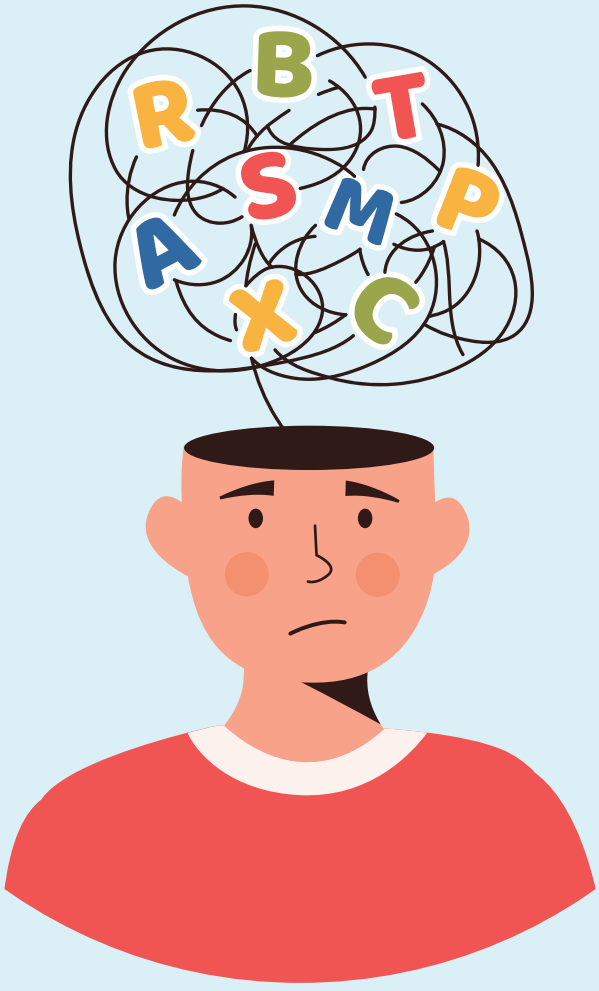
Riverside Insights

Assessment Plan

A Guide for Evaluating ADHD and Executive Functioning (Ages 7+)



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What is Executive Function?

"Executive function (also known as "executive functioning"; EF) is a term used to describe a set of higher-level cognitive functions important for implementing and sustaining goal-directed behavior and complex problem solving[1]." EF skills are essential for functioning across the cognitive, social, and emotional domains given the role they play in adapting to environmental changes and controlling lower-level cognitive functions[2].

There are three EF ability areas that are commonly discussed in literature: inhibition/inhibitory control, working memory, and cognitive flexibilit [3]. Additional EF skills can include sustained and selective attention[4].

The American Psychological Association (APA) expands this list of cognitive processes by defining EF as also including skills such as planning, decision making, problem-solving, action sequencing, task assignment and organization, effortful and persistent goal pursuit, and goal-conflict resolution. A further notes that EF skills typically require *"language, judgment, abstraction, and logic and reasoning[5]."*

[1] Decker, S. L., Davis, A. S., Eason, M., Bridges, R., Vasel, L. M. (2016). *Assessment of Executive Functions Using the Woodcock-Johnson IV Tests of Cognitive Abilities (Woodcock-Johnson IV Assessment Service Bulletin No. 9). Itasca, IL: Riverside Assessments, LLC.*

[2] Lezak, M. D., Howieson, D. B., Bigler, E. D., & Tranel, D. (2012). *Neuropsychological assessment (5th ed.).* New York, NY: Oxford University Press.

[3] Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. Cognitive Psychology, 41(1), 49–100.

[4] Diamond A. (2013). Executive functions. Annual review of psychology, 64, 135–168. https://doi.org/10.1146/annurev-psych-113011-143750

[5] American Psychological Association. (n.d.). Executive Functions. *In APA dictionary of psychology. Retrieved February 7, 2022, from* https://dictionary.apa.org/executive-functions

Executive Function and ADHD

Executive dysfunction, or delays in EF skills, can co-occur with commonly known conditions, such as Attention-Deficit/Hyperactivity Disorder (ADHD)[6]. Literature suggests that although the severity and presentation of EF complications can differ across individuals with ADHD, difficulties with EF appear to be a core element underlying th complex neuropsychology of the condition[7].

ADHD is “one of the most common mental disorders affecting childre [8].” The Diagnostic Statistical Manual, Fifth Edition (DSM-5) criteria outlines three ADHD presentations[9]: inattentive, hyperactive/impulsive, or combined (a mixture of inattentive and hyperactive/impulsive features). The DSM-5 further notes that ADHD is marked by several symptoms that must have an onset of 12 years or younger and must be present in two or more settings. Furthermore, based on the DSM-5, individuals with ADHD evidence characteristics that interfere with or reduce the quality core life functions, such as social functioning, school achievement, and/or professional work performance. Lastly, an individual’s ADHD characteristics must not be better attributed to another mental disorder.

For those engaging in adult ADHD assessment, the criteria above generally remain the same when compared to those for children. The core difference is the number of characteristics the DSM-5 indicates as being required. Specificall , clarification for children involves the identification of at least five attentive and/or hyperactive characteristics for those younger than 17. For those 17 and older, there must be at least six inattentive and/or hyperactive characteristics present). It is important to note that like childhood ADHD assessment, adult ADHD identification also requires that several of the ADHD characteristics began in childhood (prior to 12 years of age)[10].

[6] Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the executive function theory of attention-deficit/hyperactivity disorder: a meta-analytic review. *Biological psychiatry*, 57(11), 1336-1346.

