

## AD/HD a Disorder of the Executive Function System

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## AD/HD

*Is a complex **developmental** impairment of **executive functions** in the brain that may cause persisting reverberations of impairment through the life cycle. These understandings are emerging, not fully developed and established. Much work—theoretical and empirical—remains to be done.*  
(Brown, 2000)

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*AD/HD is a developmental disorder that is usually inherited, and is a result of impaired functioning of certain neurotransmitter networks in the brain, resulting in impaired executive functions.* (Barkely, 2000; Brown, 1995; Castellanos, 1999; Denckla, 2000; Douglas, 1999; Ernst, Zametkin, Matochik, et al., 1999; Solanto, Arnsten, & Castellanos, 2001; Tannock & Schachar, 1996)

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## PET Scan Research

Zametkin (199) NIMH research using PET Scan was able to show that the rate at which the brain uses glucose was lower in subjects with hyperactivity of childhood onset as compared with normals. They have also determined that the frontal lobes of the brain are involved.

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## AD/HD

AD/HD is a developmental impairment in executive function.

- Is sometimes not apparent until the child confronts the demands of the upper grades (which counters the DSM IV diagnostic criteria that at least some of the symptoms must have been present before age 7)
- concept of inattention is a broad one that involves much more than simply not paying attention while someone is speaking

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- inattention also refers to excessive problems with distractibility, and chronic difficulties in organizing tasks and activities, attending to details, following instructions and completing tasks, and undertaking tasks that require sustained mental effort, as well as problems with losing things and excessive forgetfulness. This is not an impairment of a single unitary function but a composite of diverse, but related, cognitive functions.

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## Prevalence

- ❑ Impairs at least 3 to 7% of children and adolescents (DSM-IV-TR, 2001). Is the single most common reason why children are referred to child mental health clinics today (Barkley 1981).
- ❑ School surveys completed by teachers have shown that 8 to 11% of students show enough impairment from AD/HD symptoms to warrant further diagnostic evaluation (Gaub & Carlson, 1997).

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- ❑ Although boys outnumber girls by a 3:1 ratio, research has shown that females can be just as impaired by the disorder, and in many cases, more impaired than males.
- ❑ Females tend to be diagnosed later in life. Boys tend to be diagnosed by the age of 8, while girls tend to be diagnosed around the age of 12.
- ❑ 2003 study indicates discrepancies across US in use of psychostimulant medications
- ❑ Approximately 4.3% of children in US take psychostimulant medication

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## Comorbidity

- ❑ AD/HD is very often comorbid with other disorders.
  - Biederman et al. (1992) reported that among the children with ADD in their sample, 51% met the criteria for at least one other psychiatric diagnosis; among adults in their sample, 77% had at least one comorbid psychiatric diagnosis

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- ❑ The generally reported rate of anxiety disorders in the general population of children is about 5%; among children with AD/HD the observed rate is approximately 25%.
- ❑ Similarly, elevated incidences of major depressive disorder, oppositional defiant disorder, conduct disorder, learning disorders, bipolar disorder, Tourette syndrome, substance abuse, and other psychiatric diagnoses are reported for children and adults with AD/HD.

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- ❑ The comorbidity between LD and AD/HD is reported to be between 10% and 92%, depending on the definition of LD (Semrud-Clikeman et al, 1992)
- ❑ There is evidence that AD/HD and LD are transmitted independently in families and that their co-occurrence may be a result of nonrandom mating. (Faraone et al, 1992)
- ❑ There is also evidence however that certain types of LD are genetically related to AD/HD (Light et al, 1995).

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- ❑ Dickerson et al. (2000) showed that among referred children diagnosed with AD/HD, 27% had a learning disorder in reading, 31% had a learning disorder in math, and 65% had a learning disorder in written expression.
- ❑ Among boys diagnosed with Reading Disorder, 60% met the DSM-IV criteria for inattention symptoms of AD/HD; among girls, it was 24% (Willcutt & Pennington, 2000)

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## Why Assess Comorbid Disorders?

