start the application with the same HELIX ID adding a "0" at the beginning of the ID and return to the level the child was doing using the combinations shift+n, shift+s.
4. In case the application shuts down again, do the same but adding an extra "0" each time. Ex: 0HELIX_ID; 00HELIX_ID; etc.

3.1. N-back Tests

This is a paradigm to assess working memory (WM) widely used in neuroimage research. The task consists on the retention of a stimulus previously presented (visually, in this case) according to the load or n . In other words, with a 1-back condition the subject has to remember the previous stimulus, in 2-back condition the subject is required to remember the penultimate stimulus presented and so on. In the current format adapted for the study, subjects are required to press one of the buttons (mouse buttons, see picture in the bottom) according to the load or n . The task has 2 different stimuli (colours and numbers) and 3 loads (1-, 2- and 3-back).

General conditions for application:

- The child will be located in front of the computer.
- The examiner will explain the instructions of the 1-back condition. It is not necessary to ask the child to do this game very fast. Please only give the child the standardized protocol instructions.
- The child will be required to put headphones on and to do the first training. The examiner will ensure the child understanding of the task.
- If he/she has not understood it, explain and do the training for second time. If the child asks during the training, you can answer his or her questions. (Remember that you should not talk to the child during the real test.)
- The examiner will explain the instructions of the 2-back condition.
- First training 2-back.
- If he/she has not understood it, explain and do the training for second time.
- The examiner will explain the instructions of the 3-back condition.
- First training 3-back.
- If he/she has not understood it, explain and do the training for second time.
- Repeat the instruction. Run 1-back (colours).
- Repeat the instruction. Run 2-back (colours).
- Repeat the instruction. Run 3-back (colours).
- Start with numbers. The examiner will explain to the child that the procedure will be the same as the previous stimulus (1-, 2- and 3-back).
- Repeat the instruction. Run 1-back (numbers).
- Repeat the instruction. Run 2-back (numbers).
- Repeat the instruction. Run 3-back (numbers).
- For this test it is important to only motivate the child when each level finishes, before starting the next one. However, you should not speak to the child during the test.

Instructions given to participants for n-back:

(The instructions will be done in the same manner and for the same person always following the same notes, avoiding variability in the methodology)

Hi, my name is xxx. We will be doing some fun games for a while. It is very important to be in silence all the time and to listen all the explanations for the game to go well. If

you don't understand something, you can ask before the game starts, but when are playing I won't be able to help you.

First of all, sit properly and check the headphones, are you comfortable?

Ok, we will play some computer games. The first one is THE EQUALS GAME, the second is THE FISH GAME and the third is THE FASTEST GAME. Now, I'm going to explain THE EQUALS GAME to you.

It is a concentration game. This means that the more concentrated you are the more score you will obtain.

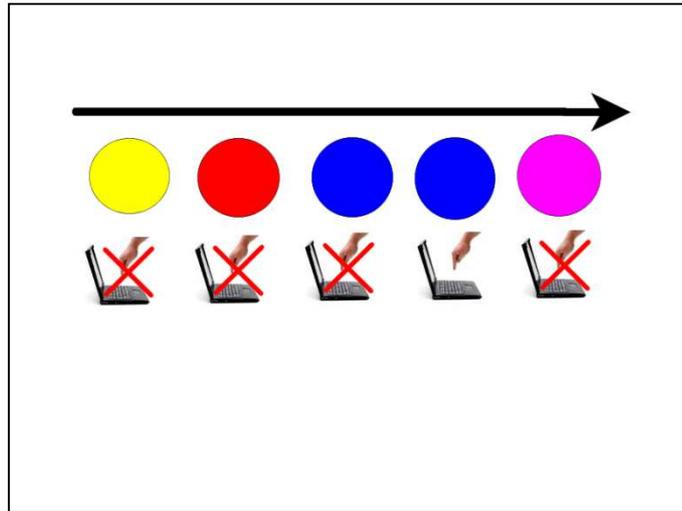


N-back (colours)

We will start playing with **coloured balls**. Coloured balls will appear on your screen one by one. What you will have to do is to press a button when the colour of the ball in the screen is **the same as the previous one**. What button? You have 2 buttons with two drawn arrows on the laptop. You have to press one of these two arrows when the ball in the screen is the same as the previous one (*example sequence and one by one: to ask colours and when he/she would press the button*). Have you understood it? Do you have any questions? You have to be very concentrated because if you press wrongly, you will lose points; if you do it correctly little faces will appear at the top of the screen.

Now you will play on your laptop. Let's start with some training. Before, put your headphones on and prepare your finger above the button. Are you ready?

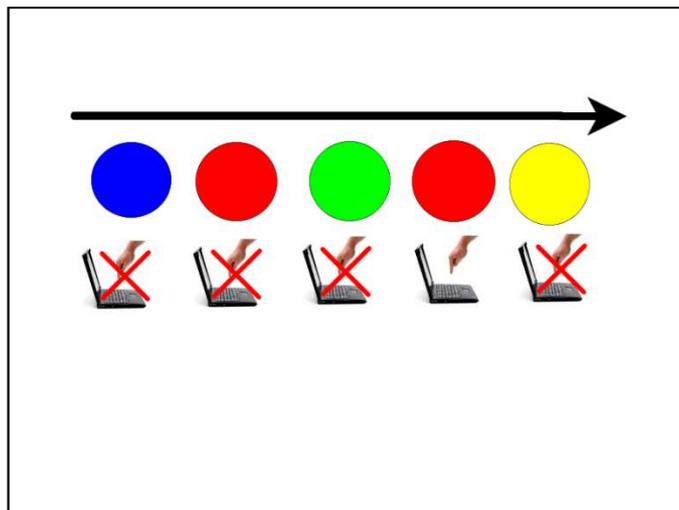
(Training 1-back)



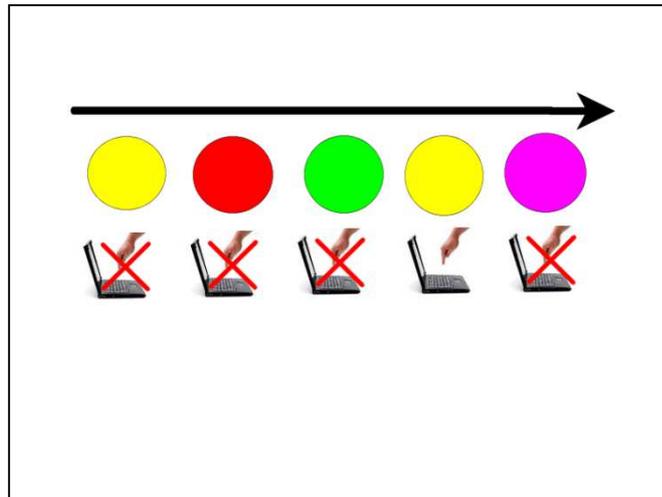
Very good! Now I'm going to explain the **2nd level**. The 2nd level is more difficult. You will have to change what you were doing; you will have to press the button when the ball on the screen is of the same colour as the second-last one ball. The two balls with the same colour will be separated from other. Let's do an example: (*sequence specifying **not one after the other**. Emphasize to remember the previous ones: "do you remember the colour of the previous one? And the first one?"*). Have you understood the rule?

