# Chapter 6
# Neuropsychological Testing for Adolescents with ADHD


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## Introduction

Attention-deficit/hyperactivity disorder (ADHD) is the most common of several conditions that fall under the umbrella term neurodevelopmental disorder or an atypical development of the central nervous system (CNS) that becomes apparent in early childhood [1, 2]. Despite being categorized as a brain disorder, ADHD is defined behaviorally. As reviewed in Chap. 2, ADHD has no distinctive biomarker, meaning there is no blood test, brain scan, or other conclusive measure to determine this diagnosis. Instead, ADHD is diagnosed based on a child's developmental and clinical history, informal and standardized reports of behavior, clinician observations, and, sometimes, neuropsychological testing. An assessment of ADHD should ideally use a multimodal and multidisciplinary approach [3] and include information obtained from several sources to assess symptoms across settings, a comprehensive history to determine age of onset and duration of symptoms, assessment of functional impairment, and evaluation for possible coexisting conditions. Currently, many children and adolescents are diagnosed with ADHD by a primary care provider [4]; however, appointment time limitations interfere with consistent adherence to the diagnostic criteria outlined by the *Diagnostic and Statistical Manual of Mental Disorders, 5th Edition* (DSM-5) [5]. A brief visit with a primary care pediatrician is not the ideal setting for diagnostic conceptualization of a teenager with a new ADHD concern [6]. Comprehensive neuropsychological evaluations are

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lengthy and more thorough and include formal testing, yet there is ongoing debate as to the added value of neuropsychological assessment in the diagnostic and treatment process in youth with ADHD. But in many regions, parents of children with inattention or school difficulties are automatically advised to "get a neuropsych eval." This chapter reviews what that means. We also cover who, when, and why a neuropsychological evaluation is indicated for an adolescent with ADHD symptoms. Finally, clinicians are directed to specific sections of this chapter, while parents and teachers may prefer to focus on boxed tips, search specific sections, or *find a specific test* to better understand its function [1–6].

## Case Example

A 16-year-old boy with dyslexia is having increased academic difficulty in 9th grade. His grades are dropping, and he is not able to complete papers and long-term assignments by the deadline. He was diagnosed with "mild" Attention-deficit/hyperactivity disorder (ADHD) and dyslexia at 9 years of age. Medication was never prescribed. Until this year, he has earned Bs and Cs while playing sports and receiving Individualized Education Program (IEP) services, including reading intervention. No substance use, depression, or anxiety is suspected. The high school recommends a full neuropsychological evaluation, but the family does not understand why he needs more testing.

## Background

To understand the neuropsychological evaluation process of ADHD, specifically in teenagers, we first need to appreciate what a neuropsychological evaluation will—and will not—clarify. Most neuropsychological evaluations include several components: a comprehensive history of the teen (usually provided by the primary caregiver), behavioral observations, performance-based measures, standardized questionnaires (parent-, teacher-, and/or self-report), and individualized recommendations. The process of gathering a comprehensive history is reviewed in a previous chapter. The remaining components (performance-based measures, standardized questionnaires, behavioral observations, and individualized recommendations) are described below, as are the ways in which the information yielded contributes to the conceptualization of the adolescent, including whether or not they present with ADHD.

## Performance-Based Measures

Performance-based measures are tests administered to a child and scored based on the responses. Results from these tests are typically interpreted in comparison to other individuals in the same age range as the test taker, resulting in standardized/norm-referenced scores that take a variety of forms. While there are numerous measures to assess these areas across the lifespan, some of the common tests used in pediatric and adolescent practice will be described so that a neuropsychological evaluation report is more accessible to every reader. Each assessment measure is listed within a specific domain below, though many of these measures yield information that spans various domains. Similarly, the specific domains reviewed below are not exhaustive, nor are they included in every neuropsychological evaluation.

Performing complex tasks—whether in school, in life, in relationships, or at work—requires a person to utilize many different skills at the same time. Imagine entering a biology class for a pop quiz. Here are some of the skills needed to earn a passing grade:

- Notice (see, hear) the social environment of quiet and independent work
- Attend to the directions (spoken and written)
- Move to the right location, put away backpack/books (gross motor skills)
- Use accurate and paced fine motor skills to provide answers in the time allotted
- Read the questions and look at the diagrams in the questions
- Relate the written questions to diagrams, pictures, and other visuals provided
- Recall previously learned information and apply this information to the (new) scenario of the question
- Maintain pace, move from one question to the next, and follow the expected sequence

All of this is expected to happen in smooth coordination! And when one of these skills is weak, like a weak link in the chain, the rest of the chinks depending on it can't function as well. Understanding the strengths and weaknesses of an individual's processing, in order to clarify their current function and determine how to best support success, becomes the ultimate objective of neuropsychological testing.

The goal of neuropsychological assessment is therefore to create a cognitive profile comprised of many areas of functioning, including, but not limited to:

- General intelligence
- Attention
- Executive functions
- Learning and memory
- Fine motor skills
- Language skills
- Visual-perceptual and complex motor abilities
- Academic achievement

## *Intellectual Functioning*

Overall intellectual functioning is assessed by the administration of several subtests that are thought to measure core cognitive abilities (e.g., verbal comprehension, visual spatial, and fluid reasoning skills) as well as areas of cognitive proficiency (e.g., processing speed and working memory). Together, these subtests yield an overall intellectual functioning score, commonly referred to as a child's "IQ." This composite score often gives at least some insight into a child's capabilities and may serve as a comparison when examining other areas of functioning (e.g., adaptive and academic functioning). Table 6.1 lists several measures commonly used to assess intelligence in teenagers.

The descriptions below provide in-depth and sometimes technical information. It is geared for clinicians, who may not have already had focused training on child and adolescent assessment. Parents and teachers may prefer to focus on boxed tips, search this section to understand how *specific domains* are assessed, or *find a specific test* to better understand its function.

## *For Clinicians*

## *Attention*

Attention is a complex construct with no universal operationalization. Neuropsychological assessment can examine many aspects of attention, such as immediate/brief attention, sustained attention or vigilance, selective or focused attention, and divided attention, with tasks that involve auditory and/or visual stimuli.