[7] Antshel KM, Hier BO, Barkley RA. (2014). Executive functioning theory and ADHD. In: Goldstein S, Naglieri JA, editors. *Handbook of executive functioning*. New York, NY: Springer; 2017. pp. 107–120.

[8] What Is ADHD? (psychiatry.org)

[9] American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596.

[10] Lovett, J.B. & Harrison, A.G. (2021) Assessing adult ADHD: New research and perspectives. *Journal of Clinical and Experimental Neuropsychology*, 43:4, 333-339, DOI: 10.1080/13803395.2021.1950640

Riverside Insights offers comprehensive primary through post-secondary assessment solutions to ensure a thorough review of pertinent EF skills and ADHD-related features, allowing practitioners to gather crucial data for intervention services and educational planning. Note that the tools listed below do not alone diagnose ADHD but can be used to inform a comprehensive evaluation. **Diagnostic impressions should only be made by an individual who is qualified, has expertise in evidence-based ADHD assessment, and for whose role diagnosis is within the scope of practice.** Furthermore, results from formal tests should always be verified by other sources of data to ensure ecological validity.

Executive Functioning & ADHD 7+ Bundle[11]	
Comprehensive Measures	**Selective Measures**
WJ IV® COG	
TOMAL-2 (for those aged 7.0-60.11)	
CAS2 (for those aged 7.0-18.11)	**WJ IV® ACH *Select Tests***
CEFI (for those aged 7.0-18.11)	**WJ IV® OL *Select Tests***
Conners 3 (for those aged 7.0-18:11)	**Stroop Color and Word Test (for those aged 15.0-90.11)**

[11] The WJ IV COG and TOMAL-2 have specific tasks tapping core e ecutive functions, in addition to those assessing areas of functioning that may be of interest to an examiner engaging in selective assessment.

Comprehensive Measures

WOODCOCK-JOHNSON® IV TESTS OF COGNITIVE ABILITIES (WJ IV® COG)

The WJ IV COG is a comprehensive battery of cognitive abilities that allows for an assessment of EF skills across the lifespan (up to those 90+). The WJ IV COG tests are listed below based on information culled from the following sources: a qualitative evaluation of the WJ IV COG's EF demands[12], *Neurocognitive Applications of the Woodcock-Johnson IV*[13], and the WJ IV COG's Examiner's Manual.

Assessment of Executive Functions Using the WJ IV COG

The WJ IV COG assesses three of the commonly researched EF ability areas based on a qualitative evaluation of the WJ IV COG's EF demands[14]. These include *inhibition/inhibitory control, working memory, and cognitive flexibility.* Additional research regarding neurocognitive applications of the WJ IV indicates that the WJ IV COG also assesses *fluid reasoning,* an additional skill related to EF[15].

[12] Decker, S. L., Davis, A. S., Eason, M., Bridges, R., Vasel, L. M. (2016). *Assessment of Executive Functions Using the Woodcock-Johnson IV Tests of Cognitive Abilities* (Woodcock-Johnson IV Assessment Service Bulletin No. 9). Itasca, IL: Riverside Assessments, LLC.

[13] Miller, D.C., McGill, R.J., & Johnson, W.L.B. (2016). Neurocognitive Applications of the Woodcock-Johnson IV. In *WJ IV Clinical Use and Interpretation* (pp. 355-388). Academic Press.

[14] Decker, S. L., Davis, A. S., Eason, M., Bridges, R., Vasel, L. M. (2016). *Assessment of Executive Functions Using the Woodcock-Johnson IV Tests of Cognitive Abilities* (Woodcock-Johnson IV Assessment Service Bulletin No. 9). Itasca, IL: Riverside Assessments, LLC.

[15] Miller, D.C., McGill, R.J., & Johnson, W.L.B. (2016). Neurocognitive Applications of the Woodcock-Johnson IV. In *WJ IV Clinical Use and Interpretation* (pp. 355-388). Academic Press.

Inhibition involves the ability to monitor and manage automatic behavioral responses to select those that are situationally appropriate[16]. The following WJ IV COG tests have aspects demanding inhibitory control:

- **Verbal Attention** is a measure of short-term working memory that taps attentional control, which is a critical ability necessary for effi ent working memory. The examinee is asked to listen to a mixed series of animals and digits, and then answer a specific question regarding the presented sequenc . For example, "Tell me number between moose and horse." Some inhibitory control is needed for the examinee to sustain attention and wait to respond until they are provided with a prompt indicating what target stimuli they need to identify.
- **Letter-Pattern Matching** requires the examinee to work quickly and accurately when locating identical letter patterns amongst distractors. Poor inhibition on this test may result in the examinee selecting a distractor.
- **Number-Pattern Matching** also demands the examinee to work efficient , while searching for identical numbers amongst distractors. Poor inhibition on this test also may result in difficulty resisting distractors
- **Pair Cancellation** is a measure of cognitive processing speed, which also offers information regarding e ecutive processing (inhibition control and interference), attention, and concentration. The examinee is tasked with locating and marking a repeated pattern as quickly as possible under timed conditions.
- **Picture Recognition** assesses visual memory for objects or pictures, which is a narrow ability of visual processing. This task requires the examinee to identify previously viewed stimuli amongst a field of distractors.

[16] Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology,* 41(1), 49–100.

