Attention Deficit Hyperactivity Disorder

Sometimes, Shannon’s so lost in her own thoughts that it seems like she’s daydreaming. And then other times, if she’s working in a group at one side of the room and somebody says something about a planet—or just says some word that sounds like a planet’s name—she’ll pick up on that and forget about the lesson.

Jude Robinson, Shannon’s sixth-grade teacher

Researchers have documented that many students with learning disabilities have attention problems. Using a variety of laboratory tasks as well as behavioral observation in classrooms, they have shown that students with learning disabilities often have difficulty with many aspects of attention (Paivio &国内外，1989). In addition, research on sustaining attention or tracking in academic tasks has shown that they often have problems with distractibility and selective attention. As we see from the evidence above, Mr. Robinson was all too aware of Shannon’s tendency to have difficulty with her distractibility. And Shannon’s distractibility also led her to problems in selective attention. Selective attention is the ability to focus on the task at hand without being distracted by extraneous aspects. Over the years, many of Shannon’s teachers have commented on how much difficulty she has focusing her attention. For example, her fourth-grade special education teacher recalled that Shannon might have problems finishing a worksheet on time, could have trouble recalling the number of crayons on a page, and would have trouble completing a task without being distracted by extraneous aspects.

What Are the Links between Learning Disabilities and Attention Problems?

Shannon was formally diagnosed as having attention deficit hyperactivity disorder (ADHD). The fact that Shannon has both learning disabilities and ADHD does not make her unusual. In fact, learning disabilities and ADHD often go hand in hand.
hand. Girls with ADHD, in particular, tend to have poorer academic achievement than do boys with ADHD (Gebhard, 2002). Studies estimate, but a conservative estimate is that about 20% of students identified as having learning disabilities could also be diagnosed as having ADHD (Ruccio, Gonzalez, & Hynd, 1994). Still other students, like Jamal, have symptoms of inattention and poor impulse control that are not severe enough to warrant a diagnosis of ADHD but still interfere significantly with academic and social functioning.

There are at least three reasons why ADHD and academic dysfunction. According to R. C. Guare (1994), these reasons include:

1. The learning disability may precede the attention problems. Students may develop inattentive behaviors because of being frustrated by repeated failures.
2. The attention problems may precede the learning disability. Inattention may result in the student failing to process important academic instruction, thus causing the student to fall behind.
3. The attention problems and learning disabilities may be separate conditions that co-occur.

It is very difficult to tell which of the three scenarios, or combination of scenarios, applies for individuals who have both learning disabilities and ADHD. As we discuss later, heredity figures in as a cause of ADHD, just as it does for learning disabilities. This has led researchers to explore whether there is a genetic link between learning disabilities and ADHD. Thus far, the evidence favors the conclusion that different genes are involved in the two conditions (Barley, 2000).

What Are the Historical Origins of ADHD?
The most striking thing you find when considering the development of the category of ADHD is that a variety of labels have been used to refer to this condition. This maze of terminology reflects the fact that researchers and practitioners have struggled to determine what exactly is the core symptom. Is it hyperactivity? Is it inattention? Is it some combination of the two? Or, as many now believe, is the primary cause a problem with self-control? Interestingly, George F. Still, the first to bring the condition we now call ADHD to the attention of the scientific community, focused on the issue of self-control.

Early Observations of ADHD Symptoms
In 1902, George F. Still delivered a series of lectures to the Royal College of Physicians in London in which he described a number of cases of children with a common set of behaviors (Still, 1902). In addition to displaying disobedience, inattention, and hyperactivity, these children also showed an inability to refrain from engaging in impulsive, inappropriate behavior (Still, 1902).

Other characteristics were similar to what has been identified as ADHD:

1. He believed that many of the children had mild brain pathology.
2. Many of the children had normal intelligence.
3. A greater percentage of the cases were boys than girls.
4. He speculated that there was a hereditary basis to the condition.
5. Many of the children also had other symptoms, such as depression and tics.

