Overview of the Cognitive Indices

|  |  |  |  |
| --- | --- | --- | --- |
| **Attention/information processing speed Index** | **Memory Index** | **Executive function Index** | **Total (overall) Cognitive index** is a composite of all three indices of Attention/information processing speed, Memory and Executive function. |
| The Attention component of this index includes tests of immediate verbal memory span and working memory. (I.e., immediate verbal recall and ability to manipulate and ‘deal with’ information in mind.)  The Speed of information processing component looks at the participant’s thinking speed, or ability to quickly process and respond to information. (Tasks used depend in part on either fine motor skill or verbal response ability.) | Overall memory index indicates general memory ability. This index includes ability to recall *both* verbal and non-verbal (visual) information over time (following a delay period).  Verbal and visuospatial memory are not differentiated with this index score. | The EF index incorporates skills of problem-solving, reasoning, concept formation, generativity, inhibition and mental flexibility (switching). |
| Tests:   * Digit Span: forwards & backwards * Symbol digit modalities test: written & oral | Tests:   * Hopkins verbal learning test-Revised (HVLT-R) * Brief visuospatial memory test- Revised (BVMT-R) | Tests:   * Neuropsychological assessment battery (NAB): EF module; including Mazes, Judgement, Categories & Word generation * Delis-K Executive Function System (D-KEFS) : Colour-word interference test |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Attention/Information processing speed** | | | | | | | | | |
| Task name | | Task description | | Test scores obtained | Cognitive skill measured | | | Comments | |
| Tests of attention  Digit Span   * Forwards * Backwards   Note: Normed against same aged peers. | | **Digit span forwards** (DSF) – after the examiner has said a string of digits, the participant must repeat back the digits in the same sequence. The task becomes increasingly difficult as the number of digits in the string become longer. (Starts with two digit sequence and ceilings at nine digits.)  **Digit span backwards** (DSB)- after the examiner has said a string of digits, the participant must repeat back the digit string in reverse order. The participant is given two practice trails of two digit strings, than the test begins starting with two digits and ceiling at 8 digits. | | DSF total: the number of correct responses per trial  **Longest digit forward span**: the number of digits the participant repeated back in their longest correctly recalled sequence.  DSB total: the number of correct responses per trial  **Longest digit backward span**: the highest number of digits the participant could correctly repeat back in reverse order. | Digit span forwards- measures the participant’s immediate verbal attention span.  Digit span backwards- measures working memory, that is, the ability of the person to mentally hold onto and manipulate information. | | | Often, individuals with a TBI have particular difficulty manipulating information in mind. On testing they tend to have poorer longest digit backward spans than longest digit forward scores. | |
| Tests of information processing speed  Symbol digit modalities test (SDMT)   * Written * Oral   Note: Normed against similar age and education backgrounds. | | **SDMT-Written**  The participant must fill in as many numbers in empty boxes according to a symbol-number key at the top of the page. There is a time limit of 90s.  **SDMT- Oral**  The participant must call out numbers that should go into the empty boxes, in accord with the symbol-number key, to the examiner who records the verbal answers. There is a time limit of 90s. | | **SDMT written total:** the number of correctly written responses.  **SDMT oral total:** the number of correctly reported responses. | SDMT written- measures ‘psychomotor speed’. These are tests that attempt to capture the speed of someone’s thinking; however, the task has a motor skill component to it.  SDMT oral- captures speed of thinking but minimises the motor requirements for the participant. | | | Individuals can perform more poorly on this task due to reasons other than slowed speed of thinking.  For example, test scores on the SDMT written task may be negatively biased in individuals with physical difficulties of the arm or hand.  Additionally, the test material is very busy and can be difficult for individuals with visual or perceptual disturbances to process. | |
| **Delayed Memory** | | | | | | | | | |
| Task name | Task description | | Test scores obtained | | | Cognitive skill measured | Comments | |