- *Immediate/brief attention* is often measured using span tests, which expose an individual to increasing amounts of auditory or visual information; after each exposure, the test taker repeats the information auditorily or motorically. Such information may come in the form of strings of digits (e.g., WISC-V and WAIS-IV *Digit Span: Forward*) or visual sequences (WISC-V *Integrated Spatial Span: Forward* [12]; *Wide Range Assessment of Memory and Learning, Second Edition [WRAML2] Finger Windows* [13]).

**Table 6.1** Common measures to assess intelligence in teenagers

| Common measures to assess intelligence in teenagers |
|---|
| Differential Ability Scales, Second Edition (DAS-II [7]) |
| Wechsler Intelligence Scale for Children, Fifth Edition (WISC-V [8]) |
| Wechsler Adult Intelligence Scale, Fourth Edition (WAIS-IV [9]) |
| Stanford-Binet Intelligence Scales, Fifth Edition (SB-5 [10]) |
| Woodcock-Johnson Tests of Cognitive Abilities, Fourth Edition (WJ IV COG [11]) |

- *Sustained attention or vigilance* is essentially the ability to remain on task for a prolonged duration while demonstrating readiness to respond (e.g., remaining focused on a teacher's voice while listening for the next instruction). *Selective attention* is associated with distractibility and requires someone to focus on relevant stimuli (i.e., targets) and filter out or ignore distractors. Vigilance tasks also require selective attention given that a target stimulus occurs infrequently. One common method of standardized assessment of these constructs in youth is through a continuous performance test, such as the *Conners Continuous Performance Test, Third Edition (Conners CPT-3* [14]*)*, *the Conners Continuous Auditory Test of Attention (Conners CATA* [15]*)*, and the *Test of Variables of Attention* (T.O.V.A. [16]). Such tasks provide a continuous string of briefly presented (auditory or visual) stimuli, and the test taker is instructed to respond only to a target stimulus (e.g., low tone, the letter "Y"). Additional tests of sustained auditory attention include the *Auditory Attention* task from *A Developmental Neuropsychological Assessment, Second Edition (NEPSY-II* [17]*)*, in which an individual responds every time "blue" is spoken during a string of words, and *Score! on the Test of Everyday Attention for Children (TEA-Ch* [18]), which requires silent counting of "scoring sounds" over several trials. *Cancellation tasks* (e.g., *Cancellation on the WISC-V and WAIS-IV, Map Mission and Sky Search on the TEA-Ch*) can tap visual sustained and selective attention in that a test taker is required to search for and cross out a target that is embedded among distractor stimuli.
- *Divided attention* refers to the ability to attend to two concurrent stimuli or activities simultaneously and allows us to multitask (e.g., listen to a class lecture while taking notes). The *TEA-Ch* includes tests that assess divided and sustained attention: *Score DT and Sky Search DT*; each test requires the simultaneous completion of two different tasks (e.g., count sounds while searching for and circling a visual target).

## *Executive Functions*

Executive functions are a set of mental processes that are required for goal-directed behavior and task completion. These skills include planning and organization, focusing and directing our attention, controlling impulses and emotional responses, and successfully managing multiple tasks. The operationalization of executive functioning is continuing to evolve, and multiple models exist to define and outline specific domains. Common areas of functioning assessed by neuropsychological tests will be reviewed, including working memory, response inhibition, set-shifting/cognitive flexibility, planning/organization, and novel problem-solving.

*Working memory* is thought of as the capability to hold and manipulate information over a short time period or hold information while focusing on other information. Span tests can be used to assess this domain, but unlike the repetition mentioned when describing brief attention, an examinee is required to manipulate the

information by providing the auditory (e.g., *WISC-V Digit Span: Backward and Sequencing*) and visual (e.g., *WISC-V Integrated Spatial Span: Backward*) information in a different order than initially presented by the examiner (e.g., backward,

There are many types of "attention." Different tests used by neuropsychologists test different types of attention. For example:

- *Immediate attention* is required for a student to listen to teacher directions.
- *Sustained attention* contributes to a student's ability to stay focused on the teacher's voice and listen for the next instruction.
- *Divided attention* is required to concurrently take a quiz and attend to teacher's reminders.

ascending order). The *WAIS-IV* includes a working memory test requiring the examinee to complete arithmetic problems without pencil and paper (i.e., mental math) and within a time limit (arithmetic), thus tapping the individual's ability to hold and manipulate information efficiently.

*Response inhibition* is the ability to control impulses or stop and think before acting. Impulsivity can be measured as commission errors, or response to a nontarget, in the *continuous performance tasks* described above or in the second test condition of the T.O.V.A. In the latter, the individual expects to respond to the majority of targets—as in the first condition—but will need to inhibit the tendency to respond much more often, as the target to nontarget ratio switches. A common measure of inhibition in youth is the third condition of the *Color-Word Interference Test from the Delis-Kaplan Executive Function System (D-KEFS* [19]*)*, a traditional *Stroop task*. A Stroop task presents a participant with color words (e.g., red, blue) that are printed in a different colored ink (e.g., the word "red" printed in green ink). The individual is asked to say the ink color as quickly as possible, thus requiring them to inhibit the brain's natural response to read the word. Difficulties with inhibition can be reflected in response speed and/or error rate. *The inhibition task* on the *NEPSY-II* is also a timed subtest assessing ability to inhibit automatic in favor of novel responses; this task utilizes shapes and arrow direction rather than colors.

*Cognitive/mental flexibility* refers to the ability to change or revise problem-solving approaches or plans when conditions change. In standardized testing, it refers to the ability to alternate one's attention between two tasks or sets of rules. These set-shifting tasks also require directing attention and maintaining a sequence in working memory. The *Number-Letter Sequencing* condition on the *D-KEFS Trail Making Test* is a pen-and-paper task that involves alternately connecting a sequencing of numbers and letters (e.g., 1-A-2-B). Verbal switching is assessed through the *Category Switching* condition of the *D-KEFS Verbal Fluency Test*, where an individual alternates between (orally) generating a word from two different categories. The *TEA-Ch* also includes *set-shifting tasks*, such as *Creature Counting*, which involves counting "creatures"; when a child reaches an arrow, it cues them to switch the direction in which they were counting.