The Strauss Syndrome
Following an outbreak in 1917 of encephalitis, an infection of the brain, a number of children in the United States were left with a variety of behavioral problems. Chief among the symptoms exhibited by these affected children were inattention, impulsivity, and hyperactivity. Through several reports in the medical literature, many physicians and educators thus became aware of the significant effects brain damage could have on cognitive and behavioral functioning.

In the 1930s and 1940s, Heinz Werner and Alfred Strauss, who worked at a residential institution for children with mental retardation, noticed that many of the children exhibited the same behaviors as those attributable to brain injury. These researchers conducted a series of experiments in which they compared the performance of supposedly brain-injured children with mental retardation to that of non-brain-injured children with mental retardation on a variety of figure-background tasks (Strauss & Werner, 1942; Werner & Strauss, 1939, 1940, 1941). For example, each child was shown slides of familiar objects (e.g., sailboat, hat, iron, cup) embedded in backgrounds (e.g., wavy lines) at very fast exposure times, such as half a second. (See Figure 9.1.) When asked what they had seen, the children in

![Figure 9.1: Example of a Slide from Werner and Strauss's Figure-Background Test](source: From: Psychopathology and Education of the Brain-Injured Child (p. 47), by A. A. Strauss and L. E. Lebovici, 1947, New York: Grune & Stratton. Copyright 1947 by Grune & Stratton. Reprinted by permission.)
the brain-injured group were more likely to refer to the background and less likely to recall the figure correctly. Werner and Strauss saw this as indicative of their distractibility.

Werner and Strauss’s work was deservedly criticized on the grounds that the diagnostic classification of their children as brain-injured was faulty; however, they did find a subgroup of students with mental retardation, brain-injured or not, who were highly distractible. Their work brought attention to the particularly devastating consequences that distractibility and hyperactivity can have on children’s functioning. Children with high levels of distractibility and hyperactivity soon came to be referred to as exhibiting the Strauss syndrome.

The Bridge from Mental Retardation to Normal Intelligence

More than a decade after Werner and Strauss’s work, William Cruickshank replicated their findings. But instead of looking at students who were mentally retarded, he tested the figure-background abilities of students with cerebral palsy who were of normal-normal, or above-normal intelligence (Cruickshank, Rice, & Walden, 1957). Unlike the children studied by Werner and Strauss, there was little doubt that the students studied by Cruickshank were brain injured. Cerebral palsy, a relatively early condition to diagnose in young children, is characterized by problems in movement and results from damage to the motor areas of the brain.

The finding of distractibility in students with cerebral palsy who were not mentally retarded served as a conceptual bridge between persons with mental retardation and those of average intelligence. Thus, by showing that a person can have normal intelligence and yet display inattention and hyperactivity, this research paved the way for linking attention problems with learning disabilities, which, by definition, can occur in students of average or above-average intelligence.

Bolstered by the results of his study of students with cerebral palsy, Cruickshank went on to set up educational programs for children who today would be referred to as having learning disabilities and/or ADHD. These were students whose intelligence levels were above those of persons with mental retardation but who exhibited academic achievement problems and high levels of inattention and hyperactivity. (Cruickshank’s educational approach is discussed later in this chapter.) At the time, many of these children were referred to as having minimal brain injury.

Minimal Brain Injury and the Hyperactive Child Syndrome

Two other labels that emerged in the 1950s and 1960s were minimal brain injury and the hyperactive child syndrome. Minimal brain injury (MBI) was used to refer to children who did not have abnormal neurological exams but who exhibited behaviors such as inattention, hyperactivity, and impulsivity—that were similar to behaviors displayed by individuals with documented brain injury. The popularity of the MBI label, however, was short lived. Professionals objected to the qualifier “minimal,” because it belied the substantial problems that these children experienced. In addition, they objected to the inference that the brains of these children had actual tissue damage, because there was insufficient neurological evidence that this was the case.