| Verbal memory  Hopkins Verbal Learning Test- Revised (HVLT-R)  Note: normed against same age peers. | The participant is asked to immediately recall a list of 12 target words (4 words from three distinct semantically related categories) over three trials.  After a 20-25 minute delay, the individual recalls as many target words as they can from the original list. (Delay free recall.)  Next, the individual identifies the target words from a longer list of words that has target words and distractor/foil items (unique words that may either be semantically related or unrelated to the target words). | | Total recall score: the summed number of correctly recalled items over the three learning trials.  **Delayed Recall**: the number of correctly remembered target items recalled by the participant.  Retention %: the percentage of words remembered at delay compared to initial learning. (I.e., delay recall score divided by best score on either learning trial 2 or 3 x 100)  Recognition discrimination index: # of true +ves minus the # of false +ves on the delayed recognition task | | | HVLT-R Delayed- measures the ability of the participant to remember new verbal information over time. | The delayed recall performance, for both HVLT- and BVMT-R, captures quite a lot, and clinically understanding the reasons for poor performance at delayed recall would be teased apart.  For instance, it seems quite obvious that if an individual is not able to initially learn new information very well, they will not be able to remember much of the (entire) original novel information over time. You can’t recall what you did not initially encode. Poor performance at delay recall is not necessarily due to loss of stored information from memory over a period of time.  The delayed score here may capture poor performance associated with loss of stored information from memory (which is what we usually think of as poor memory) but may also result from poor initial learning/encoding.  A discrepancy score between verbal and visual memory can also be calculated between the HVLT- and BVMT-R. | |
| Visual memory  Brief visuospatial memory test- Revised (BVMT-R)  Note: normed against same age peers. | The participant is shown a card with six designs on it of 10 seconds. Over three trials, the participant is required to draw the 6 designs as best they can from memory.  After 20-25 minutes, the participant attempts to draw the designs from the original display.  Next, the individual identifies 6 of the original designs from 6 foil items. | | Scores are based upon accuracy in drawing each design and also for positioning the designs in their correct location on the page in relation to the original display.  Immediate recall: Trial 1,2,3 and Total recall.  Learning: best of Trial 2 or 3 minus Trial 1.  **Delayed recall:** The score obtained from performance on the reproduction of the original design following a delay period.  (Other Recognition/ retention and bias scores- not reported here.) | | | BVMT-R Delayed- measures the ability of the participant to remember new visual information (object plus location) over time. I.e., visuospatial memory. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Executive functioning** | | | | |
| Task name | | Task description | Test scores obtained | Cognitive skill measured | Comments | |
| NAB- Executive function module   * Mazes * Judgement * Categories * Word generation   Note:  Individual tests are viewed as cognitive screens for ability within a cognitive domain. Difficulties on a task should therefore prompt further testing by the clinician to gain firmer understanding of which cognitive skill are deficient or weak in their client.  Normed against peers of similar sex, age and educational status. | | **Mazes**  The participant is required to complete pencil and paper mazes as quickly as they can. There are seven mazes, which increase in complexity as the participant continues on to the next design.  The most complex designs have a discontinuation point of four minutes.  **Judgement**  General ‘commonsense’ health and lifestyle (home safety, medical) problem scenarios are asked, which the participant has to answer as fully as possible.  **Categories**  Participants are shown photos of six individuals, with information about each person and various background patterns. The participant has use all information to organise the characters into two distinct groups. | Mazes latency: Measures how long the participant took to consider their approach to the design before they physically begin the task (i.e., put pen to paper).  **Mazes total:** Each item is provided points depending upon the speed of completion, whereby higher scores are awarded to faster completion. The Maze total score is the summary of points awarded for each item.  The number of errors occurring during the task can be noted.  **Judgement total**: Each item is given a score from zero to two. Responses demonstrating greater knowledge and appropriate responses to problems are awarded higher points. The Judgement total score is the sum of these ratings.  **Categories total**: Each response is given a score from zero to two.  A score of one may indicate that the participant has only provided one grouping, rather than the required two. | Mazes total: provides an indication of problem-solving ability.  Judgement total: is recognised as a measure of reasoning. It is designed to be a ‘daily living test’, where test performance assumes to reflect real world practice.  