Short-Term Working Memory involves the ability to hold information in immediate awareness while manipulating or transforming the information in some fashion. Working memory lends itself to achievement across life domains and facilitates higher-order cognitive processes related to executive functioning and learning and memory. For example, in the service of understanding and following directions, working memory can support the retention of key steps and details needed to execute required actions. Furthermore, working memory supports an individual's ability to successfully engage in higher-order academic tasks, such as math problem-solving, reading comprehension, and written expression. The following WJ IV COG tests tap aspects of working memory:

- **Number Series** is a fluid reasoning measure that taps the narrow abilities of quantitative reasoning and inductive reasoning. The examinee is presented with a series of numbers with one number missing in the series. Working memory is needed to hold on to information related to each series to determine the missing number that completes the series.
- **Verbal Attention (described above)** requires the examinee to hold presented stimuli in immediate awareness while determining the correct response.
- **Story Recall** is a measure of long-term retrieval that taps meaningful memory. Examinees are asked to recall elements from increasingly complex stories that are presented auditorily. Elements of working memory are required as the examinee must maintain the information from the stories to recall the necessary elements.
- **Visualization** is a two-part measure tapping distinct aspects of visualization, a narrow ability of visual processing. Spatial Relations requires the examinee to identify two or three pieces that form a target shape. Block Rotation requires the examinee to review block patterns and determine which two choices match the target pattern. Examinees must employ visual working memory skills to hold the presented information in mind and engage in mental manipulation.
- **Concept Formation** is a controlled-learning task assessing fluid reasoning. It taps inductive reasoning, categorical reasoning, and mental flexibilit . The examinee is presented with complete stimulus sets and must determine the rule that governs each set. Working memory is tapped as examinees must hold information and goals in immediate awareness to determine the rule for each item.
- **Numbers Reversed** also assesses working memory, as the examinee is asked to hold a sequence of numbers in their immediate awareness, prior to manipulating the information by reversing the sequence.

- **Visual-Auditory Learning** is a controlled-learning task requiring that the examinee learn, store, and retrieve target associations. The examinee is required to learn and recall visual representations of words and is provided feedback on their responses. The associative learning aspect of this test demands the employment of working memory skills.
- **Object-Number Sequencing** is defined as a measure of working memory capacity. The test demands that the examinee hold digits and words in their immediate awareness, divide the information into two groups (one group for objects, one for numbers), and sequentially order the information in those groups.
- **Memory for Words** tests auditory working memory span, as the examinee is required to repeat a list of unrelated words in the correct order. This task has less working memory demands when compared to other tests as the examinee is not required to manipulate the stimuli.

Cognitive Flexibility is broadly defined as the ability to adapt or change behaviors in response to changes in situational demands (Deak, 2004)[17]. The following tests of the WJ IV COG tap, to some extent, shifting and changing of mental representations across items:

- **Number Series (described above)** demands cognitive flexibilit , as the examinee must adapt and change strategies to solve each sequence.
- **Phonological Processing** is a complex measure of auditory processing, which also tests speed of lexical access. It is a three-part task, with one component tapping cognitive flexibility:
  - *Word Access* requires the examinee to provide a word that has a specific phonemic element in a target location.
  - *Word Fluency* taps speed of lexical access, as the examinee is provided one minute to name as many words as they can that begin with a target sound. **This task component requires cognitive flexibility,** as the examinee must shift thinking to identify words that contain specific speech sounds.
  - *Substitution* tasks the examinee with substituting part of a word to create a new word.

[17] Deak, G. O. (2004). The development of cognitive flexibility and language abilities. *Advances in Child Development and Behavior,* 31, 271–327.

- **Concept Formation (described above)** is identified as requiring cognitive flexibilit , as the examinee must adapt to determine the appropriate rules across the administered items.
- **Analysis-Synthesis** is a controlled-learning task measuring fluid reasoning and deductive reasoning. The examinee is task to draw conclusions from a given set of conditions. The deductive demands of this task require cognitive flexibilit .
- **Object-Number Sequencing (described above)** demands some cognitive flexibility skills, as the examinee must simultaneously order the objects and numbers presented to them to determine the correct response.

Fluid Reasoning skills are also tapped by the WJ IV COG testing an examinee's ability to adapt to meet novel demands to accurately solve problems. EF is viewed as being synonymous with fluid reasonin [18].

Specific J IV COG tests tap fluid reasoning, in addition to aspects of *problem-solving and planning. P*roblem-solving is a complex skill involving several underlying EF skills (e.g., cognitive flexibilit [19]). In turn, planning elements require the examinee to determine and apply a strategy to execute, while also self-monitoring the success of the strategy. The following tests of the WJ IV COG tap aspects of these functions (and are described in detail above):

- **Concept Formation**
- **Analysis/Synthesis**
- **Number Series**

Allocation and maintenance of attention concerns the ability to utilize sustained and selective attention and tap one's attentional capacity. The ability to allocate and maintain one's attention facilitates higher-order cognitive processes key to EF. The following tests tap these aspects of executive functioning, and are described in detail above:

- **Pair Cancellation** taps selective/focused and sustained attention.
- **Memory for Words and Story Recall** both tap attentional capacity.

[18] Miller, D.C., McGill, R.J., & Johnson, W.L.B. (2016). Neurocognitive Applications of the Woodcock-Johnson IV. In *WJ IV Clinical Use and Interpretation (*pp. 355-388). Academic Press.

[19] Drigas, A., & Karyotaki, M. (2019). Executive Functioning and Problem Solving: A Bidirectional Relation. *International Journal of Engineering Pedagogy*, 9(3).