- ❑ First, expect to find comorbid conditions—there is a strong likelihood that they are there.
- ❑ Comorbid disorders can be present actively or in remission.
- ❑ The severity of AD/HD symptoms and their responses to treatment may vary considerably as a function of increased or reduced severity of one of the comorbid disorders or interaction of changes in several comorbid disorders that may be present.

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## AD/HD as a Spectrum Disorder

- ❑ This dimensional “spectrum” approach to diagnosis seems especially appropriate for AD/HD because
  - AD/HD includes many variants of impairments in a wide range of cognitive executive functions
  - at the same time, these disparate impairments are related; they often appear concurrently, tend to run in families, and often respond to treatment with the same type of medications

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## Executive Function

- ❑ refers to a wide range of central control processes in the brain that connect, prioritize, and integrate operation of subordinate brain functions
- ❑ this central management system, often attributed to operations in the prefrontal cortex, is crucial to organizing and integrating cognitive processes over time and plays an increasingly important role as we mature

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❑ visualize executive function as the conductor of a symphony orchestra, who does not play a musical instrument in the orchestra but does play a critical role by enabling the orchestra to produce complex music. The conductor organizes, activates, focuses, integrates, and directs the musicians as they play. The brain's executive functions, in like fashion, organize, activate, focus, integrate, and direct, allowing the brain to perform both routine and creative work.

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### Historical Perspective

❑ The frontal lobes, which occupy over 1/3 of the human brain, are thought to be the primary locus of human creativity and other higher-level executive functions. In spite of this, few assessment instruments are available to clinicians specifically for evaluating these functions. Of those available, most were developed in the 1940's.

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### Comprehensiveness

❑ A critical need has been for a diverse armamentarium of executive function tests for assessing this complex and multifactorial domain of cognition in a more comprehensive manner. In addition, existing clinical instruments needed to be updated or developed into standardized clinical tools.

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## A Cognitive Process Approach

- ❑ With the exception of the *Wisconsin Card Sorting Test*, the gold standard of executive-function tests, most clinical instruments of higher-level cognitive functions yield a single score for each task. Kaplan (1988) has pointed out that reliance on a single score masks the multifarious nature of cognitive functions and is especially problematic with executive-function tasks because such tests typically tap both fundamental and higher-level cognitive skills. Individuals perform poorly for vastly different reasons.

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- ❑ A cognitive-process approach allows the component functions of higher-level cognitive tasks to be assessed.
  - by measuring the more fundamental cognitive skills on which the higher-level executive functions of a particular task depend, and
  - by measuring multiple higher-level cognitive functions that may contribute to successful performance on a particular task

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## Isolation of Fundamental Skills

- ❑ A myth underlying early executive-function tests was that deficient performance on such tests directly implicated frontal-lobe dysfunction.
- ❑ Successful performance on such tests invariably requires some combination of more fundamental cognitive skills, such as attention, perception, and language, and higher-level cognitive abilities, such as concept formation, inhibition, planning, and cognitive flexibility.

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- ❑ A breakdown in performance on executive-function tests can occur at any stage of cognitive processing, from lower-level basic skills to higher-level cognitive functions.
- ❑ Also, focal lesions in non-frontal cerebral regions, which often have their greatest effect on more fundamental cognitive abilities, can profoundly disrupt performance on executive-function tests.

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- ❑ It is therefore, a challenge to develop executive-function tests that provide, as much as possible, rigorous empirical means for determining whether poor performance is due to deficits in more fundamental cognitive skills or deficits in higher-level executive functions.

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## Developmental Demands

- ❑ Impairments in executive function may not become apparent until the individual is required to use this particular function.
  - Entry into nursery school gradually introduces the child to more demands for self-regulation and accommodation to the needs of others. Children whose executive function impairments include severe difficulties with inhibiting impulsive behavior are likely to be identified very early in their school careers.

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- Demands usually escalate rapidly in junior high school, high school, and the first 2 years of college when individuals are faced with the widest range of demands to organize and direct themselves in the broadest range of cognitive and social activities. Also parents and other adults are expected to decrease their management efforts when the child reaches early and middle adolescence.
- Executive function becomes progressively more necessary and complex as an individual gets older. Denckla (1996) suggests that growing up is essentially the development of competence in executive function. Dealing with multiple teachers, driving a car, managing finances, and parenting children place strong demands on executive function.

