**Task-based and reported measures of executive function variables**

|  |  |  |  |
| --- | --- | --- | --- |
| **Latent Variable** | **Measure** | **Executive function Domain** | **Description** |
| Working Memory | Task: CANTAB Spatial Working Memory | Spatial working memory | Spatial working memory was assessed with the SWM from the Cambridge Neuropsychological Test Automated Battery (CANTAB). The child is tasked with searching for blue tokens through 6 coloured boxes presented on a computer screen. Each box contains only one token per trial. Searching a box more than once resulted in within errors and returning to a box that had already been emptied resulted in between errors. These indicate difficulties in sustaining mental representations. The fewer the between and within errors, the stronger the spatial working memory. |
| Task: NEPSY Word List Interference | Verbal working memory | The child is aurally presented with 2 list of words in increasing lengths (2 to 5 words each). The child was first asked to repeat the two list in the same order (repetition trial). In the recall trial, the child was instructed to recall the first and second lists in the order of presentation. The total score out of 40 was converted into scaled scores (according to percentile ranks) and was used as an index of working memory. Higher the scaled score, the better the working memory. |
| Behaviour Rating Inventory of Executive Function-2nd Edition (BRIEF-P) | Working memory | General Working Memory was assessed from the working memory subscale in the BRIEF-P questionnaire. The working memory subscale assesses the capacity to retain mental representations of information to achieve goals. There are 8 questions that the parent rates on the frequency of the behaviour/action. These items are rated on a frequency scale of 1-3 (1=Never, 2=Sometimes, 3=Always) and summed. Converted T-scores were used, which accounted for the child’s age and sex. Lower working memory T-scores indicate better working memory performance in daily life. |
| Cognitive Control | Task: Dimensional Change Card Sort mixed trial | Cognitive flexibility | The paradigm is administered on a computer, using E-Prime version 2.0. Participants are asked to complete two paradigms. In the faces paradigm, four different targets cards were shown; a happy face and angry face in colours blue, green, orange and yellow. In the orientation paradigm, four target cards consisted of blue, green, orange and yellow emotionally neutral face in a right-side up or upside down position. The child was provided with a similar set of test cards and was instructed to sort the test cards according to 1) emotion/colour in the faces paradigm and by 2) orientation or colour in the orientation paradigm and place them on the matching target cards. With every trial, the experimenter repeated the instructions. The first set of rules were to sort the test card according to the colour. After several trials, the child was were given a new rule to sort the test cards (i.e., by emotion/orientation). The accuracy percentage following the new set of rules from both the faces and orientation paradigms were used as a measure of the child’s cognitive flexibility. The higher the accuracy, the higher the cognitive flexibility. |
| Task: Stop Reaction Time (RT) task | Inhibitory control | Time perception was assessed in the stop-RT task. The child was instructed by the experimenter to press the response pad as soon as a sequence of brief tones had ended 10ms in duration).There were six sequence lengths (comprising of 10 to 15 tones). Between each interval of tone sequences is the constant Stimulus Onset Asynchrony (SOA) and the child had to find the asynchronous sound to accomplish the objective. The child was given 10 practice trials before proceeding to testing. The child underwent three blocks of trials, with each trial a different duration of SOAs were used (250ms, 600ms and 1000ms). Each block contained 42 trials as the six sequence lengths were replicated 7 times for each length. The blocks were counterbalanced across participants to minimize order effects. Breaks were given between each block to reduce fatigue. An accuracy score for the 1000ms condition was used as a measure of time perception, with higher accuracy scores indicating better time perception derived from stronger inhibitory control. |
| Task: NEPSY Inhibition task | Inhibitory control and cognitive flexibility | Black and white shapes and arrows are presented to the child and they are first asked to name either the type of shape (e.g., circle or square) or the direction of the arrow (e.g., up or down). The inhibitory control condition is a Stroop task where the child has to give an opposite response according to the direction/shape presented (e.g., say up when presented with an arrow facing down). The switching condition is when an opposite response is given depending on the direction of the arrow or shape presented (e.g., only provide an opposite response when you see an arrow facing upwards). The inhibition contrast scaled score between inhibitory control (INI) and switching (INS) was used. (i.e., INI vs. INS contrast scaled score).This uses a scaled score metric to compare switching ability relative to inhibitory control. Providing an indication of switching ability while controlling for inhibitory control ability. A low score indicates poorer switching (i.e., cognitive flexibility). |