*Novel problem-solving* represents a higher-order skill that requires the simultaneous use of multiple basic executive functions. *Tower of London (TOL* [20]*)* and the *D-KEFS Tower Test* require a test taker to plan ahead in order to move rings, balls, or discs to a predetermined position while adhering to rules (e.g., one piece moved at a time, larger piece cannot go on top of smaller piece). In addition to planning, this requires self-monitoring, inhibiting immediate responses or the urge to break rules, directing and sustaining attention, and keeping prior series of completed moves in mind while completing the task. Another popular novel problem-solving measure is the *Wisconsin Card Sorting Test (WCST* [21]*)*. Examinees are provided with one stimulus card at a time, and they must match the card to one of four possible cards that remain displayed throughout the task. There are multiple ways to classify or match each card, and the only feedback provided to the participant is whether the match is correct or incorrect (thus assessing how well the individual can shift a cognitive strategy in response to feedback). In addition to assessing *problem-solving* and *set-shifting*, the WCST requires *working memory* and aspects of *regulating attention*.

There is no standardized measure that attempts to isolate the skills of *planning and organization*, but there are several neuropsychological tests that allow for quantitative and qualitative assessment of these areas of executive functioning. Learning and memory measures provide an opportunity to assess organization by observing how an individual encodes and recalls information. For example, organized approaches are seen when an individual clusters words into categories when recalling word lists (as opposed to in serial order), recalls stories in sequential order (as opposed to seemingly random ordering of details), and identifies the underlying shapes when copying a geometric form (e.g., as opposed to a part-oriented/piecemeal approach). Organization can also be evaluated during cancellation tasks (e.g., top to bottom vs. random search strategy).

## *Processing Speed*

Processing speed is assessed using measures of response speed, which require the test taker to complete tasks quickly and accurately. Several constructs may be examined through these tasks, including how quickly an individual can visually scan,

Executive functions contribute to task completion. For example:

- *Working memory* is required for algebra II: a student must recall and apply math facts in order to solve equations.
- *Response inhibition* is called for during group projects, when a student has to stop themself from jumping in and instead wait for others to reply.
- *Planning/organization* is required when completing long-term projects by the deadline; a student must determine what materials are required, what steps need to be completed in what order, and how long each step will take.

sequence, copy, transcribe, name, or discriminate information (*Symbol Search and Coding from the WISC-V and WAIS-IV; D-KEFS Trail Making Test: Visual Scanning, Number Sequencing, Letter Sequencing, and Motor Speed; D-KEFS Color-Word Interference Test: Color Naming and Word Reading*). As it is challenging to assess processing speed and efficiency in isolation, without tapping into other areas of functioning, it is important for a neuropsychologist to remain cognizant of other factors involved in measures of processing speed when interpreting testing results. For example, youth with fine motor weaknesses may struggle on tasks with such requirements (e.g., *Coding*). Similarly, deficits in rapid naming have been associated with reading and word retrieval difficulties.

## *Language*

While not nearly as in-depth as the information yielded from a comprehensive speech and language evaluation, neuropsychological assessment often includes the measurement of various aspects of language. Such assessment may be split into expressive (i.e., the ability to communicate using spoken language) and receptive (i.e., the ability to understand spoken language) language domains; each of these areas is measured at multiple levels (Table 6.2).

**Table 6.2** Neuropsychological measures assessing language

| Skill area assessed | Assessment measure(s) |
|---|---|
| *Expressive language* | |
| Confrontation naming ability | *Boston Naming Test [BNT]* [22] |
| Single-word naming | *Expressive Vocabulary Test, Third Edition [EVT-3]* [23]<br>*Expressive One-Word Picture Vocabulary Test, Fourth Edition [EOWPVT-4]* [24] |
| Ability to orally define words | *WISC-V and WAIS-IV Vocabulary* |
| Repetition of orally presented information | *WRAML2 Sentence Repetition* |
| Verbal fluency | *D-KEFS Verbal Fluency; NEPSY-II Word Generation* |
| *Receptive language* | |
| Single-word receptive vocabulary | *Peabody Picture Vocabulary Test, Fifth Edition [PPVT-5]* [25]; *Receptive One-Word Picture Vocabulary Test, Fourth Edition [ROWPVT-4]* [26] |
| Ability to comprehend orally presented instructions/stories | *NEPSY-II Comprehension of Instructions; Wechsler Individual Achievement Test, Third Edition [WIAT-III]* [27]<br>*Oral Discourse Comprehension* |

## *Learning and Memory*

Memory is not a single process, but a multistage faculty (e.g., encoding, storage, retrieval) that is associated with other cognitive skills such as attention and working memory; this section will focus on tests requiring *new learning and long-term retrieval*. Neuropsychological assessment of a teenager's ability to encode and retrieve novel information generally includes measures involving verbal and visual stimuli. Learning and memory measures also vary depending on the nature of the information that is presented; for example, stimuli may be rote, contextual, or abstract. On some tests, the learning phase includes several exposures to stimuli, which can provide information as to whether the adolescent's encoding of novel information benefits from repetition; other measures involve exposure to new information during a single trial. After an adolescent is exposed to auditory and/or visual information, immediate recall is assessed. Some measures include an interference trial prior to immediate recall or a single exposure to similar information (e.g., a different list of words), which allows for the assessment of proactive interference (i.e., when previously learned information hinders the learning of new information). Following a time period of approximately 20–30 min, the participant is asked to produce the information freely (i.e., delayed recall) and/or in the context of cues or multiple-choice or yes/no format (i.e., recognition).

There are several assessment measures that include multiple measures of *verbal and nonverbal memory*, as well as stand-alone assessments (Table 6.3).