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## Some Executive Functions

Executive functions require several higher-level cognitive abilities for successful performance. These can be assessed with tasks that require:

- initiation of effortful and novel thinking
- isolation of a common feature or attribute from among the array of target stimuli
- formation of a higher-level concept that captures the defining properties of those common features
- flexibility of thinking in order to abandon one conceptual relationship in order to apprehend new ones

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## Short term memory is a critical element of attention

- role of working memory—a subset of short-term memory functions that hold and manipulate information currently being processed. Working memory holds the focus and immediate context of current attention and refers to the brain's capacity to keep "online" and actively use bits of information crucial for current functioning, while carrying on other functions.

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### Cognitive flexibility

- One of the hallmark executive functions attributed primarily to the frontal lobes is cognitive flexibility, or set shifting.
- This ability allows the individual to abandon a previous response in order to generate a novel response.
- It is one of the key attributes that give human beings the mental freedom to engage in creative thought.
- Historically, executive function tests have placed significant demands on cognitive switching (Wisconsin Card Sort and Trail Making Test).

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### Capture Stimuli

- Another classic executive function attributed primarily to the frontal lobes is the ability to inhibit responding to the immediate physical environment in order to free an individual to engage in abstract, creative thought.
- Difficulties can vary from subtle deficits, in which individuals are occasionally derailed from their higher-level mental activity by a salient physical stimulus, to profound dysfunction, in which the person's behavior is enslaved by stimulus-bound responding.

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### **AD/HD Executive Function Impairments and Learning**

Executive function impairments of AD/HD can have significant impact on learning and academic achievement, even when no specific learning disorder is present.

Can also have significant impact on social functioning.

- Children with AD/HD show impairments in their ability to monitor and correctly interpret emotions and actions in changing social situations.

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## **AD/HD Executive Function Impairments and Social Functioning**

Children with AD/HD show impairments in their ability to monitor and correctly interpret emotions and actions in changing social situations.

Henker & Whalen (1999) describe 3 problematic social behavior patterns

- aggressive/assertive
- active/maladroit
- withdrawn/avoiding

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## **Aggressive/assertive**

Oppositional behavior with adults and contentious or disruptive interaction with peers

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## **Active/maladroit**

Children who actively seek and enjoy interaction with peers, but are often rejected because they are too intense or too insensitive to the needs and behaviors of others

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## **Withdrawn/avoiding**

Children, often shy and seeming not to enjoy social contact with peers, who tend to avoid social participation, preferring isolated activities or interaction with adults.

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## **AD/HD Executive Function Impairments and Social Problems in Family Contexts**

Children with AD/HD often have a parent, sibling, or other close relative who also has AD/HD.

This can result in chronic stress within a family that may be less able to cope with the challenges.

Some families affected by AD/HD function quite well while others are severely dysfunctional.

Children with AD/HD may be more vulnerable to negative environmental influences such as chronic family stress.

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## **School-based Assessment for AD/HD**

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## Brown ADD Scales

- To elicit parent and teacher observations of symptoms in individuals from age 3 to adolescence, and to elicit self report from children ages 8 and older, that may indicate impairment in executive functions related to AD/HD.
- The scales provide descriptions of interrelated cognitive, affective, and behavioral symptoms often characteristic of persons diagnosed with AD/HD.

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- The profile of AD/HD symptoms these clients experience suggest that developmental impairments of executive functions are considerably broader and more complex than indicated by the current diagnostic criteria for AD/HD.
- The Scale is based on an Executive Functions deficit model.
- The Scale can assist in the identification of "educational need".