In his authoritative text on ADHD, Barkley (1998) refers to the 1960s as the “Golden Age of Hyperactivity.” It was during this period that the notion of a hyperactive child syndrome arose and began to replace the MBI label. Authorities proposed this new designation because it focused on observable behavior rather than the unreliable diagnosis of subtle brain injury.

A syndrome implies a common group of behaviors. In the case of the hyperactive child syndrome, these behaviors were such things as hyperactivity, inattention, impulsivity, academic learning problems, and poor peer relationships. Although all of these behavioral characteristics were considered important, for the most part, researchers and practitioners focused on hyperactivity. By the 1980s, however, researchers began to point to inattention as the major deficit exhibited by these children. Thus, as you will see below, some authorities are pointing to problems in behavioral inhibition as the key characteristic of ADHD.
A. Either (1) or (2):
   (1) six (or more) of the following symptoms of inattention have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:
   - Inattention
     (a) often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities
     (b) often has difficulty sustaining attention in tasks or play activities
     (c) often does not seem to listen when spoken to directly
     (d) often does not finish through on instructions and fails in schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)
     (e) often has difficulty organizing tasks and activities
     (f) often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)
     (g) often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)
     (h) is often easily distracted by extraneous stimuli
     (i) is often forgetful in daily activities
   (2) six (or more) of the following symptoms of hyperactivity-impulsivity have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:
   - Hyperactivity
     (a) often fidgets with hands or feet or squirms in seat
     (b) often leaves seat in classroom or in other situations in which remaining seated is expected
     (c) often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)
     (d) often has difficulty playing or engaging in leisure activities quietly
     (e) is often "on the go" or often acts as if "driven by a motor"
     (f) often talks excessively
   - Impulsivity
     (g) often blurts out answers before questions have been completed
     (h) often has difficulty awaiting turn
     (i) often interrupts or intrudes on others (e.g., butts into conversations or games)

B. Some hyperactive-impulsive or inattentive symptoms that caused impairment were present before age 7 years.
C. Some impairment from the symptoms is present in two or more settings (e.g., at school or work and at home).
D. There must be clear evidence of clinically significant impairment in social, academic, or occupational functioning.
E. The symptoms do not occur exclusively during the course of a Pervasive Developmental Disorder, Schizophrenia, or other Psychotic Disorder and are not better accounted for by another mental disorder (e.g., Mood Disorder, Anxiety Disorder, Dissociative Disorder, or a Personality Disorder).

**TABLE 9.1 Continued**

Code based on type

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<tr>
<th>Code</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>314.01</td>
<td>Attention-Deficit/Hyperactivity Disorder, Combined Type: if both Criteria A1 and A2 are met for the past 6 months</td>
</tr>
<tr>
<td>314.00</td>
<td>Attention-Deficit/Hyperactivity Disorder, Predominantly Inattentive Type: if Criterion A1 is met but Criterion A2 is not met for the past 6 months</td>
</tr>
<tr>
<td>314.01</td>
<td>Attention-Deficit/Hyperactivity Disorder, Predominantly Hyperactive-Impulsive Type: if Criterion A2 is met but Criterion A1 is not met for the past 6 months</td>
</tr>
</tbody>
</table>

**Coding note:** For individuals (especially adolescents and adults) who currently have symptoms that no longer meet full criteria, "In Partial Remission" should be specified


- forgot things and/or activities
- talked seemingly nonstop
- interrupted conversations

Dr. Rodriguez pointed out that the first seven items on the parents checked suggested that Shannon had ADHD, Predominantly Inattentive Type. She also told them that the psychiatric profession (as indicated by the DSM) recommended, a diagnosis of this type if the person had six or more of the nine inattentive criteria on the checklist. However, Dr. Rodriguez told the Irlands two other important things. First, she wanted Shannon's teacher also to complete the checklist, because the DSM dictated that ADHD should be present in at least two settings. Second, she noted that even though Shannon didn't appear to meet the standard for having the predominantly hyperactive-impulsive type of ADHD, the Irlands had checked two criteria from this type—talking nonstop and interrupting conversations. These behaviors should be targets for change, especially if Shannon's teachers also observed them.

