

Attention Deficit Disorder

(Also known as ADHD, ADD, and Attention Deficit Hyperactivity Disorder)

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ADHD Basics

What is ADHD?

Attention-Deficit/Hyperactivity Disorder is the most common psychiatric condition among children in the United States. Differing estimates suggest that 3 percent to 10 percent of school-age children have ADHD, a disorder characterized by consistent inattention, hyperactivity, or impulsiveness. Diagnosing ADHD is difficult, since most people, and particularly children, are impulsive or inattentive some of the time. However, a patient with ADHD demonstrates these behaviors to a degree that is inappropriate to a person's age, according to guidelines from the National Institute of Mental Health.

A lifetime disorder

Although most cases of ADHD are diagnosed in children when they enter school for the first time, a growing number of children younger than 6 years old are being diagnosed. ADHD diagnoses among adults are also on the rise. ADHD expert Russell Barkley, Ph.D., of the Medical University of South Carolina, estimates that about 5 percent of American adults suffer from the condition. Some of these people may have had ADHD since childhood: Studies suggest that between 30 percent and 70 percent of children with ADHD continue to show symptoms of the disease as adults.

Co-existing conditions

Researchers have discovered that the disorder often coexists with other conditions like depression and anxiety. Recent studies show that teenagers and adults with ADHD are more likely to develop harmful health behaviors such as drug abuse and reckless driving. These comorbid conditions increase the personal and public health costs of ADHD.

Treatment options

A child with ADHD faces a difficult but not insurmountable task ahead. In order to achieve his or her full potential, he or she should receive help, guidance, and understanding from parents, guidance counselors, and the public education system. This section offers information on ADHD and its management, including research on medications and behavioral interventions, as well as helpful resources on educational options.

Because ADHD often continues into adulthood, this site also contains information on the diagnosis and treatment of [ADHD in adults](#).

Symptoms of ADHD

The principal characteristics of ADHD are inattention, hyperactivity, and impulsivity. These symptoms appear early in a child's life. Because many normal children may have these symptoms, but at a low level, or the symptoms may be caused by another disorder, it is important that the child receive a thorough examination and appropriate diagnosis by a well-qualified professional.

Symptoms of ADHD will appear over the course of many months, often with the symptoms of impulsiveness and hyperactivity preceding those of inattention, which may not emerge for a year or more. Different symptoms may appear in different settings, depending on the demands the situation may pose for the child's self-control. A child who "can't sit still" or is otherwise disruptive will be noticeable in school, but the inattentive daydreamer may be overlooked. The impulsive child who acts before thinking may be considered just a "discipline problem," while the child who is passive or sluggish may be viewed as merely unmotivated. Yet both may have different types of ADHD.

All children are sometimes restless, sometimes act without thinking, sometimes daydream the time away. When the child's hyperactivity, distractibility, poor concentration, or impulsivity begin to affect performance in school, social relationships with other children, or behavior at home, ADHD may be suspected. But because the symptoms vary so much across settings, ADHD is not easy to diagnose. This is especially true when inattentiveness is the primary symptom.

According to the most recent version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR), there are three patterns of

behavior that indicate ADHD. People with ADHD may show several signs of being consistently inattentive. They may have a pattern of being hyperactive and impulsive far more than others of their age. Or they may show all three types of behavior. This means that there are three subtypes of ADHD recognized by professionals. These are the predominantly hyperactive-impulsive type (that does not show significant inattention); the predominantly inattentive type (that does not show significant hyperactive-impulsive behavior) sometimes called ADD – an outdated term for this entire disorder; and the combined type (that displays both inattentive and hyperactive-impulsive symptoms).

Hyperactivity-Impulsivity

Hyperactive children always seem to be "on the go" or constantly in motion. They dash around touching or playing with whatever is in sight, or talk incessantly. Sitting still at dinner or during a school lesson or story can be a difficult task. They squirm and fidget in their seats or roam around the room. Or they may wiggle their feet, touch everything, or noisily tap their pencil. Hyperactive teenagers or adults may feel internally restless. They often report needing to stay busy and may try to do several things at once.

Impulsive children seem unable to curb their immediate reactions or think before they act. They will often blurt out inappropriate comments, display their emotions without restraint, and act without regard for the later consequences of their conduct. Their impulsivity may make it hard for them to wait for things they want or to take their turn in games. They may grab a toy from another child or hit when they're upset. Even as teenagers or adults, they may impulsively choose to do things that have an immediate but small payoff rather than engage in activities that may take more effort yet provide much greater but delayed rewards.

Some signs of hyperactivity-impulsivity are:

- Feeling restless, often fidgeting with hands or feet, or squirming while seated
- Running, climbing, or leaving a seat in situations where sitting or quiet behavior is expected
- Blurting out answers before hearing the whole question
- Having difficulty waiting in line or taking turns.

Inattention

Children who are inattentive have a hard time keeping their minds on any one thing and may get bored with a task after only a few minutes. If they are doing something they really enjoy, they have no trouble paying attention. But focusing deliberate, conscious attention to organizing and completing a task or learning something new is difficult.

Homework is particularly hard for these children. They will forget to write down an assignment, or leave it at school. They will forget to bring a book home, or bring the wrong one. The homework, if finally finished, is full of errors and erasures. Homework is often accompanied by frustration for both parent and child.