**Table 6.3** Neuropsychological measures of verbal and nonverbal memory

| Skill area assessed | Assessment measure(s) |
|---|---|
| Learning and memory of simple verbal information (generally presented in word lists) | *California Verbal Learning Test, Children's Version (CVLT-C* [30]*);* *California Verbal Learning Test, Third Edition (CVLT-3* [19]*);* *WRAML2 Verbal Learning and Child and Adolescent Memory Profile (ChAMP* [29]*) Lists* |
| Learning and memory of contextual verbal information (often provided in the form of stories) | *WRAML2 Story Memory* *Children's Memory Scale (CMS* [28] *Stories* |
| Visual learning and memory involving | |
| Spatial location | *CMS Dots* |
| Visual content and spatial location | *NEPSY-II Memory for Designs* |
| Geometric images | *Rey Complex Figure Test and Recognition Trial* [31]*, WRAML2 Design Memory* |
| Faces | *CMS Faces, NEPSY-II Memory for Faces* |
| Information presented with context, such as scenes | *CMS: Family Pictures, WRAML2: Picture Memory, ChAMP: Places* |

You may see neuropsychological testing assess for processing speed, language, learning, and memory.

- Processing speed is hard to assess, because one's response rate is impacted by a variety of factors, such as fine motor skills.
- Language measures are often included in neuropsychological testing but may be less comprehensive than findings of a full speech and language evaluation.
- Memory requires us to put information into our brains, leave it there, and pull it out when we need it (encoding, storage, retrieval). To assess memory, neuropsychological testing can include content that is taught—either verbally or visually—and then requested 20–30 min later.

## *Visual, Fine Motor, and Visual-Motor Integration*

Neuropsychological assessment of visually based skills may include measures involving visual closure and matching, perception of spatial orientation, figure-ground discrimination, mental rotation, pattern recognition and completion, and visual-motor construction. Some of these constructs are assessed through subtests included in the evaluation of core cognitive abilities (e.g., *Block Design, Visual Puzzles*) and others through stand-alone measures. For example, the *Judgment of Line Orientation Test (JLOT* [32]*)* requires an individual to match the angle and orientation of lines by choosing two matched lines from an array, thus assessing visual-spatial perceptual ability. Utilizing arrows instead of lines, the *NEPSY-II Arrows* task also assesses this area of functioning.

The *Berry-Buktenica Test of Visual-Motor Integration, Sixth Edition (VMI-6* [33]*)* is a screening measure for visual-perceptual and motor abilities, as well as the integration of the two. Each component of the VMI-6 is in paper-pencil form. The *Visual Perception portion of the VMI-6* requires the teen to identify a target from a series of shapes that differ slightly by size or orientation or that have a small component missing. The *VMI-6 Motor Coordination* task attempts to isolate the individual's fine motor control, requiring them to carefully trace the interior of increasingly complex and narrow shapes while remaining within boundary lines. Symbol substitution tests (e.g., *Coding*) act as a measure of graphomotor speed, as the individual is required to quickly transcribe symbols. Fine motor speed and coordination can be assessed through pegboard tasks, in which an individual must place pegs into a board as quickly as possible (e.g., *Grooved Pegboard*, *Purdue Pegboard*). The integration of motor ability with visual and perceptual skills is often assessed through measures that involve copying shapes (e.g., *VMI-6 Visual-Motor Integration*, *RCFT Copy trial*).

## *Academic Achievement*

While a neuropsychological assessment often does not include a comprehensive examination of academic skills, administering a screening (at minimum) of core academic abilities is often included. For younger or lower functioning youth, this may involve assessing academics at the skill level (e.g., single-word reading, math calculation, spelling), and for adolescents, it is important to understand their ability to apply these skills (e.g., reading comprehension, math problem-solving, written expression). Fortunately, numerous assessment tools are available that measure achievement across domains, including the *Woodcock-Johnson Tests of Achievement, Fourth Edition (WJ-ACH-IV* [34]*)*; *Wechsler Individual Achievement Test, Third Edition (WIAT-III* [27]*)*; and *Kaufman Test of Educational Achievement, Third Edition (KTEA-3* [35]*)*. Others are designed to specifically focus on one academic skill or domain, such as the *Gray Oral Reading Tests, Fifth Edition (GORT-5* [36]*)*; *Nelson-Denny Reading Test (NDRT* [37]*)*; and *KeyMath Diagnostic Assessment, Third Edition (KeyMath-3 DA* [38]*)*. Across most academic testing measures, the test taker's performance can usually be calculated using age- or grade-based norms, the latter of which may be utilized if an individual has been retained, for example.

## *Effort*

Neuropsychological assessment often includes embedded or stand-alone measures of effort (i.e., *performance validity tests*) to ensure that the test taker's performance is valid [39]. "Effort" does not only mean "*How hard did you try?"* Instead, "effort" refers to the test taker's approach to the tasks offered: how persistent were they? How did they respond to failure? How compliant were they? Measures of effort (aka performance validity tests) determine whether the test taker's approach, such as reduced effort or engagement, impacts how valid the results are. Individuals with ADHD can present as inconsistently motivated or engaged and are sometimes viewed as "lazy" or "unmotivated." Performance validity tests provide objective information about how one's approach to a test impacts the results. This can be very helpful considering that, at times, we see feigned poor performance on testing or overreported symptoms on rating scales. These actions are often motivated by individuals seeking an ADHD diagnosis, in order to access stimulant medication or academic accommodations (e.g., extended time for SATs).

How does neuropsychological testing help figure out who "really has" ADHD from those "faking it?" Look for a validity statement in the report, indicating the evaluator's indication of whether the findings are a valid estimation of the tester's profile.

## Comments About Performance-Based Measures and the Adolescent with ADHD

Neuropsychological deficits may vary as a function of chronological and developmental/mental age, and there is no exact cognitive profile for adolescents with ADHD, though literature provides evidence for various areas of weakness. For example, differences in performance (in the expected direction) between youth with and without ADHD have been shown for sustained attention and vigilance, selective attention, and divided attention [40–43]. Similarly, between-group differences have been demonstrated across areas of executive functioning, including working memory, cognitive flexibility, response inhibition, planning, processing speed, and novel problem-solving [44–48]. Importantly, despite studies indicating weaknesses on measures of attention and executive functioning for youth with ADHD, these findings and tests do not offer the sensitivity or specificity to adequately/consistently classify individuals with and without ADHD [48].