**What Is the Prevalence of ADHD?**

It is generally accepted that ADHD is the most common reason for children being referred to child guidance clinics. Studies indicate that between 3 to 5% of school-age children have been diagnosed with ADHD in the United States (National Institutes of Health, 1998). The most common subtype of ADHD is the Combined Type, accounting for about 50 to 75% of all persons with ADHD. The second most common type is the inattentive type (20 to 30%), followed by the hyperactive-impulsive type (fewer than 15%) (Wilens et al., 2002).

Some critics, mostly writing in the popular press, have claimed that ADHD is almost exclusively a U.S. condition. They state that it has become almost fashionable
to claim that one has ADHD as a way of excusing low achievement. However, similar proportions of ADHD are found in the populations of many other countries, including Australia, New Zealand, Germany, Japan, and Brazil (Kambayashi, Nakata, Fujii, Kita, & Wada, 2002; Wilens et al., 2002).

The diagnosis of ADHD is more prevalent for males than for females. Estimates vary, but we can be pretty certain that about 3 to 4 times more boys are identified as ADHD than girls (Barkley, 1998). What is not certain is whether this is due to the over-identification of boys or the under-identification of girls. Evidence that the latter might be true comes from statistics showing that the gap in prevalence of ADHD in boys and girls is narrowing (Robinson, Sker, Sclar, & Galin, 2002). In other words, it is quite possible that professionals have been slow to recognize ADHD in girls. We can speculate that this is because girls are more likely to exhibit the inattentive type of ADHD. In contrast to hyperactivity and impulsivity, which are more prevalent in boys, inattentive behaviors are less likely to bother teachers and parents.

This is probably what happened in the case of Shannon. Although she was diagnosed with learning disabilities in third grade, she was not referred and identified as having ADHD until fifth grade. As Shannon's mother says:

"All the signs—the inattentiveness, the lack of focus, the disorganization. I noticed the signs in Shannon, the signs she was having trouble. I don't know. Maybe it was because she already had learning disabilities. Maybe we thought that what was causing all the trouble was just the attention problems. Or maybe it's because she didn't really cause anyone trouble. I mean, any real trouble. She was polite and obedient and of all things I thought she'd make a great student."

Much more research is needed before we can reach firm conclusions regarding the true prevalence of ADHD, generally, and any gender differences in the prevalence of ADHD, specifically. For now, our best scientific evidence leads us to these conclusions:

1. There are undoubtedly cases of children being diagnosed as ADHD who should not be. We know of too many cases of sloppy diagnostic practices to ignore the fact that some misdiagnosis takes place.
2. There are undoubtedly cases of children who should be diagnosed as ADHD but who are not. We know of too many cases of parents and teachers who excuse a boy's hyperactivity and impulsivity with the old adage, "Oh, he's just being a boy." Likewise, we know of too many cases of children, often girls, whose inattentive type of ADHD does not gain the notice of parents and teachers because these children are compliant and quiet.
3. There is undoubtedly some referral bias operating that accounts for some of the difference in the prevalence of the diagnosis of ADHD in males and females. On the other hand, many other childhood illnesses or physical conditions (e.g., autism, cerebral palsy, stuttering, learning disabilities) are more prevalent in males than females, and virtually no conditions are more prevalent in females than males. Therefore, it is highly probable that there are constitutional differences that account for some of the higher prevalence of ADHD in males.

How is ADHD Assessed?

Authorities recommend that a diagnosis of ADHD should include three elements: (1) a medical examination, (2) a structured interview or history, and (3) the administration of teacher and parent rating scales (Barkley, 1998). In the case of older children or adults, the psychiatrist or psychologist may also administer a self-report type of rating scale.