The DSM-IV-TR gives these signs of inattention:

- Often becoming easily distracted by irrelevant sights and sounds
- Often failing to pay attention to details and making careless mistakes
- Rarely following instructions carefully and completely losing or forgetting things like toys, or pencils, books, and tools needed for a task
- Often skipping from one uncompleted activity to another.

Children diagnosed with the Predominantly Inattentive Type of ADHD are seldom impulsive or hyperactive, yet they have significant problems paying attention. They appear to be daydreaming, "spacey," easily confused, slow moving, and lethargic. They may have difficulty processing information as quickly and accurately as other children. When the teacher gives oral or even written instructions, this child has a hard time understanding what he or she is supposed to do and makes frequent mistakes. Yet the child may sit quietly, unobtrusively, and even appear to be working but not fully attending to or understanding the task and the instructions.

These children don't show significant problems with impulsivity and overactivity in the classroom, on the school ground, or at home. They may get along better with other children than the more impulsive and hyperactive types of ADHD, and they may not have the same sorts of social problems so common with the combined type of ADHD. So often their problems with inattention are overlooked. But they need help just as much as children with other types of ADHD, who cause more obvious problems in the classroom.

Is It Really ADHD?

Not everyone who is overly hyperactive, inattentive, or impulsive has ADHD. Since most people sometimes blurt out things they didn't mean to say, or jump from one task to another, or become disorganized and forgetful, how can specialists tell if the problem is ADHD?

Because everyone shows some of these behaviors at times, the diagnosis requires that such behavior be demonstrated to a degree that is inappropriate for the person's age. The diagnostic guidelines also contain specific requirements for determining when the symptoms indicate ADHD. The behaviors must appear early in life, before age 7, and continue for at least 6 months. Above all, the behaviors must create a real handicap in at least two areas of a person's life such as in the schoolroom, on the playground, at home, in the community, or in social settings. So someone who shows some symptoms but whose schoolwork or friendships are not impaired by these behaviors would not be diagnosed with ADHD. Nor would a child who seems overly active on the playground but functions well elsewhere receive an ADHD diagnosis.

To assess whether a child has ADHD, specialists consider several critical questions: Are these behaviors excessive, long-term, and pervasive? That is, do they occur more often than in other children the same age? Are they a continuous problem, not just a response to a temporary situation? Do the behaviors occur in several settings or only in one specific place like the playground or in the schoolroom? The person's pattern of behavior is compared against a set of criteria and characteristics of the disorder as listed in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR.)

Diagnosis of ADHD

Some parents see signs of inattention, hyperactivity, and impulsivity in their toddler long before the child enters school. The child may lose interest in playing a game or watching a TV show, or may run around completely out of control. But because children mature at different rates and are very different in personality, temperament, and energy levels, it's useful to get an expert's opinion of whether the behavior is appropriate for the child's age. Parents can ask their child's pediatrician, or a child psychologist or psychiatrist, to assess whether their toddler has an attention deficit hyperactivity disorder or is, more likely at this age, just immature or unusually exuberant.

ADHD may be suspected by a parent or caretaker or may go unnoticed until the child runs into problems at school. Given that ADHD tends to affect functioning most strongly in school, sometimes the teacher is the first to recognize that a child is hyperactive or inattentive and may point it out to the parents and/or consult with the school psychologist. Because teachers work with many children, they come to know how "average" children behave in learning situations that require attention and self-control. However, teachers sometimes fail to notice the needs of children who may be more inattentive and passive yet who are quiet and cooperative, such as those with the predominantly inattentive form of ADHD.

Professionals who make the diagnosis

If ADHD is suspected, to whom can the family turn? What kinds of specialists do they need?

Ideally, the diagnosis should be made by a professional in your area with training in ADHD or in the diagnosis of mental disorders. Child psychiatrists and psychologists, developmental/behavioral pediatricians, or behavioral neurologists are those most often trained in differential diagnosis. Clinical social workers may also have such training.

The family can start by talking with the child's pediatrician or their family doctor. Some pediatricians may do the assessment themselves, but often they refer the family to an appropriate mental health specialist they know and trust. In addition, state and local agencies that serve families and children, as well as some of the volunteer organizations listed at the end of this document, can help identify appropriate specialists.

Specialty	Can diagnose ADHD	Can prescribe medication, if needed	Provides counseling or training
Psychiatrists	yes	yes	yes
Psychologists	yes	no	yes
Pediatricians or Family Physicians	yes	yes	no
Neurologists	yes	yes	no
Clinical Social Workers	yes	no	yes

Knowing the differences in qualifications and services can help the family choose someone who can best meet their needs. There are several types of specialists qualified to diagnose and treat ADHD. Child psychiatrists are doctors who specialize in diagnosing and treating childhood mental and behavioral disorders. A psychiatrist can provide therapy and prescribe any needed medications. Child psychologists are also qualified to diagnose and treat ADHD. They can provide therapy for the child and help the family develop ways to deal with the disorder. But psychologists are not medical doctors and must rely on the child's physician to do medical exams and prescribe medication. Neurologists, doctors who work with disorders of the brain and nervous system, can also diagnose ADHD and prescribe medicines. But unlike psychiatrists and psychologists, neurologists usually do not provide therapy for the emotional aspects of the disorder. Within each specialty, individual doctors and mental health professionals differ in their experiences with ADHD. So in selecting a specialist, it's important to find someone with specific training and experience in diagnosing and treating the disorder. Whatever the specialist's expertise, his or her first task is to gather information that will rule out other possible reasons for the child's behavior. Among possible causes of ADHD-like behavior are the following:

- A sudden change in the child's life – the death of a parent or grandparent; parents' divorce; a parent's job loss
- Undetected seizures, such as in petit mal or temporal lobe seizures
- A middle ear infection that causes intermittent hearing problems
- Medical disorders that may affect brain functioning
- Underachievement caused by learning disability
- Anxiety or depression

Ideally, in ruling out other causes, the specialist checks the child's school and medical records. There may be a school record of hearing or vision problems, since most schools automatically screen for these. The specialist tries to determine whether the home and classroom environments are unusually stressful or chaotic, and how the child's parents and teachers deal with the child.

Next the specialist gathers information on the child's ongoing behavior in order to compare these behaviors to the symptoms and diagnostic criteria listed in the Diagnostic and Statistical Manual of Mental

Disorders (DSM-IV-TR.) This also involves talking with the child and, if possible, observing the child in class and other settings.

The child's teachers, past and present, are asked to rate their observations of the child's behavior on standardized evaluation forms, known as behavior rating scales, to compare the child's behavior to that of other children the same age. While rating scales might seem overly subjective, teachers often get to know so many children that their judgment of how a child compares to others is usually a reliable and valid measure.

The specialist interviews the child's teachers and parents, and may contact other people who know the child well, such as coaches or baby-sitters. Parents are asked to describe their child's behavior in a variety of situations. They may also fill out a rating scale to indicate how severe and frequent the behaviors seem to be.

In most cases, the child will be evaluated for social adjustment and mental health. Tests of intelligence and learning achievement may be given to see if the child has a learning disability and whether the disability is in one or more subjects.

In looking at the results of these various sources of information, the specialist pays special attention to the child's behavior during situations that are the most demanding of self-control, as well as noisy or unstructured situations such as parties, or during tasks that require sustained attention, like reading, working math problems, or playing a board game. Behavior shown during free play or while getting individual attention is given less importance in the evaluation. In such situations, most children with ADHD are able to control their behavior and perform better than in more restrictive situations.

The specialist then pieces together a profile of the child's behavior. Which ADHD-like behaviors listed in the most recent DSM does the child show? How often? In what situations? How long has the child been doing them? How old was the child when the problem started? Are the behavior problems relatively chronic or enduring or are they periodic in nature? Are the behaviors seriously interfering with the child's friendships, school activities, home life, or participation in community activities? Does the child have any other related problems? The answers to these questions help identify whether the child's hyperactivity, impulsivity, and inattention are significant and long-standing. If so, the child may be diagnosed with ADHD.

A correct diagnosis often resolves confusion about the reasons for the child's problems that lets parents and child move forward in their lives with more accurate information on what is wrong and what can be

done to help. Once the disorder is diagnosed, the child and family can begin to receive whatever combination of educational, medical, and emotional help they need. This may include providing recommendations to school staff, seeking out a more appropriate classroom setting, selecting the right medication, and helping parents to manage their child's behavior.

What Causes ADHD?

One of the first questions a parent will have is "Why? What went wrong?" "Did I do something to cause this?" There is little compelling evidence at this time that ADHD can arise purely from social factors or child-rearing methods. Most substantiated causes appear to fall in the realm of neurobiology and genetics. This is not to say that environmental factors may not influence the severity of the disorder, and especially the degree of impairment and suffering the child may experience, but that such factors do not seem to give rise to the condition by themselves.

The parents' focus should be on looking forward and finding the best possible way to help their child. Scientists are studying causes in an effort to identify better ways to treat, and perhaps someday, to prevent ADHD. They are finding more and more evidence that ADHD does not stem from the home environment, but from biological causes. Knowing this can remove a huge burden of guilt from parents who might blame themselves for their child's behavior.

Over the last few decades, scientists have come up with possible theories about what causes ADHD. Some of these theories have led to dead ends, some to exciting new avenues of investigation.

Environmental agents

Studies have shown a possible correlation between the use of cigarettes and alcohol during pregnancy and risk for ADHD in the offspring of that pregnancy. As a precaution, it is best during pregnancy to refrain from both cigarette and alcohol use.

Another environmental agent that may be associated with a higher risk of ADHD is high levels of lead in the bodies of young preschool children. Since lead is no longer allowed in paint and is usually found only in older buildings, exposure to toxic levels is not as prevalent as it once was. Children who live in old buildings in which lead still exists in the plumbing or in lead paint that has been painted over may be at risk.

Brain injury

One early theory was that attention disorders were caused by brain injury. Some children who have suffered accidents leading to brain injury may show some signs of behavior similar to that of ADHD, but only a small percentage of children with ADHD have been found to have suffered a traumatic brain injury.