Look out! When you press the button you have to keep concentrated because the game continues, even if you have already caught a ball. Let's see how do you do!

(Training 2-back)



Well done! Now you will have to **leave two balls in the middle** between the two identical ones (*example sequence, one by one, asking to remember the previous one, and the previous of the xx, and the previous of the xxx*). Are you ready? Remember that if you press when you don't have to you will lose points.



Ok, now if you are ready we can start the game. Remember, the first level: 2 balls with the same colour one after the other, press the button.

(Run 1-back colours)

Well done! Now the second level: 1 in the middle.

(Run 2-back colours)

And now the third level: 2 in the middle.

(Run 3-back colours)

N-back (numbers)

Well done! Now we will do the same but instead of colours we will play with numbers. The game will be the same, we will start with the easy level, if there are 2 equal numbers one after the other, press the button. Do you remember?

(Run 1-back numbers)

Well done! Now the second level: 1 in the middle.

(Run 2-back numbers)

And now the third level: 2 in the middle.

(Run 3-back numbers)

Outcomes:

Many outcomes could be obtained from this task. The most frequent are the measures “accuracy” and “detectability” or “d’”, calculated from the raw scores (hits, omissions, commissions and correct rejections). Hit Reaction Time measures are also available. It is important to bear in mind that all the outcomes are generated from each stimuli (colours and numbers) and each load (1-, 2- and 3-back).

3.2. ANT (Attentional Network Task)

This is the test that assesses the integrity of the 3 attentional networks described by Posner (alerting, orienting and conflict). The task consists on indicating whether the central fish from a row of 5 fish is pointing to the left or right by pressing the corresponding left or right arrow in the laptop mouse. Each trial began with a central fixation cross, then a cue appear (center, above, below or double), and finally the target, a horizontal row of five yellow fish, presented above or below fixation. Participants were instructed to maintain fixation on the cross in the center of the screen throughout the task and to respond as quickly and accurately as possible.

General conditions:

- The child will be located in front of the computer.
- The examiner will explain the instructions of the task. If the child asks during training you can answer their questions. (Remember not to speak to the child during the real test.)
- The child will be required to put headphones on and to do the training.
- The child should put a finger from the left hand on the left arrow and one from the right hand on the right arrow in order to do the test.
- The task is more fluent and the assessment must neither be altered by instructions nor encouragements.
- If a child asks for the number of test blocks that they still have left to do during the breaks between blocks, you can answer. (Remember that the breaks only last 5 seconds!)

Instructions for participants:

(The instructions will be done in the same manner and for the same person always following the same notes, avoiding variability in the methodology)

Good job! Now the second game will start. This is the fishing fish game. It’s very easy; you only have to fish all the fish you can. How do you fish them? With the arrows at the bottom of the laptop (Examiner should put arrows in the mouse buttons, see picture in the bottom). A row of 5 fish will appear on your screen and you have to focus on the fish in the middle and to indicate the direction of this fish with the arrows. (Example). Before the fish, you will see that a cue could appear and it could help you. It’s important to focus the eyes in the middle of the screen to press the arrow very fast and not to lose the fish. So, put the fingers on the buttons, keep your eyes on the centre of the screen and let’s go with the training!



(Run training)



Any question? The game has 4 blocks, between them green screens will appear for you to rest 5 seconds.

Let's go with the first block!

(Run ANT)

Outcomes:

There will be performance raw measures available (hits, errors), accuracy, Hit Reaction Time for the different conditions (congruent or not with the other fish, the cue conditions), and the 3 attentional networks calculation (alerting, orienting, conflicting).

3.3. Finger Tapping Test

It is a test designed for the motor speed measurement and for the lateralization index calculation. For this test, the joystick must be used by pressing B1.

General conditions:

- The child will be located in front of the computer.
- The examiner will explain the instructions of the task.
- The child will be asked for the writing hand to do the training and the other hand will be behind the back.
- When the training is done, the test with the dominant hand will be run 2 times, and other 2 with the non-dominant hand.
- For this test, it is important to motivate the child *during the test* by saying "faster, faster".



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Instructions:

Now, a very fast game, you have to repeatedly press the button as fast as you can for 15 seconds (example).

First, you will do it with your writing and drawing hand. So, which is your drawing hand? You have to use this hand and the other hand must be behind your back. Let's try when the computer says (training 5 seconds, 1st session dominant hand 15 seconds and 2nd session dominant hand 15 seconds).

Now you will do it with the other hand, with non-writing hand, what is your no-writing hand? Now, you have to do the same with this hand, the other hand, behind your back (1st session non-dominant hand 15 seconds and 2nd session non-dominant hand 15 seconds).

Outcomes:

Motor speed raw measures (2 for each hand) and a lateralization index.

4. Second section: Raven's Coloured Progressive Matrices (CPM)

This test is optional. It is a non-verbal assessment of general intelligence for people over 5 years of age. The proposed task is to apply logical reasoning to identify a pattern in the presented material that initially is not apparent. By pinpointing the relationship between the elements of the system, the respondent will be able to successfully solve the proposed problem. In this way, the CPM measures educative ability which is one of the two components of Spearman's general intelligence (g-factor).

It consists of 36 items that are presented in 3 sets of 12, with an increasing level of difficulty within each set. The coloured design supports the child's motivation to complete the test.

Setting up the test

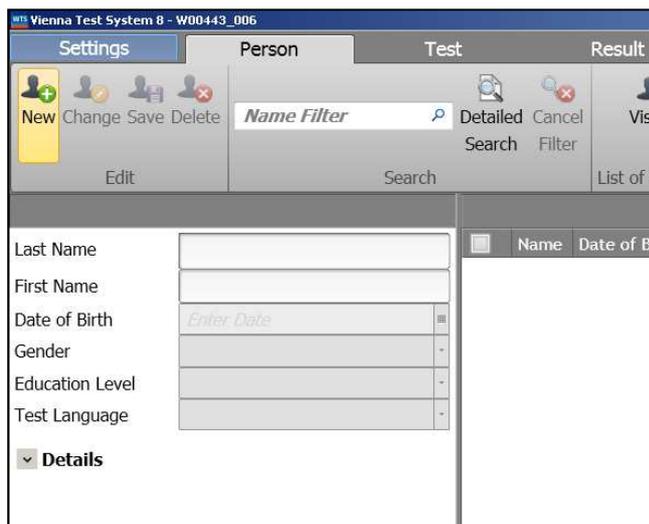
- First, make sure you have inserted the test dongle (blue usb pen-drive). Without the dongle, the test will not run, even if it has been installed on the laptop. (Please take care not to lose it!)
- Go to the Vienna Test System (VTS or WTS) icon on the desktop and click on it.
- A window will open asking for the following information:

User: admin

Password: admin1320

It is not necessary to fill in the box for Client. Please note that the user and password spaces are case-sensitive.