Associated Ability Areas of Interest in ADHD/EF Assessment Using the WJ IV COG

The WJ IV COG further allows examiners to assess associated ability areas of interest regarding ADHD and EF.

- **Cognitive Efficiency** is a clinical cluster that provides an estimate of overall functioning across the ability domains of *cognitive processing speed and short-term working memory.* Unlike working memory, processing speed is considered a separate construct that does not fall under the umbrella of EF. Nonetheless, it is important to assess when working with those suspected of ADHD/EF complications. Processing speed has been shown to influence the structure and development of EF[2021.] Both cognitive processing speed and short-term working memory lend themselves to higher-order cognitive functions. Limited or impaired cognitive efficiency can hinder performance when faced with more challengin demanding cognitive tasks. The functions tapped by this clinical cluster include:
  - Controlling/honing one's attention
  - The capacity to hold information in immediate awareness
  - The ability to mentally manipulate information to achieve a goal
  - And the ability to perform automatic tasks fluently (with accuracy and speed)

- ***Performance fluency***[22] relates to the speed, fluenc , and efficiency an examine demonstrates when processing rote or relatively simple information. The following tasks tap this area of functioning and are described above:
  - **Letter-Pattern Matching**
  - **Number-Pattern Matching**

[20] van der Ven, S. H., Kroesbergen, E. H., Boom, J., and Leseman, P. P. (2013). The structure of executive functions in children: a closer examination of inhibition, shifting, and updating. Br. J. Dev. Psychol. 31, 70–87. doi: 10.1111/j.2044-835X.2012.02079.x

[21] McAuley, T., and White, D. A. (2011). A latent variables examination of processing speed, response inhibition, and working memory during typical development. J. Exp. Child Psychol. 108, 453–468. doi: 10.1016/j.jecp.2010.08.009

[22] Miller, D.C., McGill, R.J., & Johnson, W.L.B. (2016). Neurocognitive Applications of the Woodcock-Johnson IV. In *WJ IV Clinical Use and Interpretation* (pp. 355-388). Academic Press.

Guidance for Further Assessment and Analysis using the WJ IV COG

Examiners interested in obtaining a sampling of their examinee's memory and learning capabilities are encouraged to administer additional tasks based on clinical judgment and selective testing methods (see *Selective Testing below)*. This sampling can further support an examiner's understanding of how EF skill weaknesses and ADHD characteristics may inform complications in other domains of functioning.

Once examiners have administered all tests of interest from the WJ IV COG, they can conduct procedures to determine the presence and significance of strengths and weaknesses in the cognitive abilities noted above. Specificall , *Intra-Cognitive Variations* can be conducted to identify specific cognitive strengths and weaknesses in an examinee's profil . These variations require administration of the core WJ IV COG tests (Tests 1-7). Examiners can review the profile of strengths and weaknesses to better determine if an examinee's performance aligns with the characteristics of ADHD and executive dysfunction. Examiners can also elect to conduct Comparison procedures between the WJ IV COG and other WJ IV batteries (achievement and/or oral language) to better determine how an examinee's cognitive profile relates to their other domains of functioning

WOODCOCK-JOHNSON INTERPRETATION AND INSTRUCTIONAL INTERVENTIONS PROGRAM (WIIIP™)

WIIIP is a research-based supplement that can serve as a starting point for analysis, discussion, and implementation of teaching strategy, generating personalized interventions and accommodations based on an individual's WJ IV COG results.

It includes checklists that can be synthesized into a *Comprehensive Report.* School-aged checklists include Reason for Referral, Parent's Checklist: School Age, Teacher's Checklist: School Age, and Classroom Behavior Observation Form. For older examinees, there is also a Self-Report Checklist: Adolescent/Adult. Evidenced-based interventions also can be integrated into comprehensive reports from an interventions bank that is included with the WIIIP. Suggested interventions are based on an examinee's performance across assessed domains.

The WIIIP is offered as an add-on subscription to Riverside Scor . Examiners interested in learning more about the WIIIP can view additional information in the *Overview of the WJ IV Interpretation and Instructional Interventions Program-Assessment Service Bulletin No. 5* and in our *WIIIP Overview PowerPoint.*

COGNITIVE ASSESSMENT SYSTEM – SECOND EDITION (CAS2)

The CAS2 is a comprehensive norm-referenced measure of cognitive ability designed for those up to 18 years of age. The CAS2 is aligned with PASS theory (Planning, Attention, Simultaneous Processing, and Successive Processing), an alternative view of intelligence[23], which is used to define the abilities evaluated by the instrument. The *PASS* theory offers a framework for conceptualizing the cognitive and neuropsychological functions that may be compromised in ADHD[24]. Furthermore, *PASS* theory has been applied in the literature to describe differences in cognitive functioning between those with ADHD and other conditions (e.g., reading difficulti [25]; anxiety[26]). The domains of PASS theory, each of which tap aspects of EF, and their constituent subtests, are described below.

Planning is used to determine, apply, self-monitor, self-correct, and control one's thoughts and actions, in the service of problem-solving and goal attainment. This CAS2 scale assesses the examinee's ability to generate a course of action, execute it, review that it has been implemented appropriately, and revise the plan as needed. It is comprised of the following timed subtests:

- **Planned Codes** presents the examinee with a legend that displays letters corresponding to specific codes (.g., A corresponds to OX). The examinee is shown rows of letters with empty boxes underneath. They are asked to write as many corresponding codes under each letter as they can.
- **Planned Connections** demands that the examinee connect a series of letters and numbers.
- **Planned Number Matching** presents the examinee with several rows of numbers. The examinee is tasked with identifying the matching numbers in each row as quickly as possible.