| Behaviour Rating Inventory of Executive Function-2nd Edition (BRIEF-P) | Inhibitory control | The Inhibit sub-scale measures the child’s ability to resist impulses. There is a total of 8 questions for this subscale. The parent rates the frequency of the behaviour/action on a scale of 1-3 (1=Never, 2=Sometimes, 3=Always). These were summed and then converted into T-scores, which accounted for the child’s age and sex. Lower T-score indicates better inhibitory control. |
| Emotional control | Task: Impossible Puzzle | Anger and frustration | In the Impossible Tangram/Puzzle task, children were given pictures displaying 3 sets of tangrams (made from different triangles and squares in various orientations). They were then tasked to replicate these tangrams using the wooden shapes provided. The child was only allowed to work on one tangram at a given time and were given 5 minutes to solve tangram 1 and 2. 15-minutes were given for tangram 3 due to its difficulty. A trained researcher rated the child’s frequency of anger and frustration behaviours on all three trials on a Likert scale of 1 to 5. A high score indicate greater emotional control deficits. |
| Behaviour Rating Inventory of Executive Function-preschool and 2nd edition (BRIEF-P) | Emotional control and emotion regulation | The Emotional Control subscale was taken from the pre-school version of BRIEF. This measures the child’s ability to modulate or control their emotional expressions. The emotion regulation index from the 2nd edition of BRIEF comprises of two subscales: shifting and emotional control. This measures the ability to regulate emotional responses and adjust to changes in the environment. There are a total of 8 questions for each of these subscales, that the parent rates on the frequency of the behaviour or action. These items are rated on a frequency scale of 1-3 (1=Never, 2=Sometimes, 3=Always) and summed. These were summed and then converted into T-scores, which accounted for the child’s age and sex. Lower T-scores indicate better emotional control and emotion regulation. |
| Motivational control | Task: Snack and sticker delay | Delay gratification | Delayed gratification was assessed with the sticker and snack delay task. In the snack task, stimuli were colourful chocolates or cereals. In the sticker task, stimuli were colourful stickers with emoticons demonstrating different emotions. The child was first given a snack or a sticker in order to prime interest in the game. After eating the chocolate or pasting the sticker on the template, they were instructed to place both hands flat on a mat while the experimenter placed one chocolate or sticker under a transparent plastic cup positioned 5cm away from the top of the mat. The child was instructed to wait for the experimenter to ring a bell before retrieving the chocolate or sticker. The sequence in which the snack and sticker stimuli were presented to the child was matched for colour between versions. The procedure and scoring of the Sticker Delay task, with the exception of stimulus used, were identical with the Snack Delay task. The measure of effortful control is the child’s ability to resist reaching out for the stimulus. This behaviour was scored per trial and scores ranged from 1 to 7 and up to 2 additional points could be given if the child had maintained both hands on the mat throughout the task. The final score ranges from 1 to 9 with 9 indicating the highest inhibitory control. An average score across all four trials was calculated per task version and was used in all analyses. |
| Task: Lab-TAB Transparent Box (Time spent) | Perseverance | In the Laboratory Temperament Assessment Battery (Lab-TAB) Transparent Box task, time spent is measured as the average amount of time (in seconds), the child engages with the task. A longer time spent engaging in the task, the greater the perseverance. |
| Task: Impossible puzzle | Perseverance | In the Impossible Tangram/Puzzle task, children were given pictures displaying 3 sets of tangrams (made from different triangles and squares in various orientations). They were then tasked to replicate these tangrams using wooden shapes provided. The child was only allowed to work on 1 tangram at a given time and was given 5 minutes to solve tangrams 1 and 2. 15-minutes was given for tangram 3 due to its difficulty. Whether the child continued working on the puzzle with the allocated time in the Tangram 3 (most difficult) condition or gave up was used as a measure of perseverance. This was coded as 1=continued, 2=gave up. A lower score indicates greater persistence and motivation. |