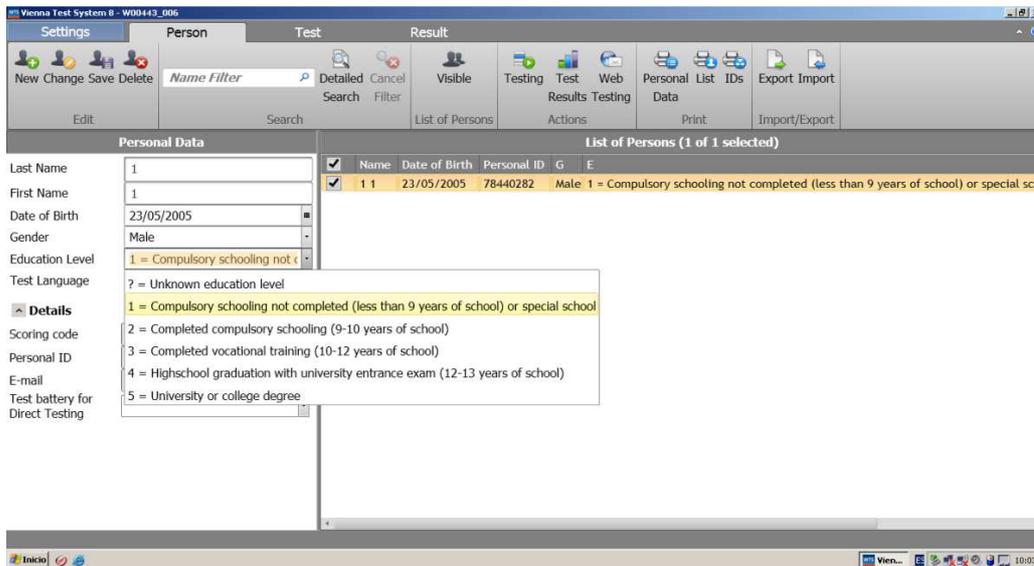
Note: if the application does not run, please make sure dongle is plugged in the back part of the laptop and re-start the laptop.



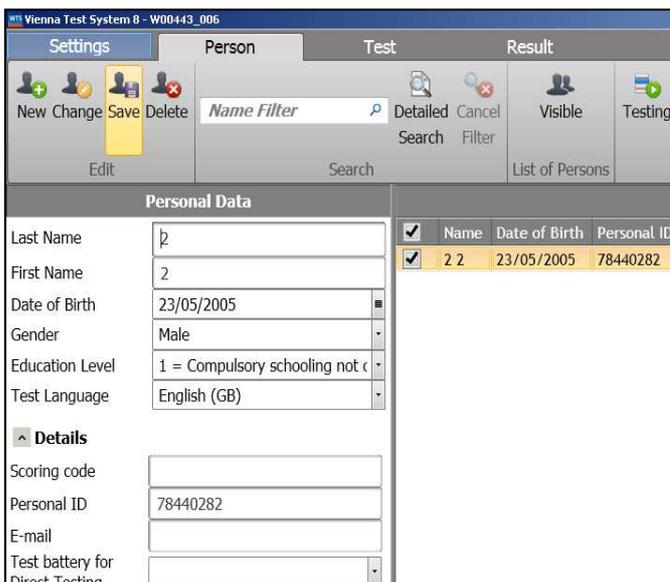
- Now you have entered the VTS. At the top left-hand corner of the screen, click on New.

- Next, fill in the information on the test subject in the spaces below.

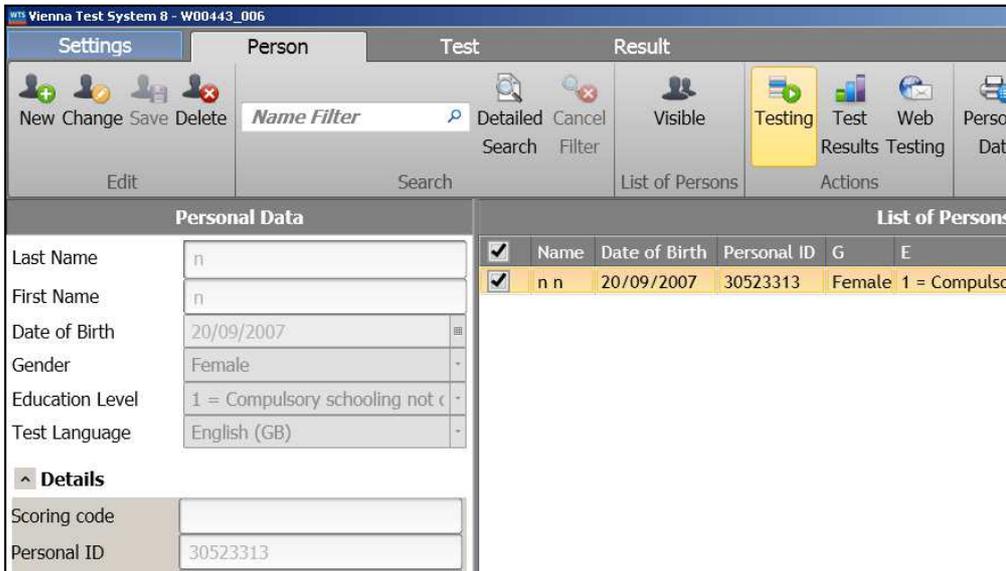
- For Names, please fill in only the ID number where it says last name. Then in the space for first name please always write the letter n.
- For the Date of Birth space, please fill in the correct month and year of the child's birth date but always write 01 for the day.
- Fill in the space for Gender.
- In the space for Educational level it should always be: 1=Compulsory schooling not completed).
- In the space for Test Language, the language parameter should always be set to English (GB).
- Leave the personal ID by default.



- Save the new data by clicking on Save at the top. You can also use the icons to change or delete the entry.



- Click on the participant to select him or her in the list of persons and click on Testing at the top.



Vienna Test System 8 - W00443_006

Settings Person Test Result

New Change Save Delete Name Filter Detailed Cancel Visible Testing Test Web Person Data

Edit Search List of Persons Actions

Personal Data

Last Name: n
 First Name: n
 Date of Birth: 20/09/2007
 Gender: Female
 Education Level: 1 = Compulsory schooling not c
 Test Language: English (GB)