Medical Exam

The medical exam can help rule out any physical reasons for the inattentive and/or hyperactive-impulsive behavior, such as thyroid problems or brain tumors. The physician can determine whether the child's behavioral problems are due to a seizure disorder, such as epilepsy. Environmental factors, such as lead poisoning, can also be considered.

The physician can also determine whether the patient has other conditions that would make it unwise to prescribe certain medications to help control the inattention or hyperactivity. For example, high blood pressure, cardiac problems, or asthma might influence what kind of medication the doctor would prescribe for the child. And if the child has tics, the physician might be more careful in using certain medications, because there is suggestive evidence that commonly used medications for ADHD might make the tics worse. Tics are repetitive motor movements that are sometimes accompanied by multiple vocal grunts or outbursts. Severe tics are one of the major symptoms of someone who has Tourette's syndrome. There is a high incidence of ADHD in individuals diagnosed with Tourette's syndrome.

Clinical Interview

The clinical interview, or history of the child and parent(s), is important because it can be used to gather information on the child, the parents, and any siblings. The clinician can obtain a picture of the dynamics of the family and the major symptoms that all of the family members see as most problematic.

Even though the interview is important, we need to recognize that it is somewhat subjective. For example, some children with ADHD can appear very attentive in a structured and novel setting. In fact, researchers have discovered what has been referred to as a doctor's office effect, whereby children can be focused in the clinician's office but just the opposite at home and school (Canetwell, 1979; Slator, Ahdin, 1981).
Ratings Scales

Because of the subjectivity of the clinical interview and the existence of such things as the doctor's office effect, professionals often use rating scales to obtain more objective, behavioral data. See the Case Connections box on page 269.

As noted in the Case Connections box, Jamal’s pediatricsian used rating scales to help determine that Jamal was not ADHD. The rating scale he used, the Conners’ Teacher Rating Scale–Revised (S) (Conners, 1997), is one of the most commonly used standardized rating scales. As noted earlier, Shannon’s psychiatrist, Dr. Rodgers, used an informal checklist, or rating form, based on the DSM criteria, to help in the diagnosis of Shannon’s ADHD. But Dr. Rodgers also requested that Shannon’s teacher fill out one portion of the Conners’ scale. (Recall that, according to the DSM, symptoms of ADHD should be observed in at least two settings.) The ratings on this scale were in agreement with those of the parents. Her teacher rated her as highly inattentive but not very hyperactive on this 28-item rating scale. (There is a longer version of this rating scale that contains 59 items.)

Using Technology to Assess ADHD

Although medical exams, clinical interviews, and rating scales will probably always be a necessary part of the identification of students with ADHD, researchers are turning to technology to find additional methods of assessing ADHD. For example, there are several commercial computerized versions of continuous performance tests (CPTs). CPTs vary somewhat. A typical one projects stimuli (e.g., Xs and Os) at a time on a screen rapidly (about one per second), and the individual is instructed to push a button every time a particular stimulus (e.g., X) appears or a particular sequence (e.g., O followed by an X) appears. The computer keeps track of the number of correct responses, failures to respond to a correct stimulus (omission errors), and incorrect responses or responses to the wrong stimulus (commission errors).

It has now become relatively common for clinicians to use a computerized CPT to help evaluate children for ADHD. There are other technologies that hold potential for helping identify ADHD that are much more experimental. See the Today's Technology box on pages 270–271 for an example.

Issues Related to Identification for Special Education Services

The overlap between learning disabilities and ADHD has created considerable controversy in the field. (See the Current Trends and Issues box on pages 272–273.) This controversy has made it difficult to keep track of how many students with ADHD are served in special education. Furthermore, it makes it difficult to keep track of such things as the gender and ethnicity of students identified as ADHD and receiving special education. This is unfortunate, because some have claimed that African American boys are disproportionately identified as ADHD. (See the Multicultural Considerations box on page 274.)

The Doctor's Office Effect

Following the recommendation of the school psychologist, Jamal’s mother had Jamal see a pediatrician to assess whether he had ADHD. When making the appointment, Mrs. Smith was asked if she had to have Jamal assessed. She explained that the school psychologist had suggested this. The pediatrician answered questions impulsively, fidgeted, and was nervous.