Food additives and sugar

It has been suggested that attention disorders are caused by refined sugar or food additives, or that symptoms of ADHD are exacerbated by sugar or food additives. In 1982, the National Institutes of Health held a scientific consensus conference to discuss this issue. It was found that diet restrictions helped about 5 percent of children with ADHD, mostly young children who had food allergies. A more recent study on the effect of sugar on children, using sugar one day and a sugar substitute on alternate days, without parents, staff, or children knowing which substance was being used, showed no significant effects of the sugar on behavior or learning.

In another study, children whose mothers felt they were sugar-sensitive were given aspartame as a substitute for sugar. Half the mothers were told their children were given sugar, half that their children were given aspartame. The mothers who thought their children had received sugar rated them as more hyperactive than the other children and were more critical of their behavior.

Genetics

Attention disorders often run in families, so there are likely to be genetic influences. Studies indicate that 25 percent of the close relatives in the families of ADHD children also have ADHD, whereas the rate is about 5 percent in the general population. Many studies of twins now show that a strong genetic influence exists in the disorder. Researchers continue to study the genetic contribution to ADHD and to identify the genes that cause a person to be susceptible to ADHD. Since its inception in 1999, the Attention-Deficit Hyperactivity Disorder Molecular Genetics Network has served as a way for researchers to share findings regarding possible genetic influences on ADHD.

Recent studies on causes of ADHD

Some knowledge of the structure of the brain is helpful in understanding the research scientists are doing in searching for a

physical basis for attention deficit hyperactivity disorder. One part of the brain that scientists have focused on in their search is the frontal lobes of the cerebrum. The frontal lobes allow us to solve problems, plan ahead, understand the behavior of others, and restrain our impulses. The two frontal lobes, the right and the left, communicate with each other through the corpus callosum, (nerve fibers that connect the right and left frontal lobes).

The basal ganglia are the interconnected gray masses deep in the cerebral hemisphere that serve as the connection between the cerebrum and the cerebellum and, with the cerebellum, are responsible for motor coordination. The cerebellum is divided into three parts. The middle part is called the vermis.

All of these parts of the brain have been studied through the use of various methods for seeing into or imaging the brain. These methods include functional magnetic resonance imaging (fMRI) positron emission tomography (PET), and single photon emission computed tomography (SPECT). The main or central psychological deficits in those with ADHD have been linked through these studies. By 2002 the researchers in the NIMH Child Psychiatry Branch had studied 152 boys and girls with ADHD, matched with 139 age- and gender-matched controls without ADHD. The children were scanned at least twice, some as many as four times over a decade. As a group, the ADHD children showed 3-4 percent smaller brain volumes in all regions – the frontal lobes, temporal gray matter, caudate nucleus, and cerebellum. This study also showed that the ADHD children who were on medication had a white matter volume that did not differ from that of controls. Those never-medicated patients had an abnormally small volume of white matter. The white matter consists of fibers that establish long-distance connections between brain regions. It normally thickens as a child grows older and the brain matures.

Although this long-term study used MRI to scan the children's brains, the researchers stressed that MRI remains a research tool and cannot be used to diagnose ADHD in any given child. This is true for other neurological methods of evaluating the brain, such as PET and SPECT.

Other Disorders That Sometimes Accompany ADHD

Learning disabilities

Many children with ADHD – approximately 20 to 30 percent – also have a specific learning disability (LD).¹⁰ In preschool years, these disabilities include difficulty in understanding certain sounds or words and/or difficulty in expressing oneself in words. In school age children, reading or spelling disabilities, writing disorders, and arithmetic disorders may appear. A type of reading disorder, dyslexia, is quite widespread. Reading disabilities affect up to 8 percent of elementary school children.

Tourette Syndrome

A very small proportion of people with ADHD have a neurological disorder called Tourette syndrome. People with Tourette syndrome have various nervous tics and repetitive mannerisms, such as eye blinks, facial twitches, or grimacing. Others may clear their throats frequently, snort, sniff, or bark out words. These behaviors can be controlled with medication. While very few children have this syndrome, many of the cases of Tourette syndrome have associated ADHD. In such cases, both disorders often require treatment that may include medications.

Oppositional defiant disorder

As many as one-third to one-half of all children with ADHD – mostly boys – have another condition, known as oppositional defiant disorder (ODD). These children are often defiant, stubborn, non-compliant, have outbursts of temper, or become belligerent. They argue with adults and refuse to obey.

Conduct disorder

About 20 to 40 percent of ADHD children may eventually develop conduct disorder (CD), a more serious pattern of antisocial behavior. These children frequently lie or steal, fight with or bully others, and are at a real risk of getting into trouble at school or with the police. They violate the basic rights of other people, are aggressive toward people and/or animals, destroy property, break into people's homes,

commit thefts, carry or use weapons, or engage in vandalism. These children or teens are at greater risk for substance use experimentation, and later dependence and abuse. They need immediate help.

Anxiety and depression

Some children with ADHD often have co-occurring anxiety or depression. If the anxiety or depression is recognized and treated, the child will be better able to handle the problems that accompany ADHD. Conversely, effective treatment of ADHD can have a positive impact on anxiety as the child is better able to master academic tasks.