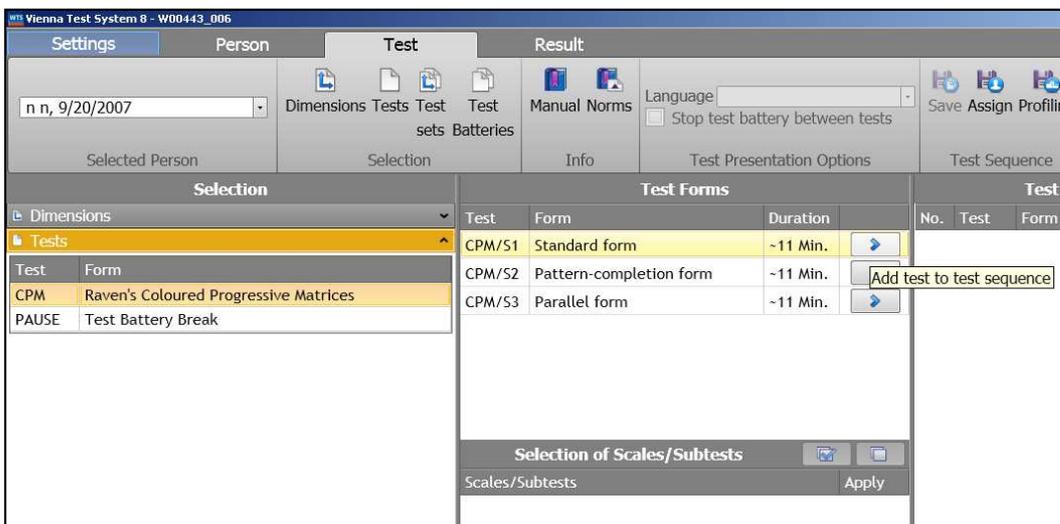
Details

Scoring code:
 Personal ID: 30523313

List of Persons

<input checked="" type="checkbox"/>	Name	Date of Birth	Personal ID	G	E
<input checked="" type="checkbox"/>	n n	20/09/2007	30523313	Female	1 = Compulsor

- Now, select the test: on the left, click on CPM and on the right, select the CPM/S1 standard form of the test. Select the blue arrow to add the test to the test sequence.



Vienna Test System 8 - W00443_006

Settings Person Test Result

n n, 9/20/2007 Dimensions Tests Test Test Manual Norms Language Save Assign Profilir

Selected Person Selection Info Test Presentation Options Test Sequence

Selection

Dimensions Tests Test sets Batteries

Test Forms

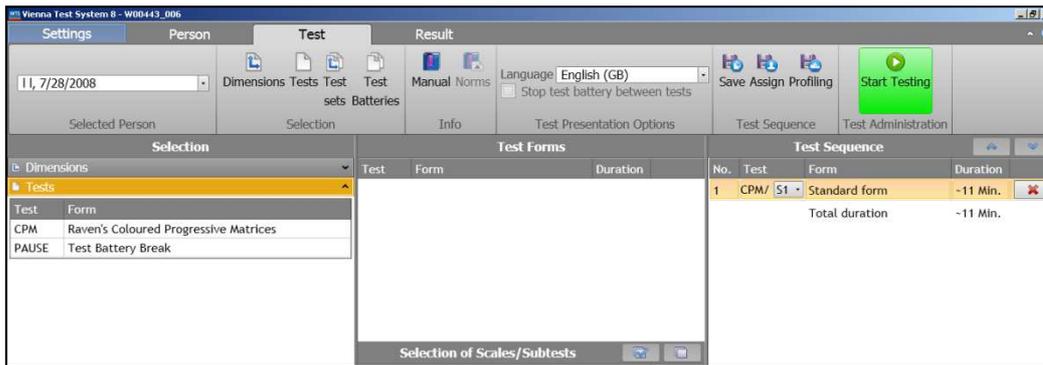
Test	Form	Duration	No.	Test	Form
CPM/S1	Standard form	~11 Min.			
CPM/S2	Pattern-completion form	~11 Min.			
CPM/S3	Parallel form	~11 Min.			

Add test to test sequence

Selection of Scales/Subtests

Scales/Subtests Apply

- Now select the CPM/S1 option under Test Sequence and click start testing at the top on the right.



In order to stop the test, you can press Esc and F5 simultaneously.

During the test, the child should click (using the mouse) on the piece that they think fits the best in the rest of the pattern. Then on Next or Back at the bottom of the screen.

At the end of the test, to start again, go to the “Person” tab at the top.

Conditions for Test Application

- The child should sit in front of the computer.
- The examiner will introduce the test and give the instructions for the CPM.
- The examiner will make sure that the child has understood the instructions.
- The child should start with the practice test (3 items), and the examiner will make sure that the child has understood what he or she has to do. If not, they will explain until the child has understood. During training you can answer questions and encourage the child.
- Once the child understands the instructions, they should be reminded that they are going to start to play on their own now and cannot ask for help with the answers. You should not talk to the child while they are doing the test.
- Allow the child to feel comfortable while answering the test and do not interrupt them until they are finished. They should wear the headphones while answering. It is important that the child answers correctly, not how fast they answer.
- Once they are finished, praise the child for their participation.

Instructions given to participants for CPM

(Instructions must always be given in the same manner and by the same person, following the same script, in order to avoid variability in methodology)



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“For us to be able to play the next game, it’s important that you be quiet and listen to everything that I’m going to explain. If you don’t understand something, you can ask me before the game starts, but I won’t be able to help you while you’re playing.

First, sit properly in your seat. You will see a small arrow on the computer screen and you can move it by using the mouse.

You are going to see some figures with designs on them that are missing a piece. Look at the design. Think what piece completes it correctly from left to right and also from up to down. Then choose the right piece from the choices you have at the bottom. You can do this by clicking on it. Once you have chosen an answer you can play the next game by clicking on “next”. If you want to change an answer you can do it and you can go back and forth between the pages on the screen by clicking on back and next.

We are going to practice first. Take your time, it’s not a race!”

Outcomes:

The number of total of correct items will be scored, as well as the expected values of all sets compared to the raw scores for the entire test and error distribution

Test correction and data extraction:

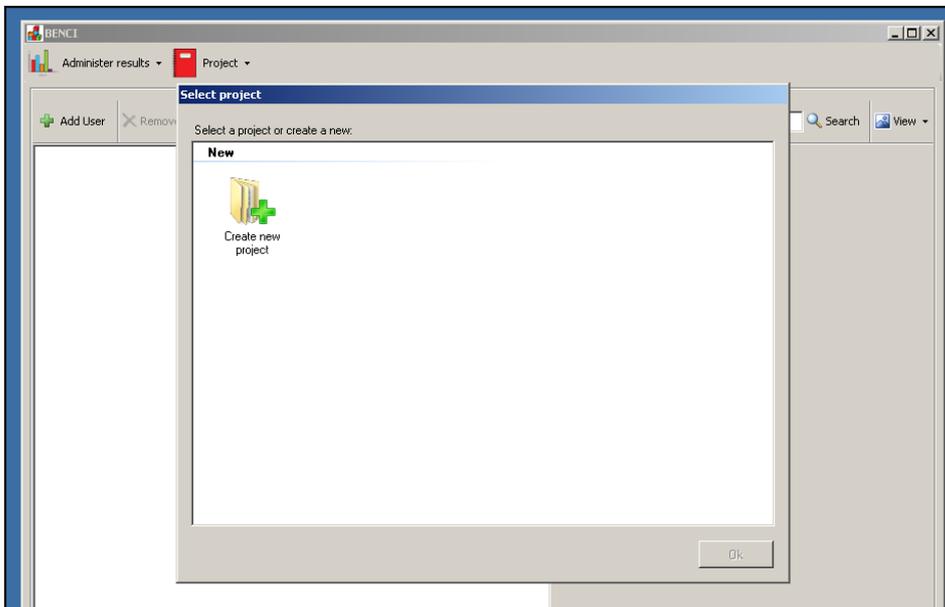
The software that the CPM runs on (Vienna Test System) permits the scoring of the test and the extraction of this information for use in a database. At the end of the day, go to Result at the top of the screen. Select always all the subjects from the list (even those assessed previously) and click on SPSS in the Export Menu. Select the RAVEN Test results folder on the desktop. Each time we export the previous file will be updated with the new subjects.