Categories total: measures concept formation (in this case, identifying conceptual/semantic similarities in information about fictional characters.) | The primary score to capture problem-solving skills is based upon speed of performance. Generally, this task captures the problem-solving difficulties experienced by people with TBI well. That is, slow completion times are reflective of concrete thinking styles (e.g., the participant who does not want to start the puzzle until they have the complete solution finalised in their mind), or those how have trouble shifting strategies when they face difficulties (they have difficulty with self-initiating alternate solutions when one approach has not worked for them; or they continue down a dead-end lane until they reach the end).  Conversely, someone who has a ‘come what may’ approach can complete the task quickly without much forethought or planning during the task. Their ‘good’ performance score on the task would not indicate their underlying cognitive challenge/s.  The Judgement task requires (socially acquired) knowledge as well as reasoning and problem-solving ability.  This task, like most of the NAB, cannot measure a pure cognitive construct as performance requires several cognitive skills.  Performance on the Categories task requires flexible thinking (generativity and mental switching), persistence, as well as ability to identify different conceptual relationships. | |

|  |  |  |  |
| --- | --- | --- | --- |
| **Executive functioning (continued)** | | | |
| Task name | Task description | Test scores obtained | Cognitive skill measured |
| NAB- EF module (cont’d)   * Word Generation | **Word generation**  The participant is presented with 8 letters. From these letters, they have to generate as many three-letter words as they can within two minutes. | Word generation total: the number of correct real-world three letter words. Cannot include abbreviated words.  Repeated words are scored as perseverative errors. | Word generation: measures the mental skill of generativity-the ability to mentally generate and retrieve varied responses to an event/problem. |
| D-KEFs   * Colour-word interference test   Note:  (Each trial includes practice)  There is no obvious pattern in the order to which the colours/words are presented on the page.  Participants have to try to respond as quickly as they can without making mistakes. The number of incorrect responses (self-corrected or un-corrected errors are recorded).  Normed against same age peers. | A. Colour naming  The participant has to name patches of colour as quickly as they can. The colours are presented as uniform squares, in the colours of red, blue and green, in a 10 item by 5 row grid.  B. Word reading  In the 10 by 5 grid the letters of the words ‘red’, ‘blue’ or ‘green’ are printed in black ink, which the participant has to read as quickly as they can.  C. Inhibition  The words red, blue or green are presented in the grid: however, the ink colour of the letters are incongruent with the written word. E.g., the letters of the word red is printed in green ink.  The participant has to name the colour of the ink the words are printed in as quickly as they can, ignoring the word itself.  D. Inhibition/Switching (Inhib/Switching).  The participant continues naming the ink colour of words, except when the word is inside a box. When the word is inside a box, the participant has to read the word, ignoring the incongruent ink colour of the printed letters. | Age scaled- scores for test completion time on each:   1. Colour naming 2. Word reading 3. Inhibition 4. Inhib/Switching   Composite scaled score for colour naming and word reading performance- Combined naming + Reading (N+R). This provides a general/ overall information processing speed score obtained from naming and reading performance.  Contrast measure scores:   1. **Inhibition vs colour naming** 2. Inhib/Switching vs combined (N+R) 3. Inhib/Switching vs Inhibition 4. **Inhib/Switching vs colour naming** 5. Inhib/Switching vs word reading   Error performance scores:   1. Colour naming total 2. Word reading total 3. Inhibition Total, corrected and uncorrected errors 4. Inhib/Switching Total, corrected and uncorrected errors | A. Colour naming: measures speed of information processing (also indicates colour perception ability).  B. Word reading: measures speed of information processing (relating to word reading).  C. Inhibition: measures an individual’s ability to inhibit automatic/rote learned behaviour.  D. Inhibition/switching: measures mental switching (ability to internally switch attention from one event to another) for a sustained period of time  Contrast measure scores:  **Inhibition vs colour naming:** provides a more ‘pure’ estimate of inhibitory control as it accounts for an individual’s speed of information processing  **Inhib/Switching vs colour naming**: provides a cleaner estimate of mental switching ability when speed of information processing is accounted for. |