Bipolar disorder

There are no accurate statistics on how many children with ADHD also have bipolar disorder. Differentiating between ADHD and bipolar disorder in childhood can be difficult. In its classic form, bipolar disorder is characterized by mood cycling between periods of intense highs and lows. But in children, bipolar disorder often seems to be a rather chronic mood dysregulation with a mixture of elation, depression, and irritability. Furthermore, there are some symptoms that can be present both in ADHD and bipolar disorder, such as a high level of energy and a reduced need for sleep. Of the symptoms differentiating children with ADHD from those with bipolar disorder, elated mood and grandiosity of the bipolar child are distinguishing characteristics.

Central Auditory Processing

Auditory processing is the term used to describe what happens when your brain recognizes and interprets the sounds around you. Humans hear when energy that we recognize as sound travels through the ear and is changed into electrical information that can be interpreted by the brain. The "disorder" part of auditory processing disorder (APD) means that something is adversely affecting the processing or interpretation of information.

Children with APD often do not recognize subtle differences between sounds in words, even though the sounds themselves are loud and clear. For example, the request "Tell me how a chair and a couch are alike" may sound to a child with APD like "Tell me how a couch and a chair are alike." It can even be understood by the child as "Tell me

how a cow and a hair are alike." These kinds of problems are more likely to occur when a person with APD is in a noisy environment or when he or she is listening to complex information.

APD goes by many other names. Sometimes it is referred to as central auditory processing disorder (CAPD). Other common names are auditory perception problem, auditory comprehension deficit, central auditory dysfunction, central deafness, and so-called "word deafness."

Central Auditory Processing Disorder: When is Evaluation Referral Indicated?

By: Sandra Cleveland (1997)

The comorbidity of central auditory processing disorders with attention deficit disorders has been well documented. But often a child's initial diagnosis depends largely on whether he or she is seen by an audiologist or psychologist. Therefore, it is important that professionals be aware of when an auditory attention deficit and central auditory processing disorder may comorbidly exist in order to make appropriate referrals for further evaluation.

It is often suggested that a child with an attention deficit be referred for an auditory processing evaluation when school performance is poor or when tasks that require listening skills are problematic.

This certainly would appear instructive when evaluating an older child. However, in younger children the manifestation of symptoms may be subtle and not apparent when evaluating academic functioning.

Subsequently, referral for an auditory processing evaluation may be delayed. Therefore, it is important to recognize additional factors that may flag the need for referral to an audiologist.

The American Speech-Language-Hearing Association (ASHA) Task Force on Central Auditory Processing Consensus Development has defined auditory processing disorder as "a deficiency in one or more of the following phenomena: sound localization and lateralization, auditory discrimination, auditory pattern recognition, recognition of temporal aspects of audition, auditory performance decrease with competing acoustic signals, and auditory performance decrease with

degraded signals." They further indicate that auditory processing disorders may stem from, or coexist with attentional deficit disorders. The prerequisites for auditory processing are as follows: auditory attention, auditory memory, motivation, maturation and integrity of the auditory pathways, decision processes, and use of linguistic cues such as grammar, meaning in context, and lexical representations. All auditory tasks are influenced by these factors. Difficulties in many of these areas are common to both children with central auditory processing difficulties and children diagnosed with attention deficit disorders, and it has been reported that both groups can show difficulties paying attention, following directions, are hyperactive, distracted, and can become easily frustrated. Organizing and sequencing information presented via the auditory track is also problematic. These characteristics can also be seen in children with learning disabilities, behavioral problems, or emotional disorders. Separating the above groups requires cooperation among professionals in order for the appropriate remedial plans to be devised.

Risk factors

In addition to poor academic functioning, the following risk factors or indicators may assist the professional in making a referral for an auditory processing evaluation in a timely manner.

A family history of auditory processing difficulties can be an indicator for referral. It is not uncommon to find that children with auditory processing difficulties have a family member who has had similar difficulties.

A second genetic influence that should prompt a referral to an audiologist is a family history of peripheral hearing loss. Peripheral hearing loss must be ruled out or confirmed prior to a diagnosis of attention deficit or central auditory processing disorder. Not only is early identification of a hearing loss critical, but children or adults with hearing loss certainly have greater than normal difficulty attending to auditorily presented information. What might appear as a processing problem or attentional deficit may reflect the reduction or distortion of auditory signals. However, the presence of a peripheral hearing loss does not exclude the possibility that the individual also has an attentional deficit or auditory processing problem.

A history of otitis media in early childhood is another factor that may indicate the need for an auditory processing evaluation, as otitis media can have an adverse effect on the development of auditory processing

abilities . The age of onset, number of episodes, and duration, are important factors. Hohn and Kunze found that auditory skills were significantly depressed in those children with a significant history of otitis media in early life. Visual skills and other cognitive tasks were not significantly different between the two groups. Research using a prospective study design was completed by Schilder and colleagues. They found that children with a history of persistent otitis media at a preschool age showed only slight effects on their ability to discriminate speech in noise. However, the subjects in this study received ventilation tubes on a routine basis if the episode of otitis media persisted for more than 2-3 months. This illustrates the effects of duration of the otitis media episode on the development of auditory processing skills.

Familial handedness is another factor which should be explored. Not only has it been found that an individual's hand preference is a diagnostic indicator, but also that a familial history of handedness can help to predict brain organization for language processing.