[23] Practitioners seeking to learn more regarding the CAS2 and PASS theory are encouraged to review the following resource: Naglieri, Jack A., and Tulio M. Otero. *Essentials of CAS2 Assessment.* Hoboken, New Jersey: Wiley, 2017. Print.

[24] Goldstein, S., & Naglieri, J. A. (2008). The school neuropsychology of ADHD: Theory, assessment, and intervention. *Psychology in the Schools,* 45(9), 859-874.

[25] Naglieri, J. A., Salter, C. J., & Edwards, G. H. (2004). Assessment of children with attention and reading difficulties using th PASS theory and Cognitive Assessment System. *Journal of Psychoeducational Assessment,* 22(2), 93-105.

[26]

Attention involves the ability to selectively focus on target stimuli in one's environment while inhibiting responses to extraneous input. Assessment of attention via the CAS2 involves the following subtests:

- For those aged 8.0 to 18.11, **Expressive Attention** presents examinees with rows of words across three pages. Page one requires the examinee to read color words printed in black ink. The second page demands the examinee to name the colors of rectangles. The final page presen s the examinee with color words (printed in color) and requires them to name the color of the ink rather than reading the text.
- **Number Detection** taps the examinees' ability to identify target numbers amongst a field of extraneous digits.
- **Receptive Attention** requires the examinee to underline pairs of letters that are identical in appearance or similar in name (lexically alike).

Simultaneous Processing assesses how well an examinee can perceive parts of a whole, synthesize parts into integrated units, and understand relationships between stimuli. This form of processing is central to the organization of nonverbal and verbal information into groups or a coherent whole. Adequate performance in this domain, in part, requires intact decision-making, problem-solving and organizational skills[27]. This scale can be derived by administering the following subtests:

- **Matrices** incorporates interrelated shapes and geometric placements. The examinee is asked to analyze the relationships between the stimuli and is provided with a series of response options. They must select the best option that completes the item based on the established relationship.
- **Verbal Spatial Relations** requires the examinee to select a visual stimulus out of an array that best matches a verbal description.
- **Figure Memory** tasks the examinee with viewing two-to-three dimensional figures for a brief period and then identifying the same figures when the embedded in a more complex geometric pattern.

[27] Naglieri, J. A., & Otero, T. M. (2017). *Essentials of CAS2 assessment.* John Wiley & Sons.

Successive Processing taps the ability to integrate information in a specific orde . Tasks in this domain tap working memory, an EF skill area. Successive Processing tasks require the examinee to recall or understand information that is arranged in a specific serial orde , in addition to more complex cognitive functions (e.g., manipulation of verbally presented information). This scale includes:

- **Word Series** that requires examinees to hold a string of high-frequency words in immediate awareness, prior to repeating the words verbatim.
- **Visual Digit Span** tests the examinee's ability to recall a series of visually presented numbers in the order that they were presented.
- **Sentence Repetition** (for those aged 7 and younger) requires the examinee to repeat a series of sentences spoken by the examiner.

  Sentence Questions (for those at least 8 years of age) requires the examinee to listen to low-context and syntactically correct questions and provide an answer (e.g., "The green and orange yellowed the blue; who yellowed the blue?"). This task goes beyond simply restating what is held in immediate awareness, as the examinee must reason using the presented information to determine the correct response.

Examiners also can derive additional scales pertinent to the assessment of EF and ADHD: *Executive Function* and *Working Memory.* Descriptions of the scales and their constituent subtests are listed below.

- The **Executive Function** (with Working Memory) scale taps similar functions to the Executive Function scale, in addition to an examinee's ability to keep information in memory during problem solving.
  - **Planned Connections**
  - **Expressive Attention**
  - **Verbal Spatial Relations**
  - **Sentence Questions** (for those at least 8 years old)
  - **Sentence Repetition** (for those 7 years of age)

- The **Executive Function** scale provides an estimate of an examinee's ability to use planning and task organization skills to achieve goals. This scale also provides a measure of the examinee's ability to hone their attention to pertinent information while ignoring extraneous input.
  - **Planned Connections**
  - **Expressive Attention**

- The **Working Memory** scale offers an estimate of an examine ’s ability to hold information in immediate awareness, recall the information, and manipulate it over brief durations of time.
  - **Verbal Spatial Relations**
  - **Sentence Questions** (for those at least 8 years old)
  - **Sentence Repetition** (for those 7 years of age)

Upon full administration of the PASS scales, examiners can derive a CAS2 *Full Scale* score, which serves as an overall estimate of an examinee’s cognitive functioning. Data derived from the CAS2 can be used to identify specific learning strengths and weaknesses, neurocognitive deficiencies, in addition to interventions and supports that best align with a student’s functional profil .

TEST OF MEMORY AND LEARNING SECOND EDITION (TOMAL-2)

The TOMAL-2 is a comprehensive 14-subtest memory battery appropriate for examinees up to 60 years of age. It is designed to provide a robust and targeted assessment of verbal and nonverbal memory. In the context of ADHD and EF assessment, examiners can derive an **Attention/Concentration Index** using the following tasks:

- **Digits Forward** demands the examinee to recall strings of digits as presented.
  - **Digits Backward** requires the examinee to recall strings of digits reverse order.
- **Letters Forward** is described as the language complement to digits forward, requiring the examinee to recall strings of letters as presented.
  - **Letters Backward** is described as the language complement to digits backward, requiring the examinee to recall strings of letters in reverse order.
- **Manual Imitation** requires the examinee to repeat a sequence of motor movements modeled by the examinee.