PARENTS: In other words, no single test or combination of tests definitively indicates that a person has—or doesn't have—ADHD. Testing is not *required* to diagnose ADHD, nor are all individuals with ADHD going to perform poorly on tests of attention or executive function.

Scores on neuropsychological measures don't differentiate ADHD subtypes from one another. Classification of an individual subtype/presentation seems fairly straightforward when utilizing standardized report questionnaires, with many funneling individual item responses into composite scores or symptom counts, capturing inattention and hyperactivity/impulsivity as well as specific areas of executive dysfunction. In contrast, these presentations—and ADHD criteria in general—do not neatly emerge from the cognitive profiles yielded by neuropsychological testing. This is in part due to the neuropsychological heterogeneity of ADHD [49, 50]. For instance, some literature outlines group differences in processing speed deficits in the inattentive (but not combined) presentation [46], and there is research suggesting that individuals with ADHD, predominantly inattentive presentation, may have more diffuse cognitive deficits relative to individuals with combined or hyperactive/impulsive presentations [51]. Additionally, executive dysfunction is a prominent feature of ADHD, but not all children and youth who meet ADHD diagnostic criteria demonstrate these deficits [48, 50, 52]. Only about 30% of youth with an ADHD diagnosis have significant executive function impairment on neuropsychological testing [53]. Meaning, we are not surprised to find diffuse cognitive deficits in a child with ADHD, predominantly inattentive presentation, or executive dysfunction in any teen with ADHD, but there are those with ADHD who have no cognitive or executive function deficits on formal testing.

Many children appear relatively unimpaired in the context of standardized testing in a structured one-to-one setting with few distractions.

Parents often ask if the findings on neuropsychological testing correlate to classroom function; just because a student "can do it" in the 1:1 testing environment without any distractions, "doing it" in class may be another story. Ecological validity is a measure of how test performance predicts behavior in real-world settings. A long-standing theme in the neuropsychological testing of ADHD is the ecological validity (or lack thereof) of assessment measures, chiefly seen on performance-based measures of attention and executive functioning. Many norm-referenced neuropsychological measures have only moderate ecological validity [54], including tests assessing domains perhaps most relevant to a diagnosis of ADHD [55]. Additionally, each measure is relatively short in duration as compared to tasks in daily life requiring sustained focus and executive functioning.

As such, clinic-based test performance can provide a useful albeit incomplete assessment of executive functions [56–58]. Standardized questionnaires are a valuable compliment to performance-based measures by providing informant and self-report of day-to-day functioning.

## Self-, Parent-, and Teacher-Report Questionnaires

Standardized questionnaires are norm-referenced and compare ratings to other individuals of the same age and, sometimes, gender. These checklists and rating scales are usually designed for multiple raters, including caregivers, teachers, and the adolescent being assessed (Table 6.4). The individual completing the questionnaire reads each item and rates the statement using a Likert scale based on how often or how true the statement is (e.g., 0, not true; 1, sometimes or somewhat true; and 2, very true or often true). A specific time period is generally suggested by each questionnaire when completing the ratings (e.g., within the past 6 months). Standardized score ranges are classified based on severity (e.g., clinically significant, at-risk, average). Raw scores do not typically translate into clinically significant standardized scores, but a response pattern can be informative. For example, while an entire scale may not be clinically elevated, the examination of the items that were endorsed at a high frequency within that scale may provide some insight into the teen's experience or presentation.

There are broad-based questionnaires aimed to assess multiple areas of social, emotional, and behavioral functioning, as well as scales designed to measure specific sets of symptoms or diagnostic presentations (Table 6.4).

**Table 6.4** Commonly used self-, parent-, and teacher questionnaires

| Domain assessed | Standardized questionnaires |
|---|---|
| Multiple areas of social, emotional, and behavioral functioning | Behavior Assessment System for Children, Third Edition (BASC-3 [59])<br>Achenbach System of Empirically Based Assessment (ASEBA [60])<br>Conners, Third Edition (Conners3 [68])<br>Disruptive Behavior Disorder (DBD) Rating Scale [66] |
| Anxiety/depression | Revised Children's Anxiety and Depression Scale (RCADS [61])<br>Multidimensional Anxiety Scale for Children, Second Edition (MASC-2 [62])<br>Beck Depression Inventory, Second Edition (BDI-II [63]) |
| ADHD (including symptom count) | Vanderbilt ADHD Rating Scales (VARS [64, 65])<br>ADHD Rating Scale-5 for Children and Adolescents [67]<br>Conners, Third Edition (Conners3 [68])<br>Disruptive Behavior Disorder (DBD) Rating Scale [66] |
| Executive functioning | Behavior Rating Inventory Function, Second Edition (BRIEF2 [69]) |
| Adaptive functioning (independence in daily living skills) | Adaptive Behavior Assessment System, Third Edition (ABAS-3 [70])<br>Vineland Adaptive Behavior Scales, Third Edition (Vineland-3 [71]) |

## Self-, Parent-, and Teacher-Report: ADHD-Specific Questionnaires

Reviewed in previous chapters, many of the same questionnaires used to gather data for diagnosis in the outpatient clinician setting are used in neuropsychological assessment.

A neuropsychological assessment office is clearly not an environment representative of an adolescent's daily life at home or at school. Similarly, the performance-based measures used to assess attention and executive functions are a poor reflection of how those skills are expressed in everyday tasks. For example, working memory may be gauged by comparing the ability to repeat strings of digits in backward order during standardized testing, while day-to-day indications of working memory dysfunction could be seen in difficulty completing multistep directions or forgetting task directions. Further, the risk-taking activities that illustrate impulsivity in adolescents certainly do not equate to inhibiting the urge to read a word and, instead, name the ink color. As such, while the quantitative and qualitative data gathered during an evaluation are beneficial in diagnostic conceptualization and treatment planning, questionnaires provide an efficient and developmentally referenced assessment of social, emotional, and behavioral functioning outside of the testing environment. This is useful not only in collecting evidence for diagnostic criteria specific to ADHD but also in determining factors that may be accounting for apparent ADHD symptoms (e.g., anxiety) and assessing functional impairment. Further, in addition to their utility in the initial diagnostic process, rating scales can be used as measures of treatment response.