A hypersensitivity to loud sound or distractibility in noise may be additional indicators for referral. It has long been assumed that children with auditory processing disorders have a lower tolerance for loud sounds due to abnormal central suppression effects. Likewise, Geffner, Lucker, and Koch found that children with attention deficit disorder had significant differences (from normal controls) in their preferences for comfortable listening levels and tolerance of loud sounds. This raises the question of whether children with attentional disorders have deficits in central suppression that need to be evaluated for appropriate management in the classroom.

A child presenting with developmental speech and language delays, including articulation problems, can also be at risk for central auditory processing problems. Even a past history of speech and language delay may place the child at risk for associated central auditory processing difficulties and a referral may be indicated. Children having delays in these areas generally have poor phonic ability and subsequent difficulties in reading and spelling. Central auditory processing tasks involving blending, closure, and sequencing can be an area of weakness in these children.

Evaluation

The purpose of the central auditory processing evaluation is to help define the specific auditory processing difficulties that a child may be

experiencing and to recommend appropriate remediation. Performance on auditory processing tests is measured according to chronological age expectancies. It is generally believed that development of the auditory processing pathways continues up to age 12 or 13. The premise of testing is that degraded speech, or speech in noise, will tax the auditory pathways of the central nervous system more than recognition of unaltered speech or speech in quiet. An individual with normal central auditory processing abilities can, to some extent, compensate for these degraded signals, whereas an individual with a central auditory processing deficit cannot.

Early work on central auditory processing was completed on brain-lesioned adults. Words were filtered in order to reduce intelligibility. Results of Bocca and colleague's research indicated that discrimination was poorer in the ear opposite the side of the lesion. Research evaluating the effects of manipulation of the speech or tonal signals on auditory perception continues to date. For an extensive review of the major developments that have occurred in the area of central auditory processing, the reader is referred to an article by Musiek and Baron. Behavioral measures presently used include the various manipulations of speech and non-speech signals such that they are frequency-distorted, compressed in time, or are administered in the presence of a competing signal (e.g., noise). Materials are also presented in a dichotic mode such that different signals are presented to each ear simultaneously, requiring the individual to either separate or synthesize the information. Ideally, an auditory processing test battery will include a variety of measures that correlate with different central auditory processing skills and behaviors in the classroom.

Temporal processes have been found to correlate with spelling and reading skills. The temporal processes are evaluated using tests that require the individual to perceive patterns (e.g., tonal patterns) and to then verbalize the sequence (e.g., High-High-Low). The premise of temporal processing tests is that an interaction between both hemispheres of the brain is needed in order to decode patterns and report them verbally.

Low-redundancy speech materials assess the processing of speech that has been filtered or is masked by a competing signal such as noise. These materials have been altered so that the extrinsic cues in the signal have been reduced. The individual then needs to rely on the intrinsic cues provided by their auditory systems to perceive the signal. If intrinsic redundancy is compromised, performance will be adversely affected. Performance on these tests frequently correlate

with speech discrimination ability in a classroom where background noise is present or where reverberation of the sound source is causing distortion of the primary signal.

The interaction between the right and left hemispheres, and subsequently maturation of the auditory system, is evaluated using dichotic tasks. These materials present different stimuli to each ear simultaneously and require the listener to repeat the two signals heard. Prior to complete maturation of the auditory system or, in cases of dysfunction, sounds heard in the less dominant ear (generally left ear) are "beaten out" by signals presented to the more dominant ear. Research evaluating performance on dichotic tasks has shown promise in assisting the professional in making a differential diagnosis between children with attention deficit and auditory processing disorders and those with only attention deficit or auditory processing disorders. Binaural interaction tasks evaluate the ability of the brainstem to synthesize partial auditory information presented to each ear into a complete intelligible message. Children having difficulties on these tasks are often found to have difficulty listening in the presence of background noise.

Phonemic synthesis and sound blending are other skills evaluated. Difficulties in these areas frequently can be seen in children having reading, spelling, and language problems.

Physiologic measures include evoked potentials testing and otoacoustic emissions evaluation. Research utilizing these measures and associating results with their behavioral correlates is in its infancy. These measures assess electrophysiologic measures of the auditory system relating to such phenomena as attention, detection of signals in noise, and perception of signals.

Management

Management techniques are generally classified into two categories: enhancement of the primary signal via manipulation of the listening environment, and specific training of auditory skills. The latter will frequently include the teaching of compensatory strategies that allow the child to better function in the classroom and at home. The below discussion mentions only a few of the many recommendations that may be made for a child with an auditory processing disorder.

The presence of background noise or acoustic reverberation of the speech signal can significantly compromise the child's ability to receive the desired speech signals. Reduction of noise in the classroom can be

accomplished by acoustic treatment of the room by use of acoustic tiling, draperies, or carpets. Reverberation of speech will likewise be reduced with such modifications. Further, teachers should be aware that when he or she speaks toward a reverberant surface such as the chalkboard, the speech signals will most likely be distorted. A visual display of information presented auditorily can be useful. In addition to the above suggestions aimed at improving the signal quality, the primary signal can be enhanced by increasing the volume of the desired signal. This can be accomplished via the use of preferential seating toward the primary speaker, or by use of an amplification device such as a wireless F.M. system, a device worn by both the child and by the primary speaker. The child wears a headset and receiver which is coupled similar to a personal stereo. The speaker uses a lapel-worn microphone. Use of this F.M. system helps to maximize the level of the teacher's voice, and background noise and poor acoustics are minimized since the child receives the teacher's voice as if in a one-to-one listening situation. Fitting of such a system needs to be completed by an audiologist in order to minimize any adverse effects.