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## Typical ADHD symptoms

- Inattention**—chronic problems with
  - listening attentively
  - organizing their work
  - sustaining effort for tasks
  - screening out distractions
  - keeping track of assignments and belongings
  - excessive forgetfulness in daily activities

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**❑ Learning problems**

- ❑ trouble remembering what they have read or recalling what they have learned
- ❑ low grades may result from poor work performance
- ❑ inconsistent performance from day to day
- ❑ poor “work habits”—they have trouble starting a task and staying with a task to completion
- ❑ trouble participating in group learning experiences

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**❑ Problems with Social Behavior**

- ❑ trouble monitoring and correctly interpreting emotions in themselves and others
- ❑ frequently annoy peers or elicit rejection because of chronic difficulties in modulating their emotions and actions in changing social situations

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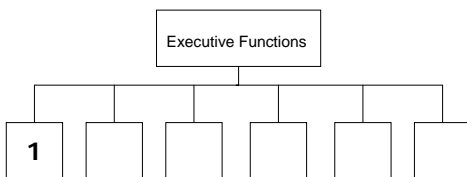
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**Brown ADD Scales for Children**



**1. Activation:** Organizing, Prioritizing and Activating to Work

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## Cluster 1 Activation

Elevated scores are often due primarily to chronic problems with organization, a chronically high threshold for arousal, and/or a chronically high level of anxiety that inhibits action.

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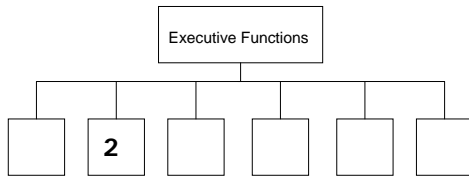
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## Brown ADD Scales for Children



**2. Attention:** Focusing, Sustaining and Shifting Attention to Tasks

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## Cluster 2 Attention

Elevated scores are often due to chronic problems in sustaining attention for tasks that are not self selected. Some relate to inattention in receptive modes; others relate to vulnerability to distraction in more active modes.

Some high scores are due to more fundamental problems in reading or language use that may be consistent with a separate LD diagnosis.

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**Brown ADD Scales for Children**

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graph TD
    EF[Executive Functions] --- B1[ ]
    EF --- B2[ ]
    EF --- B3[3]
    EF --- B4[ ]
    EF --- B5[ ]
    EF --- B6[ ]
    
```

**3. Effort:** Regulating Alertness, Sustaining Effort and Processing Speed

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**Cluster 3 Effort**

Elevated scores indicate problems sustaining alertness which may be associated with chronic sleep problems, or chronic lack of energy that may be interpreted as laziness.

When high score is matched with high score on Cluster 1, may reflect lethargic mode often seen in Predominantly Inattentive Type.

Scoring high might indicate a specific slowness in cognitive processing of information.

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**Brown ADD Scales for Children**

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graph TD
    EF[Executive Functions] --- B1[ ]
    EF --- B2[ ]
    EF --- B3[ ]
    EF --- B4[4]
    EF --- B5[ ]
    EF --- B6[ ]
    
```

**4. Emotion:** Managing Frustration and Modulating Emotions.

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## Cluster 4 Emotion

Elevated scores may indicate excessive vulnerability or sensitivity. Some of these children also exhibit excessive worry.

Some children scoring high on these items and on anxiety-related items in Cluster 1 may need to be examined further for Generalized Anxiety Disorder, Obsessive-Compulsive Disorder, or both.

Also contains items related to chronic unhappiness or depressive mood, and symptoms may reflect a Dysthymic Disorder or Major Depressive Disorder.

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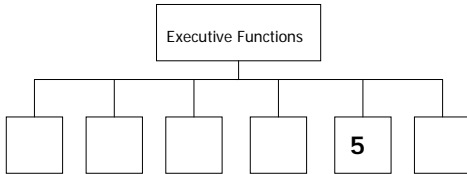
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## Brown ADD Scales for Children



**5. Memory:** Utilizing Working Memory and Accessing Recall

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## Cluster 5 Memory

Elevated scores are seen in children who often forget to bring home papers or books or to hand in homework they have completed.

Scores should be compared to standardized working memory test scores such as WISC III Digit Span or CMS Stories subtests.