Examiners seeking to further investigate a larger sampling of an examinee’s memory and learning capabilities are encouraged to administer additional tasks based on clinical judgment and selective testing methods (*see Selective Testing* below).

Behavioral Rating Scales

COMPREHENSIVE EXECUTIVE FUNCTION INVENTORY (CEFI)

The CEFI is a robust norm-referenced behavior rating scale assessing an array of executive functions for those as old as 18 years of age. Respondents can include parents, teachers, and the examinee[28]. Rating scale data are crucial when conducting a comprehensive evaluation of EF and ADHD as they provide information regarding an examinee's presentation outside of the one-to-one testing setting. Furthermore, data garnered from the CEFI can be reviewed in conjunction with standardized formal measures to determine the presence of variations and/or consistencies in strengths and weaknesses across settings. Administration of the CEFI yields a **Full Scale score**, in addition to nine scale scores. The nine scales include:

- **Attention** measures how well an individual can ignore distractions, concentrate, and sustain attention while completing tasks.
- **Inhibitory Control** provides an estimate of how well an individual can control their impulses and behaviors.
- **Emotion Regulation** concerns how well one can control and manage their emotions.
- **Flexibility** relates to how well an examinee can adapt their behavior to changes in their environment, including the ability to problem-solve.
- **Initiation** pertains to how well an individual can begin tasks without being prompted.
- **Organization** provides a description of how well an examinee can manage their academic and personal tasks, in addition to their management of personal belongings.
- **Planning** refers to how well an examinee can develop and implement a strategy to achieve a goal.
- **Self-Monitoring** concerns how an individual rates their performance and behaviors.
- **Working Memory** reflects how well an examinee can hold important information in immediate awareness (e.g., remembering instructions).

[28] Examinees aged 12.00-18.11 years can provide their self-reports on the CEFI.

Examiners utilizing the CEFI's scoring software have the option to generate several different reports to facilitate data analysis. Th interpretive report provides information about a single administration. It includes an evaluation of the ratings provided by an endorser, regarding the consistency of their responses, impression styles (positive and negative), and the number of omitted items. An examiner should review this information to gain insight regarding the validity and reliability of the data provided by a respondent. The interpretative report also offers scores indicating how the examinee compares to peers in the norming sample, in addition to an analysis of intra-individual variability across the CEFI scales. EF strengths and weaknesses are labeled in the examinee's profil , expediting the identification of areas that can be capitalized on and those that may warrant support.

Examiners who administered the CEFI to multiple respondents can choose to run a comparative report, which offers a multi-rater perspec ive regarding an examinee's EF skills. The visual format of this report helps examiners identify the variability in EF skills across settings. Once specific areas of weakness have been identified examiners are encouraged to consider evidence-based strategies for remediation purposes. Intervention strategies are offered to the examiner when generating an interpretative report. The effectiveness of EF interve tions can be monitored via the CEFI's progress monitoring and treatment effectiveness report, which visually displays the same rater's endorsements across up to four administrations.

CONNERS 3

The Conners 3 is a behavior assessment tool that can be administered to examinees up to 18 years of age. A self-report rating form can be administered to those between the ages of 8.0 to 18.11, in addition to parent and teacher forms. The Conners 3 can be used to identify individuals who demonstrate elevations in ADHD symptoms across home and school settings.

Due to the Conners 3's symptom-level alignment, it does not include all of the DSM-5's ADHD criteria (e.g., course, age of onset, differential diagnosis). As such, it should be used in conjunction with other assessment tools if examiners seek to diagnose ADHD.

Respondents can identify the presence of ADHD symptoms in accordance with:

- **DSM-5 symptom-level criteria**
- **Level of impairment in academic, social, and home living domains[29]**
- **An overall ADHD Index**

In addition to symptom-level ADHD criteria and impairment levels, the Conners 3 provides information regarding ADHD's most common co-morbid behavioral (Oppositional Defiant Disorder and Conduct Disorder) and social-emotional conditions (Anxiety and Depression). The behavioral conditions are also assessed in accordance with DSM-5 symptom criteria.

Additional content scales are available concerning:

- Inattention
- Hyperactivity/Impulsivity
- Learning Problems[30]
- Executive Functioning[31]
- Learning Problems/Executive Functioning[32]
- Defiance/Aggression
- Peer relations
- Family relations[33]

[29] Impairment in home living is assessed by the parent/caregiver and the examinee via self-reports.

[30] Learning Problems is identified as a scale for parent forms, and a subscale for teacher forms. Teacher forms include this subscale under the Learning Problems/Executive Functioning Scale.

[31] Executive Functioning is identified as a scale for parent forms, and a subscale for teacher forms. Teacher forms include this subscale under the Learning Problems/Executive Functioning Scale. **This scale is not assessed as part of the self-report forms.**

[32] The Learning Problems/Executive Functioning scale is unique to the teacher forms.

[33] The Family Relations scale is unique to the self-report form.

Information related to restlessness/impulsivity and emotional lability can also be derived via the parent and teacher forms' Conners 3's Global Indices.

- **Conners 3 Global Index**
- **Restlessness/Impulsivity Index**
- **Emotional Lability Index**

Lastly, critical items (e.g., fire starting) are provided, facilitating the identification o children who need immediate support.