ADHD-specific questionnaires can be helpful in capturing symptoms in daily life for initial diagnosis as well as evaluating response to treatment (e.g., fewer symptoms following a few months of therapy).

Most questionnaires have versions for parents/caregivers, teachers, and the adolescent themself, which is in line with general recommendations to maximize diagnostic information by gathering data from multiple sources [72, 73]. It is important to get each perspective on an individual's functioning, especially as an ADHD diagnosis requires the presence of several symptoms across settings as well as evidence of impairment. While there is evidence that standardized ratings scales are sensitive to the presence of ADHD in adolescence [74–76], they are not without limitations.

How can subjective ratings by teachers and parents be accurate? Sometimes, they are not. Ratings scales are subject to reporting bias and levels of agreement between raters and across settings are often low [77, 78]. A classroom environment is logically an ideal setting to look for ADHD symptoms, given requirements to inhibit responses (e.g., not speak in class) and sustain auditory (e.g., lectures) and visual (e.g., reading) attention, but it is not always realistic to ask a teacher to rate such symptoms due to large class sizes, varying experience and tolerance, and given that instructors may spend under an hour with a student. As such, it is not surprising that agreement among high school teachers is variable and often poor [79, 80] and parent-teacher discrepancies on ratings scales are high [81, 82]. Unfortunately, adolescents tend to demonstrate poor insight into the presence and severity of their symptom presentation on self-report rating scales [83, 84], and the accuracy of both parents and adolescents is questionable when providing retrospective accounts of behavior [85]. In addition to variable agreement across raters, the DSM-5 symptoms of ADHD are arguably more prominent in younger children; as such, some behavior checklists may not be sensitive to the clinical presentation of ADHD in adolescence. In fact, some argue that the symptom threshold should be less strict when diagnosing ADHD for the first time during adolescence [86].

## Clinical Interview and Record Review

As you know from previous chapters, neuropsychological testing is one method for diagnosing ADHD. A comprehensive interview and record review accompany the testing. Knowledge of the components examined through neuropsychological testing should inform any diagnostic interview of an adolescent with a question of

ADHD. In reviewing school history, ask about grade retention, special education services, and presence or history of learning difficulties. Listen for problems that point to specific areas of executive dysfunction. Reviewing previous records (e.g., report cards, developmental evaluations, pediatrician notes) along with conducting a clinical interview with the adolescent can provide evidence of slow processing speed, impaired working memory, inhibition, cognitive rigidity, problems with sustaining or dividing attention, language deficits, and poor fine motor skills. Gathering a developmental history in adolescents with undiagnosed ADHD often reveals longstanding patterns of emotional-behavioral concerns, failed friendships, and variable or poor academic performance [87–89]. Again, ask for the details. Ask about functional impairment as well; for adolescents this typically means school performance that may have declined following the transition to high school, often due to the impact of the executive dysfunction commonly seen in ADHD (e.g., working memory ability is highly related to academic achievement [90]). Further, including an interview with the teenager being assessed is especially important when considering impairment; while adolescents may not be valid reporters of their ADHD symptoms, they are often the best source of information relating to negative social behavior [91]. Interviewing the teen also provides information about their level of insight, which will be relevant to intervention.

Many disorders of childhood and adolescence present with apparent symptoms of ADHD. Moreover, ADHD co-occurs with many medical and psychiatric conditions. As such, gathering background information around the adolescent's history of academic achievement and emotional-behavioral functioning helps to consider coexisting diagnoses and differentiate ADHD from other causes of functional impairment. If an adolescent presents with the report of clinically significant symptoms of inattention, and/or hyperactivity/impulsivity, it must be determined if these features manifested earlier in childhood. For example, the late onset of ADHD symptoms may correspond with a psychosocial stressor or traumatic event or a learning disorder emerging in the context of increased academic demands. Alternatively, characteristics associated with ADHD may reflect other psychopathology or be better accounted for by a different neurodevelopmental disorder.

Emotional-behavioral dysregulation is a common component of the clinical presentation of ADHD [92]; however, it is also observed in separate conditions, as reflected in the high co-occurrence rates of ADHD and oppositional defiant disorder and conduct disorder [93]. Internalizing disorders involving symptoms of anxiety or depression are also highly comorbid with ADHD [89, 94] but can also be the underlying cause of apparent ADHD symptoms (e.g., restlessness due to anxiety, depression resulting in poor focus and motivation). Several of the broad-based screening tools above identify risk for these comorbidities.

ADHD commonly co-occurs in other neurodevelopmental disorders, such as autism spectrum disorder, intellectual disability, and specific learning disorders. ADHD is present in 30–80% of ASD cases [95, 96].

While most individuals with ASD have attentional difficulties, a neuropsychological evaluation helps to determine if symptoms are independently causing significant functional impairment, warranting separate consideration of a co-occurring ADHD along with treatment. ADHD symptoms must be maladaptive, but they also must be inconsistent with the child's developmental level.

Intellectual disability is often accompanied by ADHD [97, 98], but symptoms must be excessive for mental/developmental age. For example, if a 14-year-old has an intellectual age equivalent of a 7-year-old, the attention and behavioral self-control deficits must be immature for a 7-year-old. The measures of intelligence and adaptive functioning that are completed in neuropsychological evaluations allow for standardized assessment of developmental level or mental age. Academic problems are frequently described in youth with ADHD and sometimes accounted for by a separate specific learning disorder [99].