5. Third section: Trail-Making Test A and B (BENCI)

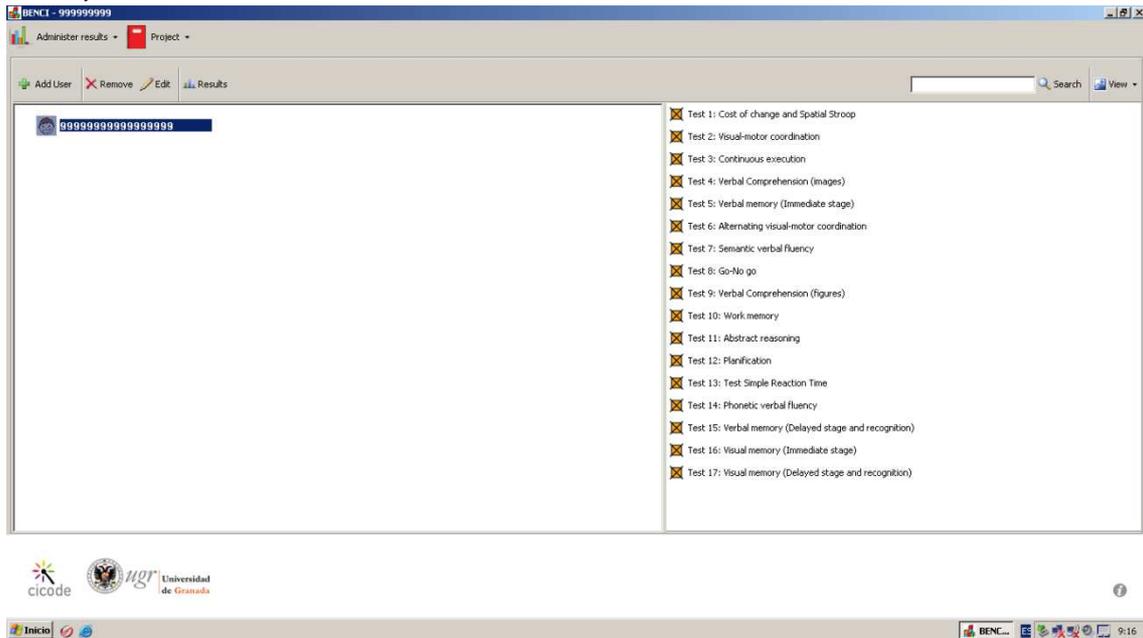
The Trail Making Test (TMT) is one of the most popular neuropsychological tests and is included in most test batteries. The TMT provides information on visual search, scanning, speed of processing, mental flexibility, and executive functions. The TMT consists of two parts. TMT-A requires an individual to draw lines sequentially connecting 25 framed numbers distributed on the screen. Task requirements are similar for TMT-B except the person must alternate framed and encircled numbers. The score on each part represents the amount of time required to complete the task and the number of errors. This test has been designed to be completed by children of ages 6 and over.

Instructions for running the test:

- Click on the BENCI icon on the desktop.
- Double click on Create new project.



- Write "INMA" in the space for name, in case it is not already done.
- Check in "Project Properties" that the number of elements for "Alternating visual-motor coordination" is 20.
- Add the ID number in the Name Field, then click on OK.
- Select user in the left column and double click on Test 2 (Visual-Motor Coordination TMT-A)



- You are now inside the test. Click on Train at the bottom left to start training.
- The child should select each number in order by clicking once on it, as fast as they can.
- Once the child has understood and finished the training, click on the Start button at the bottom right.
- The test goes up to the number 20.
- When the child has finished, another screen will appear for “Continuous Execution”. DO NOT go on with this test. Click on the Home icon on the top left.
- You will be directed back to the main menu. Here you should select the child again on the left and this time the examiner should click on Test 6: Alternating visual-motor coordination TMT-B.
- Again, do training first until the child has understood. This time, the child should click on the numbers in an ascending fashion while alternating the shape. Then start Test 6.
- Once the test has finished, click on home at the top of the screen.
- Test results should be exported at the end of each day, to the BENC I results folder on the desktop.

Conditions for Test Application

- The child should sit in front of the computer.
- The examiner will introduce the test and give the instructions for the TMT.
- The examiner will make sure that the child has understood the instructions.
- The child should start with training, and the examiner will make sure that the child has understood what he or she has to do. If not, they will explain until the child has understood. In this test, it is important for the child to do it as fast as they can without making mistakes.
- Once the child understands the instructions, they should be reminded that they are going to start to play on their own now and cannot ask for help.

- Make the child comfortable during the test and do not interrupt them until they are finished with encouragements or instructions if they ask anything. Headphones should be worn while doing the test.
- Once they are finished, praise the child for their participation.

Instructions given to participants for TMT

(Instructions must always be given in the same manner and by the same person, following the same script, in order to avoid variability in methodology)

“You are doing well. Now I’m going to explain the last kind of game we’re going to play. If you don’t understand something, you can ask me before the game starts, but I won’t be able to help you while you’re playing.

First, sit properly in your seat. You will see a small arrow on the computer screen and you can move it by using the mouse.

You are going to see some numbers that are not in order. I want you to click on the numbers in order starting with the number 1. You only have to click on each number once and you should try to do it as fast as you can without making any mistakes. First we are going to practice”

- Do the training example.

“Are you comfortable? Now we are going to play the game.”

- Start Test 2.

“Very good! Now we will do the next level. First some training. This time, for each number there is a black ball and a white square. You have to click on the numbers in order: first both ones, then both twos and so on, while also always clicking on the black balls and white squares in turns. For example: “Black ball 1, white square 1, black ball 2, white square 2, black ball 3, white square 3 and so on.”

- Do the training example.

“Are you ready? Now we are going to play the game.”

- Start Test 6.

Outcomes:

This test provides us with the total time to complete each test and with the number of errors made.

Test correction and data extraction:

At the end of each day, go to administer results at the top of the menu page, and click on Export (do not select any user of the project). Select the BENCI results folder on the desktop and write a file name (benci). Next time the results are exported, the same file can be updated with the new information.

6. Fourth section: Parent n-back

Instructions for running the test:

The instructions for running the test are the same as for the first section tests but the icon you have to click is “Breathe parents” and the code you have to introduce is the ID of the child if is the mother who perform the test. If the father also wants to do the test, add 90 in front of the ID (e.g. 90ID).

N-back:

This test is similar to the one used in children but has less test types included: only 2- and 3-back with numbers.