Examiners can elect to hand-score, or computer score their administrations. Those opting to use the Conners 3 scoring software will have access to an interpretative assessment report that can guide clinical diagnosis and intervention. The report includes detailed information regarding how an examinee compares to the normative sample across the content scales, ADHD index, and Global Index. Examiners are also provided with examples of functional manifestations of challenges in each content scale area. A DSM-5 overview is provided with examiner guidelines for interpretation depending on the symptom count and scores an examinee obtains across the inattentive and hyperactive/impulsive areas of functioning. For all DSM-5 aligned conditions, probability markers are provided, indicating the likelihood of an individual meeting diagnostic criteria. Furthermore, DSM-5 symptom tables are displayed, which indicate the specific criteria identifie by a given respondent. As with other rating scales, examiners are encouraged to review its validity scales: Positive Impressions, Negative Impressions, and Inconsistency. Data from these scales provide insight regarding the reliability of a respondent's endorsements.

Selective Testing

Selective Testing refers to the careful selection of instruments to further assess skill areas pertinent to the referral concerns, when deemed necessary based on clinical judgment. Selective Testing allows an examiner to obtain the most diagnostic information in the least amount of testing time, for any given individual's unique needs. Selective Testing may also be conducted based on an individual's functional profile (.g., pattern of strengths and weaknesses that emerges during testing) to provide further information that can be used for diagnostic purposes and educational program planning.

WOODCOCK-JOHNSON® IV TESTS OF COGNITIVE ABILITIES (WJ IV® COG)

Woodcock Johnson IV
Tests of Cognitive Abilities

Although individuals with ADHD and EF deficits typically struggle with short-term working memory, a complete evaluation of one's memory and learning profile can inform interventions and supports to ensure educational goals are met. Examiners can administer the following WJ IV COG tests to tap *immediate verbal memory, immediate visual memory, verbal-visual associative memory, and semantic memory.*

- Immediate verbal memory is tapped by **Memory for Words** and **Story Recall,** both of which are tests demanding the examinee attend to auditory stimuli, hold it in their awareness, and present target information back to the examiner after a brief delay.
- **Picture Recognition** measures immediate visual memory, as the examinee is required to identify previously viewed stimuli amongst a field of distractors.
- **Visual-Auditory Learning** is a controlled-learning task tapping verbal-visual associative memory which demands the examinee recall associations between visual and lexical stimuli (i.e., rebuses and their associated names).

Semantic memory is tapped by two tests of the WJ IV COG, **General Information** and **Oral Vocabulary.**

- **General Information** is a two-part measure of comprehension-knowledge, tapping the depth of an individual's general information stores and knowledge. One component of this test assesses where objects typically can be found in one's environment. Another component questions what objects are typically used for. As the test progresses, target objects become less frequent in the environment.
- **Oral Vocabulary** is another two-part measure of comprehension-knowledge that taps general information stores and knowledge. The test requires the examinee to listen to a word and provide an appropriate word with the same or similar meaning (Synonyms), or an opposite meaning (Antonyms).

WOODCOCK-JOHNSON® IV TESTS OF ACHIEVEMENTS (WJ IV® ACH)

Examiners interested in reviewing neurocognitive functions in the context of academic tasks can use the **Woodcock Johnson IV Tests of Achievement** (WJ IV ACH®) to assess an examinee's *acquired knowledge fluency, in addition to their problem-solving, fluid reasoning, and planning skills.*

Acquired knowledge fluency can be compared to an examine 's demonstrated skills on the WJ IV COG's performance fluency tasks, to determine if their cognitive fluenc aligns with their fluency on applied measures of reading, mathematics, and writing. This domain of functioning is assessed by the following tests:

- **Oral Reading** is a measure of story reading accuracy and prosody, which requires the examinee to read text aloud that increases in difficul . The examinee's performance is based on their accuracy and the fluency of their expression. Item scoring is based on the errors committed throughout the test, and examiners can document errors in the following categories: mispronunciations, omissions, insertions, substitutions, hesitations, repetitions, transpositions, and ignoring punctuation.
- **Sentence Reading Fluency** assesses reading rate and processing speed capabilities. Examinees are required to read simple statements under timed conditions and decide whether each statement is true or false. Upon determining the validity of each statement, the examinee must circle *Yes* or *No*.
- **Word Reading Fluency** is another test of reading rate, which measures vocabulary knowledge and semantic fluenc . Processing speed also is tapped by this task, as the examinee works under time constraints. The examinee is required to mark the two words in a row that share some relationship (e.g., synonyms/antonyms, within similar semantic category).
- **Sentence Writing Fluency** measures an examinee's ability to formulate and write simple sentences quickly and accurately.
- **Math Facts Fluency** is a speeded measure requiring the examinee to solve basic addition, subtraction, and multiplication facts.

Examiners can then elect to assess problem-solving, fluid reasoning, and planning skills via the **Number Matrices** test of the WJ IV ACH for an additional sample of an examinee's capabilities in these domains.

- **Number Matrices** taps math quantitative knowledge and fluid reasoning and falls within the math problem solving cluster. The examinee is shown matrices and must identify the missing number.

WOODCOCK-JOHNSON® IV TESTS OF ORAL LANGUAGE (WJ IV OL®)

Examiners can also use the **Woodcock Johnson IV Tests of Oral Language** (WJ IV OL®) to gather additional information regarding an examinee's i*mmediate verbal memory, attentional capacity,* and *performance fluency* in the context of tests tapping oral expression and the speed of lexical access.