Specific training of auditory skills and compensatory strategies is generally provided by a speech and language pathologist. Young children diagnosed as having auditory processing disorders should be seen by a speech and language pathologist in order to determine if subtle language deficits are impacting on their ability to process speech. Emphasis of training can revolve around increasing knowledge of phonology, grammar, vocabulary, and world knowledge in order to help the child "fill in the blanks" of a message that may be unclear.

Conclusions

Auditory processing disorders comorbidly exist with attention deficit disorders. Our means of identifying this coexistence is many times more an art than a science. Research continues to assist in the differential diagnosis of these two disorders. Until further indicators are developed, awareness on the part of the professional may help in the identification process.

About the author

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Central Auditory Processing Disorder: When is Evaluation Referral Indicated?

By: Sandra Cleveland (1997)

The comorbidity of central auditory processing disorders with attention deficit disorders has been well documented. But often a child's initial diagnosis depends largely on whether he or she is seen by an audiologist or psychologist. Therefore, it is important that professionals be aware of when an auditory attention deficit and central auditory processing disorder may cormorbidly exist in order to make appropriate referrals for further evaluation.

It is often suggested that a child with an attention deficit be referred for an auditory processing evaluation when school performance is poor or when tasks that require listening skills are problematic.

This certainly would appear instructive when evaluating an older child. However, in younger children the manifestation of symptoms may be subtle and not apparent when evaluating academic functioning.

Subsequently, referral for an auditory processing evaluation may be delayed. Therefore, it is important to recognize additional factors that may flag the need for referral to an audiologist.

The American Speech-Language-Hearing Association (ASHA) Task Force on Central Auditory Processing Consensus Development has defined auditory processing disorder as "a deficiency in one or more of the following phenomena: sound localization and lateralization, auditory discrimination, auditory pattern recognition, recognition of temporal aspects of audition, auditory performance decrease with competing acoustic signals, and auditory performance decrease with degraded signals." They further indicate that auditory processing disorders may stem from, or coexist with attentional deficit disorders.

The prerequisites for auditory processing are as follows: auditory attention, auditory memory, motivation, maturation and integrity of the auditory pathways, decision processes, and use of linguistic cues such as grammar, meaning in context, and lexical representations. All auditory tasks are influenced by these factors. Difficulties in many of these areas are common to both children with central auditory processing difficulties and children diagnosed with attention deficit disorders , and it has been reported that both groups can show

difficulties paying attention, following directions, are hyperactive, distracted, and can become easily frustrated. Organizing and sequencing information presented via the auditory track is also problematic. These characteristics can also be seen in children with learning disabilities, behavioral problems, or emotional disorders. Separating the above groups requires cooperation among professionals in order for the appropriate remedial plans to be devised.

Risk factors

In addition to poor academic functioning, the following risk factors or indicators may assist the professional in making a referral for an auditory processing evaluation in a timely manner.

A family history of auditory processing difficulties can be an indicator for referral. It is not uncommon to find that children with auditory processing difficulties have a family member who has had similar difficulties.

A second genetic influence that should prompt a referral to an audiologist is a family history of peripheral hearing loss. Peripheral hearing loss must be ruled out or confirmed prior to a diagnosis of attention deficit or central auditory processing disorder. Not only is early identification of a hearing loss critical, but children or adults with hearing loss certainly have greater than normal difficulty attending to auditorily presented information. What might appear as a processing problem or attentional deficit may reflect the reduction or distortion of auditory signals. However, the presence of a peripheral hearing loss does not exclude the possibility that the individual also has an attentional deficit or auditory processing problem.

A history of otitis media in early childhood is another factor that may indicate the need for an auditory processing evaluation, as otitis media can have an adverse effect on the development of auditory processing abilities. The age of onset, number of episodes, and duration, are important factors. Hohn and Kunze found that auditory skills were significantly depressed in those children with a significant history of otitis media in early life. Visual skills and other cognitive tasks were not significantly different between the two groups. Research using a prospective study design was completed by Schilder and colleagues. They found that children with a history of persistent otitis media at a preschool age showed only slight effects on their ability to discriminate speech in noise. However, the subjects in this study received ventilation tubes on a routine basis if the episode of otitis media

persisted for more than 2-3 months. This illustrates the effects of duration of the otitis media episode on the development of auditory processing skills.

Familial handedness is another factor which should be explored. Not only has it been found that an individual's hand preference is a diagnostic indicator, but also that a familial history of handedness can help to predict brain organization for language processing.

A hypersensitivity to loud sound or distractibility in noise may be additional indicators for referral. It has long been assumed that children with auditory processing disorders have a lower tolerance for loud sounds due to abnormal central suppression effects. Likewise, Geffner, Lucker, and Koch found that children with attention deficit disorder had significant differences (from normal controls) in their preferences for comfortable listening levels and tolerance of loud sounds. This raises the question of whether children with attentional disorders have deficits in central suppression that need to be evaluated for appropriate management in the classroom.