General conditions:

- The mother/father will be located in front of the computer.
- The examiner will explain the instructions of the 2-back condition.
- The subject will be required to put headphones on and to do the first training. The examiner will ensure the subject understanding of the task.
- If he/she has not understood it, explain and do the training for second time.
- The examiner will explain the instructions of the 3-back condition.
- First training 3-back.
- If he/she has not understood it, explain and do the training for second time.
- Repeat the instruction. Run 2-back (numbers).
- Repeat the instruction. Run 3-back (numbers).

Instructions:

(The instructions will be done in the same manner and for the same person always following the same notes, avoiding variability in the methodology)

“Hi, my name is xxx. We will be doing a test. It is very important to listen to all the explanations for the test to go well. If you don’t understand something, you can ask before the game starts, but when are playing I won’t be able to help you.

First of all, sit properly and check the headphones, are you comfortable?

Ok, you will do the “n-back test”. It is a concentration test. This means that the more concentrated you are the more score you will obtain.

Single numbers will appear on your screen one by one. You will have to press the button when the number on the screen is the same as the second-last one number. What button? You have 2 buttons with two drawn arrows on the laptop. You have to press one of these two arrows when the number in the screen is the same as the penultimate one (*example sequence and one by one*). Have you understood it? Do you have any questions?

Let’s start with some training. Before, put your headphones on and prepare your finger above the button. Are you ready?

(Training 2-back)

Well done! Now you will have to leave two numbers in the middle between the two identical ones (*example sequence, one by one*). Are you ready?

(Training 3-back)

Ok, now if you are ready we can start the test. Remember, the first level: 1 in the middle.

(Run 2-back numbers)

And now the second level: 2 in the middle.

(Run 3-back numbers)

Outcomes:

Many outcomes could be obtained from this task. The most frequent are the measures “accuracy” and “detectability” or “d’”, calculated from the raw scores (hits, omissions, commissions and correct rejections). Hit Reaction Time measures are also available.

It is important to bear in mind that all the outcomes are generated from each load (2- and 3-back).

7. Questionnaires

Both of these scales should be completed at home by the mother and then handed-in during the evaluation appointment.

Child Behavior Checklist (CBCL):

The CBCL is a recognized tool for the assessment of the behavior of children and includes several subscales which allow identification of possible problem areas. For the protocol, we will only be using the second part of the test, (that is starting on page 3 of the original test), with the instruction of classifying the frequency of different conducts in their child during the past 6 months (0=Not true, 1=somewhat or sometimes true, 2=Very true or often true). Since this page does not ask for identification, it is important to check that each questionnaire is properly identified when it is handed in. Please also check that all of the items have been completed by the mother and that none are blank or have more than one answer.

Instructions for mothers:

The CBCL already has standardized instructions at the start of the test. Nevertheless, it is important for mothers to be asked to read the instructions carefully, take their time answering and make sure that they have answered all the items.

Conner's Rating Scale Revised short form (parent version):

This scale consists of 27 items to be rated by the mother at home and provides information on child behavior, particularly in relation to inattention and hyperactivity.

Please make sure that all items have been answered by circling only one option when it is handed in. Also, make sure that the questionnaire is properly identified.

Instructions for mothers:

The CRS-R also has standardized instructions at the top of the page. Therefore, mothers should be asked to read the instructions carefully and answer according to their child's behavior during the last month, taking their time, and making sure that they have answered all the items.

8. Coding Subtest from WISC-IV

This is one of the core subtests included in the neuropsychological test WISC IV (Wechsler Intelligence Scale for Children, fourth edition). Together with the subtest symbol search, it evaluates the Processing Speed Index (PSI). It also yields measures of specific cognitive abilities such as visual perception, selective and sustained attention, very short-term memory, eye-hand coordination, associative learning and cognitive flexibility.

In this test the child has to copy symbols that are paired with simple geometric shapes or numbers. Using a key, the child draws each symbol in its corresponding shape or box within a specified time limit.

Material:

Administration and scoring instructions.

Response sheet.

Score sheet.

Scoring stencil.

Stopwatch.

2 pencils (no eraser).

General information:

- First of all, the examiner will have to select the correct version according to the child's age. This is, Code A for the ages 6 and 7, and Code B for children aged 8 and older.
- If during the sample items the examiner observes that a left handed child covers the key with his/her arm, the examiner can place, on the right hand side of the child, another response sheet with the key clearly visible and side by side with the other one. It is important that the key is at all times visible to the child.
- The examiner will make sure that the surface of the table is flat and free of irrelevant objects.
- No eraser is required since the child cannot, under any circumstances, erase his/her work. If during the task the child asks what to do when he/she makes a mistake, the examiner will instruct the child to not worry about the mistake and carry on with the task.
- The examiner will allow the child to do spontaneous corrections, unless this becomes a constant and repetitive disruptive behaviour. If this is the case, the examiner can persuade the child to not worry about the mistakes and to carry on with the task until been asked to stop. This instruction can be given during the test wherever necessary.
- If the child skips an item or starts a line from the end, the examiner will remind the child to not skip any items and to do them in order, as he/she points to the next item and instructs the child to continue from this point. This instruction will not be repeated again.
- It is very important to record time accurately. This task has a time limit of 120 seconds. The examiner will begin timing immediately after giving the instruction to START, and stop timing as soon as the child has completed the task or after the 120 seconds.

Instructions:

CODE A (age 6-7)

Sample items:

- Place the response sheet in front of the child.
- Point to the key on the upper part of the sheet, this consists of five geometric shapes with a different symbol drawn inside each one, and say to the child:
“Here there are some shapes with symbols inside. Each shape has its own symbol.”
- Then go through the sample items and say:
“All these are empty shapes that you will have to fill in.”
Point to the first shape, a circle, and say:
“This is a circle. The circle above here (point to the circle in the key) has two lines like this (use your finger to point out the horizontal direction of the lines). Therefore, I will draw two lines inside this circle, like this” (draw the lines).
- Point to the second shape of the sample items, a star, and say:
“This is a star. If we look inside the star above (point to the star at the key) there is a vertical line, therefore, I will draw the same line inside this star” (draw the vertical line).
- At this point you can give the child a pencil and say:
“Now you can try these exercises (point to the remaining sample items). Stop when you reach this line” (point to the black line separating the sample items from the rest of the test).
- Allow the child to work on his/her own. If the child completes the sample items correctly you can say:
“Well done, you have learned how to do it. However, if the child makes a mistake, correct him/her immediately, use this same item to explain the way the task has to be resolved and use instructions such as: look, this is a cross (while pointing to the key) and inside we find a small circle, therefore, you have to draw a circle inside this cross” (while pointing to the example).
- It is important that the child understands the task before starting the test.
- Once the child has finished and understood the sample items you can continue with the rest of the test.

Test items:

- Now say:
“When I say START, you have to complete these exercises on your own (point to the rest of the items). Start with this one (while pointing to the first item) and follow this order (while following with your finger the rows from left to right of the child, indicating the order) without missing any shapes. It is important that you work as quickly as you can without making any mistakes, all the way until I ask you to STOP. Are you ready? ... START!”