Jamal’s pediatrician, Dr. Snyder, talked with Jamal and administered some informal tests of motor skills in his office. He also requested that Jamal’s mother and teacher each complete a brief rating scale about hyperactive behavior. Based on his assessment, he sent this letter to Mrs. Smith.

Dear Mrs. Smith,

Thank you for bringing Jamal in for evaluation of possible attention deficit by hyperactivity disorder (ADHD). I am glad you and Hereford School are working together to ensure that Jamal obtains a good education and is successful in school.

Jamal presented as a healthy, alert, inquisitive young man. He is within normal range for height and weight and has no apparent developmental motor or speech difficulties. He used language well and appeared to be happy and to be well adjusted.

To evaluate the possibility of ADHD, I interviewed Jamal, administered tests for subtle neurological problems, and obtained ratings of his behavior. Based on these tests and my observations, I do not believe that he has a level of degree of problem consistent with the DSM criteria for ADHD. There were no anomalies in my assessment of his neurological functioning. He did not display any inattention, impulsivity, or hyperactivity in my office. But as I told you when you visited, there’s always the possibility of what we call a doctor’s office effect. That’s why I also asked you and his teacher to fill out the rating scales. The scores on the Conners’ Teacher Rating Scale indicate that Jamal’s teacher completed did not indicate that he has ADHD. Your rating of his impulsivity and hyperactivity were a little bit on the high side but not high enough to fall into the clinical range. Plus, the teacher’s ratings were well below the cutoff for ADHD.

I do not consider a diagnosis of ADHD to be correct for Jamal. He is a young boy with lots of energy and sometimes blurts out answers. He may need other help, but medical management for these issues is not indicated at this time.

Sincerely,

George Snyder, M.D.

In a handwritten sticky note on the letter, Dr. Snyder added a personal comment: because he knew Mrs. Smith from her nursing background. "Irene, Jamal’s doing well. He’s not hyperactive. Work with his teacher on his reading and don’t worry about his adjustment."
Have you seen any differences among groups of children in the eye-movement studies?

Yes, for her dissertation, Rosa Olimdi devised a new study comparing the performance of students with and without ADHD while they were viewing a word page, with the students asked to identify the words. She found that children with ADHD often show increased sensitivity in new situations but become accustomed to the routine and demonstrate improved performance. This observation is the basis for the sustained vigilance tasks that are sometimes used in ADHD identification.

The second paragraph briefly describes the work of a student on ADHD. It mentions the importance of recognizing the differences in performance between children with and without ADHD, and the potential for improving performance through a different experimental setup.

Do you think that this method can be used to identify kids with ADHD?

Yes, the method has potential but requires further research to confirm its effectiveness. The study suggests that differences in performance can be used to identify children with ADHD, which could lead to early intervention and support.

The third paragraph discusses the potential benefits of using eye-movement studies to identify children with ADHD. It mentions the importance of recognizing the differences in performance between children with and without ADHD, and the potential for improving performance through a different experimental setup.

Neurological Factors

The development of neuroimaging technologies has come to the discovery of areas in the brain that are likely to be affected in individuals with ADHD. Using techniques such as MRI scans, researchers have pointed to the prefrontal and
How Many Students with ADHD Are Served in Special Education?

Because ADHD is such a prevalent condition, one would think that it would be relatively easy to find out how many students with ADHD receive special education services. Federal law, after all, requires that schools report how many students with a given disability have been identified for special education services. However, when Public Law 94-142 (the Education for All Handicapped Children Act) was passed in 1975, ADHD was not included as one of the separate categories of special education. This was due to two interrelated factors: (1) the research on this condition was still in its infancy, and (2) the advocacy base for children with ADHD was not yet well developed. For example, the major advocacy organization for people with ADHD, CHADD (Children and Adults with Attention-Deficit Disorder) was not founded until 1987.