It is also important to rule out a medical cause of ADHD symptomatology, such as traumatic brain injury, substance use, seizures, hypothyroidism, or sleep disturbance, further highlighting the importance of gathering a comprehensive developmental and medical history (see Chap. 2). For example, a recent change in attention and executive functioning could be observed in an adolescent who recently sustained a concussion [100], but they may not otherwise have a significant history of ADHD symptoms. Drug use, which becomes increasingly relevant as youth age, can also result in cognitive and behavioral issues that mimic an underlying neurodevelopmental disorder [101]. ADHD symptomatology and diagnosis also are common in many types of epilepsy [102], and youth with epilepsy are particularly at risk for symptoms associated with ADHD, predominantly inattentive presentation [103]. Another area that is particularly important to assess is sleep. Chronic sleep issues can be difficult to distinguish from ADHD as both are associated with poor focus, mood swings, and hyperactivity. If a teen has experienced chronic sleep issues and has not received proper treatment, it may not be appropriate to diagnose ADHD, even if the symptoms criteria appear to be met. For example, shorter sleep duration is associated with increased teacher-report ratings of ADHD symptoms in healthy and typically developing children [104]. Additionally, several studies indicate inattention, planning issues, and restlessness in patients with obstructive sleep apnea (OSA) [105], and OSA treatment is associated with a reduction—and, sometimes, a disappearance—in ADHD symptoms [106].

## Behavioral Observations

Another critical component of a neuropsychological evaluation includes the behavioral observations, which offer qualitative observations of the individual being assessed. Qualitative observations are arguably just as (if not more) valuable as standardized scores. Any clinician diagnosing ADHD should include behavioral observations as essential pieces of information. While ADHD symptoms are not necessarily as overt in the structured clinical setting as they may be in larger settings or with peers, especially in adolescent populations, many test takers show signs of hyperactivity/impulsivity (e.g., interrupting, fidgeting, attempting to start tasks before completion of directions, reaching for object from examiner's hand, quickly responding followed by self-correction) and inattention (e.g., missing prompts, easily distracted by hallway noise and own thoughts, inconsistent pattern of correct and incorrect responses on items of similar difficulty, looking away from visual stimuli, careless errors). These behavioral observations can provide useful information when considering day-to-day functioning. For instance, if a test taker is having trouble attending to directions in a one-on-one structured setting, it is likely that it is even more difficult for that individual to attend to longer durations of spoken language in more distracting environments, such as a classroom.

Testing anxiety can present similarly to ADHD symptoms. One possible distinction between the two causes comes from changes in inattention and hyperactivity/impulsivity over relatively short periods of time. Given that neuropsychological testing tends to last several hours, individuals with ADHD often show increasing symptoms over the course of the evaluation. In contrast, if an examinee is initially anxious, behavior that looks like ADHD can decline as the test taker becomes more comfortable.

Attention, activity level, and impulse control are just some of the behavior observations noted during a neuropsychological evaluation. Additional areas observed include mood/affect, general appearance (e.g., grooming, dress), and functional hearing and vision. Gross motor functioning is assessed informally based on the examinee's ability to ambulate independently and gait quality (e.g., balance, posture). Handedness is noted as well as lateral dominance on tasks; informal assessment of fine motor functioning may also look for a tremor, pencil grasp, and general control when manipulating small objects and completing pencil-and-paper tasks.

Speech is assessed for qualities such as rate, volume, and intonation. It is noted if expressive language is largely comprised of single words, multiword phrases, or full, complex sentences and if spoken language is logical, coherent, and organized. Comprehension of spoken language is gauged in the context of informal exchanges and an examinee's ability to understand task directions (e.g., required repetition or simplification of task directions, inconsistently provided contingent responses to questions during conversation). It is noted if any modifications are required to understand test demands, such as repetition of directions, use of visual aids, and additional sample/demonstration items, when standardization procedures allow. Pragmatic language and social interaction skills are assessed by observations of the

adolescent's ability to modulate eye contact, participate in back-and-forth conversation, coordinate verbal and nonverbal communication, and appropriately respond to the examiner (e.g., returns social smiles).

## Recommendations

Regardless of diagnostic outcome, a neuropsychological evaluation yields recommendations specific to the individual. Such recommendations are based on information obtained throughout the evaluation, including the teen's cognitive and academic profile, social/emotional/behavioral functioning, developmental history, medical history, and diagnostic presentation. Often, recommendations are made for school and home environments and include suggested accommodations and/or interventions. In addition, recommendations are provided that highlight the individual's strengths and the ways in which these strengths can be used to support areas of struggle. While a neuropsychological evaluation produces recommendations spanning psychiatric, neurodevelopmental, and medical disorders, the examples provided below will focus on areas most relevant to youth with ADHD.

A common school-based recommendation is the provision of classroom support and/or special education services through a Section 504 Plan or Individualized Education Program (IEP) (Table 6.5). These documents provide a blueprint for services, modifications to the learning environment, and/or special education and related services. The level of support and whether the teenager requires individualized services depends on the degree of impairment caused by their ADHD symptoms. The utility of these recommendations varies based on several factors, such as level of cognitive functioning, the presence of co-occurring disorders, and the ADHD symptom profile (i.e., inattentive, hyperactive/impulsive, or combined presentation).

Depending on the teenager's level of difficulty with task initiation, specific interventions can target areas of weakness (Table 6.6). Those with trouble in working

**Table 6.5** Examples of common recommendations for classroom-based supports

| Examples of common recommendations for classroom-based supports |
|---|
| Preferential seating |
| Testing in a distraction-free environment |
| Regular breaks |
| Teacher checks for understanding |

**Table 6.6** Examples of recommendations for those with difficulty with task initiation

| Examples of recommendations for those with difficulty with task initiation |
|---|
| External prompting |
| Working in small groups |
| Providing assistance with the initial step of a task or assignment |

memory and attending classroom lectures may require access to notes or note outlines, particularly as note taking demands increase as the teenager moves through school. Without this type of accommodation, teenagers with ADHD and accompanying difficulties with working memory and organization often find themselves with incomplete or inaccurate notes, interfering with the ability to study for tests or complete assignments. In college, students with ADHD sometimes seek permission to record class lectures, so that they are able to review information on their own time.