- At this point start the stopwatch and allow 120 seconds from now. Do not help the child in any way. Just remind him/her, if necessary, to follow the order of the items and to continue with the task.
- If after the 120 seconds the child is still working, ask the child to “STOP”.
- Write down the time used to complete the task in the appropriate box of the response sheet.

CODE B (age 8-16)

Sample ítems:

- Place the response sheet in front of the child.
- Point to the key on the upper part of the sheet, this consists of nine numbers with their corresponding symbols, and say to the child:
“Look at these boxes. Each one has a number at the top (point to the nine numbers) and a symbol at the bottom (point to the nine symbols). As you can see, each number has its own symbol.”
- Then point to the sample items and say:
“All these boxes have numbers but they are missing their symbols. You will have to draw the corresponding symbol for each number.”
- While pointing to the first example, number 2, and the code for number 2, say:
“This is number 2. Number 2 has this symbol, therefore, I will draw this same symbol in the box under number 2” (draw the symbol).
- Point to the second sample item, number 1, and the code for number 1, and say: “This is number 1. Number 1 has this symbol, therefore, I will draw this same one in the box under number 1” (draw it).
- Now you can give the child a pencil and say:
- “Now you can try these exercises on your own (point to the remaining sample items). Stop when you reach this line” (point to the black line separating the sample items from the rest of the test).
- Allow the child to work on his/her own. If the child completes the sample items correctly you can say:
“Well done, you have understood the task”. However, if the child makes a mistake correct him/her immediately, use this same item as an example of the task and use instructions such as: look, this is a 6, and number 6 has this symbol, therefore, I will draw it down here” (while pointing to the example).
- It is important that the child understands the task before starting the test.
- Once the child has finished and understood the sample items you can continue with the rest of the test.

Test items:

- Now say:
“When I say START, you have to complete these exercises on your own (point at the rest of the items). Start with this one (pointing to the first item) and follow this order (while pointing with the index finger two rows from left to right as if indicating the order to follow) without missing any shapes. It is important that you work as quickly

as you can and without making any mistakes, until I ask you to STOP. Are you ready? ... START!"

- At this point start the stopwatch and allow 120 seconds from now. Do not help the child in any way. Just remind him/her, if necessary, to follow the order of the items and to continue with the task.
- If after the 120 seconds the child is still working, ask the child to "STOP."
- Record the time used to complete the task in the appropriate box of the response sheet.

Directions for scoring

- Stop the stopwatch as soon as the child completes the task, and record the time used in the appropriate box of the score sheet. There are time-bonus credits for CODE A.
- If the child has not completed the task after the 120 seconds, record this time in the appropriate box of the score sheet.
- Use the scoring stencil to correct the test.
- Any answer that resembles the symbol and it is clearly different from the other symbols can be considered as correct. For example, if the two lines of the circle are not completely horizontal or they meet at some point, they can still be considered correct as long as they can be clearly differentiated from the two vertical lines in the square.
- Allow 1 point for each correct symbol drawn within the time.
- Allow 1 point if the child has spontaneously drawn a correct symbol next to or on an incorrect answer.
- The sample items are not to be taken into account.
- The items with no answer are not to be taken into account.
- If the child only completes one line or less of the whole exercise, the total score for the task will be 0.

CODE A

- Raw scores is the number of correct symbols drawn within the 120 seconds. Only in the circumstances when the child has achieved the maximum score of 59, the examiner will be able to use the time-bonus credits table to calculate the total score.
- Maximum score including time-bonus credits: 65

CODE B

- Raw scores is the number of correct symbols drawn within the 120 seconds. There are no time-bonus credits.
- Maximum score: 119

9. Symbol Search Subtest from WISC-IV

This is one of the core subtests included in the neuropsychological test WISC IV (Wechsler Intelligence Scale for Children, fourth edition). Together with the subtest Code, it evaluates the Processing Speed Index (PSI). It also yields measures of specific cognitive abilities such as visual perception, selective and sustained attention, very short-term memory, eye-hand coordination, associative learning and cognitive flexibility.

In this test the child scans a search group and indicates whether the target symbol(s) matches any of the symbols in the search group within a specified time limit.

Material:

Administration and scoring instructions.
Response sheet.
Score sheet.
Scoring stencil.
Stopwatch.
2 pencils (no eraser).

General information:

- First of all, the examiner will have to select the correct version according to the child's age. This is, Code A for the ages 6 and 7, and Code B for children aged 8 and older.
- The examiner will make sure that the surface of the table is flat and free of irrelevant objects.
- No eraser is required since the child cannot, under any circumstances, erase his/her work. If during the task the child asks what to do when he/she makes a mistake, the examiner will instruct the child to not worry about the mistake and carry on with the task.
- The examiner will allow the child to do spontaneous corrections, unless this becomes a constant and repetitive disruptive behaviour. If this is the case, the examiner can persuade the child to not worry about the mistakes and to carry on with the task until asked to stop. This instruction can be given during the test when necessary.
- If the child skips an item or starts a line from the end, the examiner will remind the child to not skip any items and to do them in order, as he/she points to the next item and instructs the child to continue from this point. This instruction will not be repeated again.
- The examiner can turn the page and ask the child to continue with the task, if the child gets to the end of a page and stops working.
- It is very important to record time accurately. This task has a time limit of 120 seconds. The examiner will begin timing immediately after giving the instruction to START, and stop timing as soon as the child has completed the task or after the 120 seconds.

Instructions:

SYMBOL SEARCH A (age 6-7)

Examples:

- Place the response sheets in front of the child with the first page on top.
- Point at the first example and say:
“Look at all these symbols. While pointing to the target symbol on the left, say **this symbol is the same as this one** (and point to the third symbol of the search group on the right, the same symbol) **therefore, I will tick the YES box, like this**” (tick the box with a diagonal line).
- Then point to the second example and say:
“Look at these other symbols. **This one** (pointing to the target symbol on the left) **is not within these symbols in here** (point the three symbols on the right). **Therefore, I will tick the NO box, like this**” (tick it).
- Now say:
“The task consists on **ticking the YES box if this symbol** (point to the target symbol) **also appears on this side** (point at the three symbols on the right hand side) **and ticking the NO box if none of them are equal to it. Have you understood?**”
- Now you can proceed with the practice items.

Sample items:

- At this point you can give the child a pencil, point to the sample items and say:
“Now you can try these exercises on your own.”
- Allow the child to work on his/her own. If the child completes the sample items correctly you can say:
“Well done, you have understood the task.” Proceed to the test exercises.
- If the child makes a mistake, correct him/her immediately as you explain which one is the correct answer and why.
- It is important that the child understands the task before continuing with the test.

Test items:

- Turn to the second page, the beginning of the exercise and say:
“When I say **START** you can begin with the exercises. You have to do them the same way as we have done the practice items. You have to start with **this one** (point to the first item) and do them all, one by one, in order and without skipping any of them. Work as quick as you can without making any mistakes. When you finish this first page go on to the second and then the third page (as you turn the page briefly to show the child the other pages). **Are you ready?**”
- Start the stopwatch as soon as you have said “**START.**”
- If the child gets to the end of the page and he/she stops working, turn the page and ask him/her to carry on working as fast as possible until you say “**STOP.**”
- If after the 120 seconds the child is still working say “**STOP.**”
- Record the time used to finish the task in the appropriate box of the score sheet.

