

Psych Ed

Assessment Services

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Measuring Executive Functions

Research in the area of executive functions has not yet resulted in a universally agreed upon definition. As shown below, executive functions generally refer to: ability to pay attention, be organized, keep track of tasks and timelines, start and finish tasks in a timely manner, inhibit impulsive responses, avoid overly strong displays of emotions, monitor task performance (notice/fix mistakes; ask for help as appropriate; keep track of time) and working memory (see description of working memory below).

1. Questionnaires

The “Comprehensive Executive Functions Inventory”, (**CEFI**), currently the most widely used questionnaire which aims at assessing executive functions, is based on the adolescent’s/adult’s, parent’s/observer and/or teacher’s answers. It consists of nine subscales, which measure:

1. ability to sustain attention
2. ability to control expression of emotions
3. flexibility*
4. ability to inhibit impulsive responses
5. ability to initiate tasks in a timely manner
6. organizational skills
7. planning skills
8. ability to monitor task performance
9. working memory**

*flexibility is measured by questions regarding ease of adapting to change.

**working memory is measured by asking about: likelihood of forgetting instructions, being able to remember several tasks, keeping goals in mind when making decisions, requiring repetition of instructions, difficulties recalling what was heard or read, forgetting where one put things.

Research has not yet resulted in a universally agreed upon definition of working memory. It is generally understood to refer to the ability to keep all relevant information in mind during task performance. More information is provided on the next page.

The **Conners-3** questionnaires (self-report, parent’s report and teacher’s report), currently the most widely used questionnaires aimed at assessing AD/HD symptoms, also include a subscale called “executive functions”. Items on that subscale ask about efficiency of initiating and completing tasks in a timely manner, likelihood of failing to complete tasks, forgetting to hand in completed work, irritability, weak organizational skills, losing things.

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2. Neuropsychological measures

In the last forty years a number of tasks have been developed which aim at assessing brain based specific functions, “neuropsychological” measures. The best known are variations of a numbers-letters connecting task (“Trails”); variations of a design copying task and variations of a sorting task, which requires deductions of sorting principles from information provided and flexibility in changing the sorting principles in the face of changes in information provided. (e.g. “Wisconsin Card Sorting Test” can first provide information which tells the examinee to sort by colour but then, without warning, starts labelling these choices wrong, The examinee has to deduce which new principle will now lead to correct sorting of the cards.)

A test of executive functions using these kinds of neuropsychological tasks which is becoming more widely used is the “Delis-Kaplan Executive Function System” (D-KEFS), published in 2001. A note of caution if your child’s assessment includes this test: a) the majority of people completing all or the great majority of subtests will obtain at least one very low score i.e. below the 16th percentile b) the lower the intelligence and education level the more likely is it that low scores will be seen c) children and adults whose intelligence is extremely low i.e. below the 5th percentile, are likely to obtain scores above the 5th percentile on D-KEFS measures d) ability to sustain necessary effort over multiple tasks affects test scores

Performance on all neuropsychological measures is correlated with intelligence i.e. the higher the intelligence the better the performance. This makes sense, since the brain based processes measured by the neuropsychological tasks are important components of intelligence.

3. Neuropsychological measures vs. questionnaire responses

Effectiveness in daily functioning is better predicted by standard intelligence tests and questionnaire responses than by neuropsychological test scores. (See Russell Barkley’s research.)

Research findings call into question the usefulness of neuropsychological measures in predicting functioning beyond what can be learned from measures of intelligence and education. They also cast doubt on the validity of these measures in distinguishing among different neurological disorders.

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4. Measures of Working Memory

The most widely used theoretical model of working memory was developed by Baddeley and Hitch, more than twenty five years ago. It proposes a “central executive function”, which is a supervisory system that control information coming from two hypothesized subsystems. They are the “phonological loop”, i.e. language based information, and the “visuo-spatial sketchpad”, i.e. visually presented information.

The most widely used measure of “phonological loop” based working memory i.e. of auditory working memory, consists of asking the examinee to repeat sequences of numbers of increasing length backwards.

A widely used measure of the “visuo-spatial sketchpad” requires drawing, from memory, designs made of a number of interlocking shapes.

In more recent years software programs have been developed to assess working memory.

They typically require sustained concentration on a set of items presented on the screen which require the examinee to make different responses depending on changes in the presented pattern. Ability to inhibit wrong responses e.g. after a sudden shift in pattern, speed in providing correct responses and ability to keep in mind increasing number of pieces of relevant information are measured. Speed is important because slow speed in processing of visual stimuli has been found to be a sensitive measure of functional impairments e.g. it is often related to AD/HD and learning disabilities.

5. Weaknesses in working memory are associated with AD/HD and learning disabilities: can working memory be improved?

The best known program which aims at developing working memory is a software called “Cogmed”. While daily practice improved performance, several studies have shown that this does not lead to better academic skills or lessening of AD/HD symptoms. This is not suprising, since working memory is a small component of the cognitive processes required for reading, writing and mathematics and for functioning in daily life.

If you want to improve reading, writing and mathematical skills, practice them. If you want to become better organized and less forgetful, you can learn strategies to address these challenges. These approaches will be more effective than trying to improve working memory using currently available programs.