By the time of the reauthorization of the law as the Individuals with Disabilities Education Act (IDEA) in 1990, however, there was substantial research on ADHD, and CHADD's membership was well on its way to its present level of 22,000 members. CHADD and other advocacy organizations did combine to have a separate category in the IDEA, arguing that children with ADHD were being denied services because they couldn't qualify for special education only if they also had another disability such as learning disabilities or emotional disturbances. The lobbying was successful: However, the US Department of Education in 1991 determined that students with ADHD would be eligible for special education under the category "other health impaired." (OHI) instances where the ADD is a chronic or acute health problem that results in limited attention which adversely affects educational performance. (This definition of ADHD was based on the diagnostician's judgment, and the label was retroactively given to students with ADHD who also qualify for accommodation under another law (Section 504).)

Many professionals are still disappointed with the decision not to include ADHD as a separate category because they say that using the OHI category is too broad about a means of identification, and section 504 is not completely satisfactory because it does not require an individual education program (IEP) basis for students identified.

However, the growth of the OHI category since 1991 suggests that more and more students with ADHD are being identified as OHI. (See Figure A) Although numbers in the OHI category have quadrupled in ten years, the (5-10) percent reported for (1999-2000) is still well below the prevalence estimates of 3 to 5 percent. Many authorities think that fewer than half of students with ADHD are receiving special education services. As long as ADHD is not recognized as a separate category of special education, it will be virtually impossible to know exactly how many, school age, children with ADHD are receiving special education services.

Council for Exceptional Children
CEC Knowledge Quest
Even though PET scans show that individuals with ADHD have reductions in cerebrovascular activity in critical cognitive areas of the brain, would individuals with ADHD havereceive less blood flow in the frontal lobes and basal ganglia in persons with ADHD? (Lou, Henriksson, & Bruhn, 1984; Lou, Henriksson, Bruhn, Borner, & Nielsen, 1989).

Theprefrontal and frontal lobes are located in the front of the brain. (See Figure 9.2, page 274). The forebrain, in particular, is involved in the ability to control one's behavior, or executive functions. (We discuss executive functions more fully later.) The basal ganglia, responsible for motor movement, consist of several parts, with the caudate and the globus pallidus being the structures that tend to be smaller in persons with ADHD. The cerebellum is also responsible for the coordination and control of motor behavior. Research has suggested that the more cognitive aspects of ADHD, for example the inattention and disorganization, are related to impairments in the prefrontal and frontal cortex, whereas the hyperactivity aspect of ADHD is related to impairments in the basal ganglia and/or cerebellum (Solanto, 2002).

There has also been considerable research on the particular neurotransmitters implicated in ADHD. Neurotransmitters are chemicals that enable electrical impulses to travel from one neuron to another. Dopamine and norepinephrine are two of the most likely neurotransmitters that are out of balance in persons with ADHD (Barkey, 2000; Solanto, 2002).
Hereditary Factors

There is strong evidence for a hereditary basis to ADHD. For example, research has suggested that if a child has ADHD, the odds of a sibling also having ADHD are about 32% ( Barkley, 1998). Also, the parents of a child with ADHD are two to eight times more likely to have ADHD than are the parents of non-ADHD children (Faraone & Doyle, 2001).

Studies of identical (from the same egg) versus fraternal (from two eggs) twins also indicate that ADHD can be inherited. When an identical twin and a fraternal twin each has ADHD, the second identical twin is much more likely to have ADHD than the second fraternal twin (Gilluls, Giller, Pennington, & DeFries, 1992; Sherman, Horan, & McGue, 1997; Stevenson, 1992).