Having the teenager attend a structured study hall, where they have access to academic and organizational support, is sometimes beneficial, particularly as individuals with ADHD often fail to use unstructured time effectively. Such executive function "coaching" could include teaching approaches for breaking down tasks into smaller units, improving study habits, building note taking strategies, and effectively using a (daily/weekly/monthly) planner. Teenagers with ADHD also may require check-ins with teachers/counselors to ensure the accurate recording of academic assignments and that they have the materials required to complete these assignments. Of course, the goal should always be to promote independence, but habits and systems that set the student up for success must first be established, which initially requires assistance (i.e., scaffolding). Again, information obtained through a neuropsychological evaluation can help inform intervention targets and level of need.

The implementation of a behavioral intervention within the classroom that targets specific areas of impairment (e.g., work completion, accuracy, and organization) may also be recommended. While the neuropsychologist does not typically assist in the creation and implementation of a behavioral intervention, recommendations provided by the neuropsychologist can help to identify intervention targets. For example, if a neuropsychologist learned that a teenager completes and returns their work in math class but that they lose points for mistakes, accuracy may be an appropriate target of intervention.

Behavioral intervention in the home also is often recommended to families of teens with ADHD. Like at school, specific intervention targets are identified based on areas of impairment or problems reported by the parent or teen (e.g., chore and homework completion, complying with household rules). As other chapters in this book will illustrate, there are specific behavioral concerns that are associated with ADHD during adolescence as opposed to early developmental periods, such as delinquency [107], risky sexual behavior [108], and school dropout [109]. As such, it is often imperative that parents closely monitor their teen(s) with ADHD, particularly during evenings and weekends, when adolescents are relatively less likely to be engaged in structured activities. To combat the potential dangers of unstructured time for teens with ADHD, a neuropsychologist may recommend their involvement in structured activities that they would enjoy (e.g., cooking class, joining the basketball team).

While most neuropsychologists do not have prescribing privileges and thus medication management is outside of their areas of expertise, recommendations yielded

from a neuropsychological evaluation may include consultation with a prescribing physician. More specifically, it may be recommended that the teen and parents meet with their primary care provider or specialist to learn about medication options, if pharmacological interventions have not yet been initiated to treat the adolescent's ADHD symptoms. Consultation with a PCP or psychiatrist also may be recommended when there is evidence that a teenager's ADHD symptoms are not optimally controlled on their current medication regimen. Adequate medication management is particularly important given the positive effect on classroom behavior, delinquency, and the parent-teen relationship [110, 111]. A recent study evaluated the added value of neuropsychological assessment to routine care in the identification and treatment of ADHD and found that youth who underwent neuropsychological evaluations were more likely to receive behavioral and pharmaceutical treatment [112].

Recommendations related to health, sleep, and social functioning are frequently included in the neuropsychological evaluation report of a teenager with ADHD (e.g., increase exercise, improve sleep hygiene, attend social skills group), as such youth can demonstrate suboptimal functioning in these areas. Further, it is often important to monitor the emotional functioning of individuals with ADHD given the toll on self-esteem to put forth effort and be eager to perform well yet experience variable performance and underachievement. When information yielded from evaluation suggests the presence of comorbid mood or anxiety symptoms, treatment recommendations (e.g., cognitive behavioral therapy [CBT]) for these areas also will be included. In addition to individual treatment, family therapy, a family-oriented approach to work on problem-solving skills, basic communication, and parenting issues for adolescents, may be suggested.

Finally, the recommendations section of a neuropsychological evaluation can be used to provide psychoeducation to parents and teachers of youth with ADHD, as well as to the teenager themselves. Such information may review evidence-based treatments, managing appropriate expectations, and what we know about impairment often experienced by youth with ADHD. Book or website recommendations are often provided, as are community and treatment resources.

## Case Revisited

You tailor your questions to better understand why his grades are dropping and find that he cannot keep up with the volume of reading expected in 9th grade. He is overwhelmed with the number of assignments (nightly homework, lengthy papers, and individual and group projects). You suspect that his history of ADHD and dyslexia are becoming more interfering given the increased demands for independent organization, task management, sustained attention, and reading comprehension

with the transition to high school. You explain to the family that neuropsychological testing will help clarify his reading, executive functioning, and attention abilities, along with ruling out other factors contributing to his difficulties, such as anxiety or sleep disturbance. Recommendations may point toward a change in IEP services and whether it might be time to revisit the use of stimulant medication.

## Conclusions

ADHD is a chronic and highly prevalent childhood disorder, warranting adequate assessment and treatment. However, complete and accurate assessment of a behavioral diagnosis such as ADHD can be a challenge, particularly in adolescents. The stipulations that symptoms must be inappropriate for one's developmental level and that functional impairment must be present are not clearly defined. Further muddying the diagnostic process is the extremely high rate of comorbid conditions.

Given the inattentive, hyperactive/impulsive, and combined presentations, adolescents with ADHD don't all look the same. A behaviorally defined disorder is subject to controversy, both in classification and diagnosis, and experts don't agree on how the ADHD population looks on neuropsychological testing. Standardized scores can be useful for individualized recommendations and treatment planning, but standardized performance-based measures (such as an IQ test result or reading test level) and rating scales are only one piece of a neuropsychologist's diagnostic conceptualization puzzle.

Despite the limitations of standardized tests assessing attention and executive functioning, neuropsychological evaluations can be useful for identification of adolescents with ADHD. A neuropsychologist does not solely collect data from scores on tests but taps a variety of sources to examine multiple dimensions of everyday life over extended periods of time. This is completed through obtaining a detailed developmental history; administering standardized questionnaires; gathering information on current functioning through interview with the parent, teacher, and/or teenager; and directly observing the individual during the evaluation. A comprehensive evaluation determines relative strengths and weaknesses, how the latter contribute to functional impairment, and results in recommendations for individualized treatment across settings.

**Tips**

- When you review neuropsychological testing for adolescents, look for the following areas:
  Performance-based measures
  - Intellectual function
  - Attention
  - Executive function
  - Processing speed
  - Language
  - Learning and memory
  - Visual, fine motor, visual-motor integration
  - Academic achievement
  - Effort

  Standardized questionnaires
  Clinical interview
  Record review
  Behavioral observations
  Summary and diagnostic conceptualization
  Recommendations
- Look for a validity statement in the report, indicating the evaluator's indication of whether the findings are a valid estimation of the tester's profile

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