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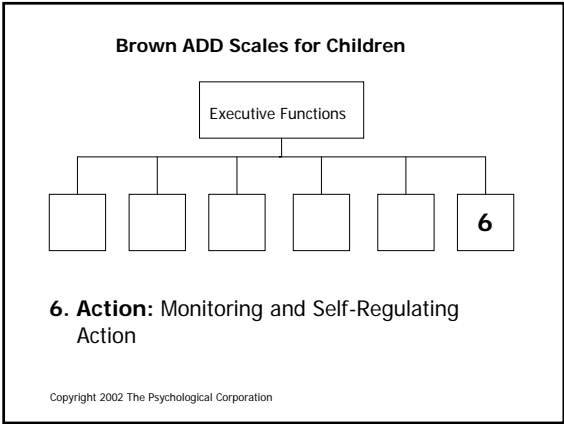
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**Cluster 6 Action**

Addresses problems related to self-regulation and may be typical of Predominantly Hyperactive-Impulsive or Combined Types of ADHD.

Also reflects problems in self-regulating the pace of action so that child fails to color within the lines or fails to write legibly or rides a bike into the street without looking.

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- Uses of Brown ADD Scales**
- Initial screening of children suspected of having ADHD
  - Comprehensive diagnostic assessment tool in a battery of assessment instruments
  - Results can help identify "educational need"
  - Test results can aid in the development of appropriate interventions
  - Can be used to evaluate which ADHD symptoms are responding to intervention
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## Using Diagnostic Forms

- A. Clinical interview with child and parents
- B. Threshold interpretation and cluster scores graphs
- C. Multi-rater evaluation form for DSM-IV AD/HD Diagnostic Criteria

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- D. Screener for other learning and psychiatric disorders
- E. Examiner's worksheet for comparing psychoeducational test scores
- F. Display of psychoeducational test scores
- G. Summary of diagnostic data and impressions

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## Conceptual Assumptions of Brown ADD Scales

- AD/HD impairments are dimensional disorders.
- AD/HD symptoms may vary according to task and context.
- Hyperactivity/impulsivity is **not** an essential element in AD/HD.

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Brown ADD Scales alone are not sufficient for making an AD/HD diagnosis. Within the more comprehensive diagnostic evaluation for AD/HD impairments, the Brown ADD Scales can serve to identify the presence, and gauge the intensity, of a variety of symptoms and to delineate the patterns of impairment.

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### **Delis-Kaplan Executive Function System**

- Ages 8- adulthood
- D-KEFS is the first nationally standardized set of tests to evaluate executive functions
- Assesses higher level thinking and cognitive flexibility
- Two forms are available to limit practice effects when used for pre- and post-testing.

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### **Comprehensive Evaluation Using 9 Tests**

- Card Sorting Test
  - Evaluates problem-solving, verbal and spatial concept formation, flexibility of thinking on a conceptual task
- Trail Making Test
  - Evaluates flexibility of thinking on a visual-motor task
- Verbal Fluency Test
  - Evaluates fluent productivity in the verbal domain

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- Design Fluency Test
  - Evaluates fluent productivity in the spatial domain
- Color-Word Interference Test
  - Evaluates verbal inhibition
- Tower Test
  - Evaluates planning and reasoning in the spatial modality; impulsivity
- 20 Questions Test
  - Hypothesis testing; evaluates verbal and spatial abstract thinking; impulsivity

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- Word Context Test
  - Evaluates deductive reasoning; verbal abstract thinking
- Proverb Test
  - Evaluates metaphorical thinking; generating versus comprehending abstract thought

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### Correlated

- with Wechsler Abbreviated Scale of Intelligence (WASI)
- with California Verbal Learning Test (CVLT-II)
- Provides information concerning the role of intellectual ability and memory on D-KEFS performance

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## Intervention

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## What Works?