A child presenting with developmental speech and language delays, including articulation problems, can also be at risk for central auditory processing problems. Even a past history of speech and language delay may place the child at risk for associated central auditory processing difficulties and a referral may be indicated. Children having delays in these areas generally have poor phonic ability and subsequent difficulties in reading and spelling. Central auditory processing tasks involving blending, closure, and sequencing can be an area of weakness in these children.

Evaluation

The purpose of the central auditory processing evaluation is to help define the specific auditory processing difficulties that a child may be experiencing and to recommend appropriate remediation. Performance on auditory processing tests is measured according to chronological age expectancies. It is generally believed that development of the auditory processing pathways continues up to age 12 or 13. The premise of testing is that degraded speech, or speech in noise, will tax the auditory pathways of the central nervous system more than recognition of unaltered speech or speech in quiet. An individual with normal central auditory processing abilities can, to some extent, compensate for these degraded signals, whereas an individual with a central auditory processing deficit cannot.

Early work on central auditory processing was completed on brain-lesioned adults. Words were filtered in order to reduce intelligibility. Results of Bocca and colleague's research indicated that discrimination was poorer in the ear opposite the side of the lesion. Research evaluating the effects of manipulation of the speech or tonal signals on auditory perception continues to date. For an extensive review of the major developments that have occurred in the area of central auditory processing, the reader is referred to an article by Musiek and Baron. Behavioral measures presently used include the various manipulations of speech and non-speech signals such that they are frequency-distorted, compressed in time, or are administered in the presence of a competing signal (e.g., noise). Materials are also presented in a dichotic mode such that different signals are presented to each ear simultaneously, requiring the individual to either separate or synthesize the information. Ideally, an auditory processing test battery will include a variety of measures that correlate with different central auditory processing skills and behaviors in the classroom.

Temporal processes have been found to correlate with spelling and reading skills. The temporal processes are evaluated using tests that require the individual to perceive patterns (e.g., tonal patterns) and to then verbalize the sequence (e.g., High-High-Low). The premise of temporal processing tests is that an interaction between both hemispheres of the brain is needed in order to decode patterns and report them verbally.

Low-redundancy speech materials assess the processing of speech that has been filtered or is masked by a competing signal such as noise. These materials have been altered so that the extrinsic cues in the signal have been reduced. The individual then needs to rely on the intrinsic cues provided by their auditory systems to perceive the signal. If intrinsic redundancy is compromised, performance will be adversely affected. Performance on these tests frequently correlate with speech discrimination ability in a classroom where background noise is present or where reverberation of the sound source is causing distortion of the primary signal.

The interaction between the right and left hemispheres, and subsequently maturation of the auditory system, is evaluated using dichotic tasks. These materials present different stimuli to each ear simultaneously and require the listener to repeat the two signals heard. Prior to complete maturation of the auditory system or, in cases of dysfunction, sounds heard in the less dominant ear (generally left ear) are "beaten out" by signals presented to the more dominant ear.

Research evaluating performance on dichotic tasks has shown promise in assisting the professional in making a differential diagnosis between children with attention deficit and auditory processing disorders and those with only attention deficit or auditory processing disorders. Binaural interaction tasks evaluate the ability of the brainstem to synthesize partial auditory information presented to each ear into a complete intelligible message. Children having difficulties on these tasks are often found to have difficulty listening in the presence of background noise.

Phonemic synthesis and sound blending are other skills evaluated. Difficulties in these areas frequently can be seen in children having reading, spelling, and language problems.

Physiologic measures include evoked potentials testing and otoacoustic emissions evaluation. Research utilizing these measures and associating results with their behavioral correlates is in its infancy. These measures assess electrophysiologic measures of the auditory system relating to such phenomena as attention, detection of signals in noise, and perception of signals.

Management

Management techniques are generally classified into two categories: enhancement of the primary signal via manipulation of the listening environment, and specific training of auditory skills. The latter will frequently include the teaching of compensatory strategies that allow the child to better function in the classroom and at home. The below discussion mentions only a few of the many recommendations that may be made for a child with an auditory processing disorder.

The presence of background noise or acoustic reverberation of the speech signal can significantly compromise the child's ability to receive the desired speech signals. Reduction of noise in the classroom can be accomplished by acoustic treatment of the room by use of acoustic tiling, draperies, or carpets. Reverberation of speech will likewise be reduced with such modifications. Further, teachers should be aware that when he or she speaks toward a reverberant surface such as the chalkboard, the speech signals will most likely be distorted. A visual display of information presented auditorily can be useful. In addition to the above suggestions aimed at improving the signal quality, the primary signal can be enhanced by increasing the volume of the desired signal. This can be accomplished via the use of preferential seating toward the primary speaker, or by use of an amplification

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The information contained in this document is intended only as a resource and should be used as a guide. It is not medical or legal advice or an endorsement of the programs or services referenced. You must determine what is best for your child and your family. You are strongly encouraged to seek additional information from other resources, including your physician, social worker, insurance company and school personnel.