- **Sentence Repetition** is measure of oral expression which taps the ability to remember and repeat individual words, phrases, and sentences. During this task, sentence meaning can be used to aid recall. This test assesses immediate verbal memory and taps attentional capacity.
- **Rapid Picture Naming** is a measure of cognitive and linguistic fluenc , allowing an examiner to assess performance fluenc . It provides information concerning an examinee's processing speed, speed or word retrieval, and speed of lexical access (naming facility). Under timed conditions, the examinee is asked to recall the names of simple pictures.

Selective Memory and Learning Assessment

TOMAL-2

Further evaluation of an examinee's memory and learning profile can be conducted through administration of the TOMAL 2's Verbal and Nonverbal Memory Indices.

To derive the **Verbal Memory Index**, examiners must administer:

- **Memory for Stories** is a highly contextual task that demands the examinee to engage in verbal free recall of orally presented stories. The examinee is granted credit for correctly recalling specific story elements.
- **Word Selective Reminding** is a lower context task that tests the examinee's ability to recall a list of orally presented words across six trials. The examiner informs the examinee of any omitted words after a trial, prior to the examinee repeating the list again.
- **Object Recall** involves the examiner presenting a series of 15 visual stimuli associated with specific names. The examinee is then required to present the name of a target illustration. The stimulus presentation is randomized as the examinee progresses through the task.
- **Paired Recall** is an associative learning task involving word pairs. During the learning trials, the examinee is presented with word pairs. They then are shown halves of these word pairs and must verbally recall the word that completes the target pair. The presentation of the word pairs is randomized across trials. Examiners can generate scores for easy versus challenging word pairs for further analysis, in addition to an overall score based on the total number of pairs recalled.

The **Nonverbal Memory Index** can be derived from the administration of the following subtests:

- **Facial Memory** taps recognition of meaningful information (facial recognition skills) in the presence of extraneous stimuli.
- **Abstract Memory** assesses recognition of less semantic, yet abstract, stimuli (geometric figures) among a series of distractors.
- **Visual Sequential Memory** demands that the examinee recall the specific order that abstract designs were presented. Examinees first are shown a series of abstract designs, and then are asked to correctly identify the sequence of the stimuli, when shown the same designs in a randomized order.
- **Memory for Location** assesses visual-spatial memory as examinees must recall the location of dots in a picture book. After the initial dot presentation, the examinee must place chips on a grid indicating where the dots were previously placed.

After administering the Verbal and Nonverbal Memory indices, examiners can generate a **Composite Memory Index** that serves as an overall estimate of memory functioning. Furthermore, examiners can review performance within and across the verbal and nonverbal memory indices to determine an individual's strengths and weaknesses. Specific supplemental subtests can also be administered to gather more information regarding the examinee's functional profil . It is important to note that supplemental subtests can be administered to substitute for spoiled subtests.

The TOMAL-2 has a total of six supplemental subtests: Digits Forward; Digits Backward, Letters Forward; Letters Backward, Manual Imitation, Visual Selective Reminding, Memory for Stories Delayed, and Word Selective Reminding Delayed. Note that the first five subtests listed are used to derive the **Attention/Concentration Index** noted above.

- **Visual Selective Reminding** is the visual complement to the **Word Selective Reminding** task. The examiner first models a pattern by touching dots in a specific orde . The examinee then must recall the pattern modeled by the examiner. The examiner informs the examinee of any steps they omitted after a trial, prior to the examinee attempting the trial again.
- **Memory for Stories Delayed** tests the examinee's long-term memory and retrieval skills for highly contextual information, as they are asked to identify elements from the stories presented to them during the **Memory for Stories** task.
- **Word Selective Reminding Delayed** tests the examinee's long-term memory and retrieval skills for less contextual information, as they are tasked with recalling the list of orally presented words first prese ted during the **Word Selective Reminding** subtest.

Administration of these supplemental subtests allows an examiner to derive additional domains for review, including Verbal Delayed Recall, Attention and Concentration (described in detail above), Sequential Recall, Free Recall, Associative Recall, and Learning Skills. The tasks that comprise these domains are as follows:

Verbal Delayed Recall

- Memory for Stories Delayed
- Word Selective Reminding Delayed

Sequential Recall

- Visual Sequential Memory
- Digits Forward
- Letters Forward
- Manual Imitation

Free Recall

- Facial Memory
- Abstract Visual Memory
- Memory for Location
- Object Recall

Associative Recall

- Memory for Stories
- Paired Recall

Learning Skills

- Word Selective Reminding
- Visual Selective Reminding
- Object Recall
- Paired Recall

Significance and cumulative frequency tables are available when scoring, allowing the examiner to make comparisons between all composites and supplementary indices. Examiners can also review scatter within each supplementary index. Furthermore, a learning curve analysis can be conducted for specific subtests, and a mean number of elements recalled by trial and age are provided for norm-based comparisons. Overall, administration of the TOMAL-2 can yield important information regarding an examinee's memory strengths and weaknesses, which can inform educational planning and intervention implementation.

Assessment of Inhibitory Control

STROOP COLOR AND WORD TEST

The Stroop Color and Word Test is a quick-to-administer neuropsychological measure that can be utilized to further assess an examinee's inhibition skills. During this timed test, the examinee must inhibit a reading response to properly name stimuli. The examinee is required to respond to three stimulus cards. The first card demands the examinee to read a list of color words (e.g., blue) printed in black ink. The second card requires the examinee to name the text color of nonword stimuli. The final card presents the child with color words that are printed in a different color than the word itself (e.g., red printed in blue ink). The child is asked to name the color of the text for each word, rather than reading the word itself.