- Behavior therapy
  - consistent behavior intervention based on positive reinforcement
  - use of response cost (e.g., losing tokens for undesirable behavior)
- Family understanding of AD/HD
  - parent training
  - counseling
  - support

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- A healthy sense of self-esteem
  - Experiences of success in which peer and family response to the child is positive and immediate
- Medical interventions
  - Drug therapy
- Educational interventions
  - Appropriate educational accommodations provided by knowledgeable teachers
- Counseling
  - Training in social skills, coping skills, and goal-directed strategies

[Clare Jones: *ADD: Strategies for School-Age Children*]

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## What Doesn't Work

- Any intervention in isolation from other interventions
- Megavitamin therapy
  - APA and AA Pediatrics have concluded there is no information justifying the use of very high doses of vitamins and minerals to treat AD/HD
- Dietary intervention
  - There is no research showing that reducing food coloring, food additives, and sugar offers significant help

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- Optometric vision training
  - AA Pediatrics, AA of Ophthalmology state there is no evidence that these programs are effective in treating reading or attention disorders
- Chiropractory treatment
  - No research has been done to support the effectiveness of this form of treatment
- Biofeedback: an inconclusive treatment
  - Barkley contends that the information collected to date was not collected in a scientifically valid way. The treatment is very expensive and long-term. Jury is still out on this one.

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## For the Classroom Teacher

- Three principles of instruction
  - brevity
  - variety
  - structure and routine (predictability)
- Ways to "connect"
  - The least effective way to correct a child with AD/HD is verbally.
  - Make eye contact
  - Stand in close proximity
  - Use strong facial gestures

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## Appropriate Accommodations

- Modified assignments
- Close monitoring of medication effects
- Reduced written or copying tasks
- Alternative testing methods
- Use of compensatory tools in classroom
- Advance notice and reminders of due dates
- Outline of class discussion including key vocabulary words

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- Supplement verbal instructions with visual information
- Use of peer tutor
- Copies of notes on a chapter provided directly to the student
- Modified textbooks or worksheets
- Provision on an extra book at home
- Buddy phone system of names to call when unsure of assignment
- A "directions helper" in class
- Modification of nonacademic time (lunch, recess, physical education)

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## 5 Important Questions Teachers Ask RE AD/HD

1. How can I help just one child in the room at a time? I have 30 other children in my class.

*The techniques for handling children with AD/HD are simply good teaching skills—and all children benefit from these strategies.*

*You are not the only teacher in the room, nor are you the only model. Children learn from their peers, from visuals, from what they read and do in class. You facilitate the environment so the students can learn. Make use of these "teachers".*

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2. When I do something for one student, say reducing a weekly spelling list to half the words, I don't feel I am being fair to the others. How can I handle this?

*First understand the distinction between fair and equal. Fair is helping you to do the best you can with the techniques I have. Equal is treating everyone the same.*

*The master teacher lets everyone know at the first of the year that accommodations will be made for individuals in the class. "I will offer you every strategy you may need when you are struggling. My goal is for all of you to learn. Let's all work together, but understand that we all learn differently."*

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3. How do I know the difference between attention deficit and just plain lazy?

*AD/HD is a fully encompassing situation. It doesn't just occur in your classroom, but everywhere in this child's life. Every child with AD/HD has a long history of difficulties. Talk to other teachers, to parents, to previous teachers. Gather data. There is a reality to this disorder, and it has not escaped observation by others in the child's life.*

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4. How can I motivate the child with AD/HD?

*How do you motivate any child? You find what interests him and use it as a factor in your instruction. We know that all children respond to strong visual hands-on presentations in school and opportunities to be leaders. A dynamic classroom, with a skilled teacher who is genuine in his or her presentation and provides opportunities for student feedback and success, can light this child's internal spark.*

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5. If I teach the student with AD/HD only one skill, what should it be?

*List making! Teach the child how to list tasks and then cross them off as they are accomplished.*

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### Study Tools for Students with AD/HD

- clipboard
- electronic hand speller with dictionary
- post-it notes
- post-it tape pop-ups
- 3-hole punch
- super-large, 3 ring notebook with colored dividers
- lightweight mechanic pencils and fine-tipped pens

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- colorful, stick-on dots
- small, hand-held tape recorder
- colorful highlighting markers
- index cards in a variety of colors
- memory tape recorder
- large, brightly colored paper clips
- personal organizational planners
- wall calendar at home
- phone-address book (filled in)

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**For more information**

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