SYMBOL SEARCH B (age 8-16)

Examples:

- Place the response sheets for Symbol Search B in front of the child with the first page on top.
- Point to the first example and say: **Look at all these symbols.** While pointing to the two target symbols on the left, say: **one of these symbols is the same as one of these** (and point to the five symbols of the search group on the right). **Look these two are equal. Therefore, I will tick the YES box, like this** (tick the box with a diagonal line).
- Then point to the second example and say: **Now look at these other symbols. None of them appear in this group. Therefore, I will tick the NO box, like this** (tick it). **Have you understood?**
- Now you can proceed to the practice items.

Sample items:

- At this point you can give the child a pencil, point to the sample items and say: **Now you can try these exercises on your own.**
- Allow the child to work on his/her own. If the child completes the sample items correctly you can say: **well done, you have understood the task.** Proceed with the test exercises.
- If the child makes a mistake, correct him/her immediately as you explain which one is the correct answer and why.
- It is important that the child understands the task before continuing with the test.

Test items:

- Turn to the second page, the beginning of the exercise, and say: **When I say START you can begin with the exercises. You have to do them in the same way as we have done the practice items. You have to start with this one** (point to the first item) **and do them all, one by one, in order and without skipping any of them. Work as quick as you can and without making any mistakes. When you finish this first page go on to the second and then the third page** (as you turn the page briefly to show the child the other pages). **Are you ready?**
- Start the stopwatch as soon as you have said START.
- If the child gets to the end of the page and he/she stops working, turn the page and ask him/her to carry on working as fast as possible until you say STOP.
- If after the 120 seconds the child is still working say **STOP.**
- Record the time used to finish the task in the appropriate box of the score sheet.

Directions for scoring

- Stop the stopwatch as soon as the child completes the task, and record the time used in the appropriate box of the score sheet.
- Use the scoring stencils to correct the test.
- Two ticked boxes, both YES and NO, is an incorrect answer, unless one of them has been clearly scribbled out.



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- The sample items are not to be taken into account for the scoring.
- The items with no answer are not to be taken into account.
- The raw score will be the number of correct answers minus the number of incorrect answers.

10. Semantic Verbal Fluency Test

The child is asked to list all of the animals he or she can think of in the next 60 seconds

Material:

Stop watch

Response sheet

Instructions:

“I would like you to tell me the names of as many animals as you can think of, as quickly as possible.”

Start the stop watch as you say “start”. Stop the stop watch after 60 seconds and say “stop”.

Record all responses in the score. Including the repeated ones or the wrong ones.

If the child says nothing for 15 seconds, say “A dog is an animal. Can you tell me more animals?”

If the child stops before 60 seconds, say “Any more animals?”

Directions for Scoring:

- Count all animals, including birds, fish, reptiles, insects, humans, extinct animals, etc.
- Points can be given for general category terms (e.g. dog) and for specific instances (e.g. terriers) when both are given.
- If more than one specific instances are given score up to a maximum of 2 points (e.g. terrier, bulldog, poodle...). The rest of the animals in the serie will be counted as repetition, not as a mistake.
- If the animal's name changes with its sex (e.g. cow/bull), age (cow/veal) or condition (bull/ox) each name given will receive a point.
- If only changes the termination of the word with sex or age (e.g. in Spanish: perro/perra or perro/perrito) only 1 point will be given for each of these pairs, the other name will be counted as a repetition, not as a mistake.
- If changes in the termination of the word imply a different animal, each animal will be counted (e.g. in Spanish: lagarto/lagartija).
- If the same animal is given in two different languages (e.g. gos/perro) only 1 point will be given for these kind of pairs.
- If an animal is given (e.g. whale) and the same name is used in order to form the name of another animal (e.g. whale shark), 1 point will be given for each animal.
- If two different names are given for the same animal (e.g. ass/donkey) only 1 point will be given for each pair, the other name will be counted as a repetition, not as a mistake.
- No extra point will be given for unusual animals (e.g. narwhal, cassowary, kiwi, okapi)
- Points cannot be given for TV or well-known animal figures such as Pluto, Bambi, Dumbo...
- Repetition errors should be counted. For example, if the child says dog three times, then two repetition errors should be counted.
- If the child says words which are not animals (e.g. sand, carpenter) or if the child invents new words (e.g. percíaso, toó) these words will count as errors.

Annex 1: Conner's Rating Scale Revised short form – Parent version

Instructions: Below are a number of common problems that children have. Please rate each item according to your child's behaviour **in the last month**. For each item, ask yourself, "How much of a problem has this been in the last month?", and circle the best answer for each one. If none, not at all seldom, or very infrequently, you would circle 0. If very much true, or it occurs very often or frequently, you would circle 3. You would circle 1 or 2 for ratings in between. Please respond to each item.

		NOT TRUE AT ALL (Never, Seldom)	JUST A LITTLE TRUE (Ocasionalmente)	PRETTY MUCH TRUE (Often, Quite a Bit)	VERY MUCH TRUE (Very Often, Very Frequent)
1	Inattentive, easily distracted	0	1	2	3
2	Angry and resentful	0	1	2	3
3	Difficulty doing or completing homework	0	1	2	3
4	Is always "on the go" or acts as if driven by a motor	0	1	2	3
5	Short attention span	0	1	2	3
6	Argues with adults	0	1	2	3
7	Fidgets with hands or feet or squirms in seat	0	1	2	3
8	Fails to complete assignments	0	1	2	3
9	Hard to control in malls or while grocery shopping	0	1	2	3
10	Messy or disorganized at home or school	0	1	2	3
11	Loses temper	0	1	2	3
12	Needs close supervision to get through assignments	0	1	2	3
13	Only attends if it is something he/she is very interested in	0	1	2	3
14	Runs about or climbs excessively in situations where it is inappropriate	0	1	2	3

15	Distractibility or attention span a problem	0	1	2	3
16	Irritable	0	1	2	3
17	Avoids, expresses reluctance about, or has difficulties engaging in tasks that require sustained mental effort (such as schoolwork or homework)	0	1	2	3
18	Restless in the "squirmy" sense	0	1	2	3
19	Gets distracted when given instructions to do something	0	1	2	3
20	Actively defies or refuses to comply with adults' requests	0	1	2	3
21	Has trouble concentrating in class	0	1	2	3
22	Has difficulty waiting in lines or awaiting turn in games or group situations	0	1	2	3
23	Leaves seat in classroom or in other situations in which remaining seated is expected	0	1	2	3
24	Deliberately does things that annoy other people	0	1	2	3
25	Does not follow through on instructions and fails to finish schoolwork, chores or duties in the workplace (not due to oppositional behavior or failure to understand instructions)	0	1	2	3
26	Has difficulty playing or engaging in leisure activities quietly	0	1	2	3
27	Easily frustrated in efforts	0	1	2	3