In the case of Shannon, there is some evidence that her ADHD inherited from her father. Interestingly, Mr. Ireland was not formally diagnosed with ADHD until after Shannon was referred for evaluation. Because we have become better aware of ADHD as a serious condition in the past 20 or 30 years, many adults with ADHD were not diagnosed with the condition as children. Thus, Mr. Ireland's description of the following scenario is not uncommon:

**Factors That Don't Cause ADHD**

Over the years, a number of myths have developed concerning causes of ADHD. As one prominent ADHD expert has put it, “Some of these were originally founded in sound hypotheses but have since been disproved. Others are sheer falsehoods; there is not now and never has been any scientific support for them” (Barkley, 2000, p. 79). Chief among these unsubstantiated claims are food additives, sugar, and bad parenting.

Back in the 1970s, Benjamin Feingold, a pediatric allergist, introduced the theory that certain food additives caused hyperactivity in children (Feingold, 1975). Specifically, he claimed that such things as artificial food coloring, preservatives, and salicylates, which occur naturally in many foods, should be eliminated from the diets of children with ADHD. The Feingold diet is highly restrictive, because so many foods contain not only additives but relatively high levels of salicylates (e.g., olives, honey, avocados, cherries, grapefruit, apples, broccoli, and cucumbers, to name a few).

Although there are still proponents of the Feingold diet, research has long ago disproved it as of benefit for most children with ADHD (Kavela & Forness, 1983).
Sugar, too, has been implicated as a culprit in causing hyperactivity. However, careful research has demonstrated that sugar does not cause high levels of motor activity in most children (Wolraich, Wilson, & White, 1996). Where the mistaken notion that sugar causes hyperactivity may have gotten its start is from the frequent observation that children are hyperactive in situations where sweets are served. Parents and teachers often remark that young children's birthday parties are an occasion for high levels of motor activity and distractibility. They often point to the sugar in the cake or cookies as causing this hyperactivity when it's more likely that the unstructured and stimulating nature of the situation are the causes.

Although research has clearly shown that food products, whether it be food additives, salicylates, or sugar, are not causes of ADHD, we should be open to the possibility that some individuals may have a relatively small reaction to foods because of food allergies. However, the evidence is overwhelming that such reactions are, at most, extremely rare.

It is common for parents of children with ADHD to be targeted as the reason for their child's condition. Many people believe that overly lenient parenting and/or disorganized and dysfunctional family dynamics account for children's ADHD. This seems especially true of children with ADHD, Predominantly Hyperactive-Impulsive Type. Shannon's mother has not experienced this, but the following quote from the mother of a child with ADHD, Predominantly Hyperactive-Impulsive Type, is instructive.

"I don't know what it is about some people. I guess I can kind of understand it. Before we had Michael, I think I was guilty of the same thing. Whenever I saw a kid who was out of control in the supermarket, I'd immediately jump to the conclusion that his parents must be terrible. But I think we must have some kind of terribly disorganized family life that we don't discipline him when he misbehaves. I wouldn't want to think of having a child with Michael's problems on anyone. But I do think it's usually parents who happen to be blessed with near-perfect children who think this way. If you were to have a child with ADHD, I think they'd quickly change their tune.

Sharon Irving, mother of a child with ADHD, Predominantly Hyperactive-Impulsive Type, ADHD"

Some have observed that many parents of children with ADHD exhibit ADHD symptoms themselves. However, this may be explained by the fact, which we have already discussed, that ADHD is highly heritable (Barlow, 2000). One team of researchers (Biederman, Faraone, & Monuteaux, 2002) for example, compared the behavior of over 1,000 offspring from three groups of parents: (1) parents who currently displayed ADHD, (2) parents who had previously displayed ADHD but no longer did so, and (3) parents without ADHD. Children of parents with ADHD were much more likely to have ADHD. However, children's risk of having ADHD did not differ between parents who had persistent ADHD and those who did not have active ADHD symptoms during the child's lifetime. One interpretation of these results is that a child's being exposed to ADHD behavior in the parent does not put the child at as great a risk for having ADHD as does the fact of being genetically linked to a parent with ADHD.

In summarizing the research on parenting and ADHD, one authority has concluded:

"All of this evidence makes it highly unlikely that any purely social cause, such as "bad parenting" or a disruptive, stressful home life, creates ADHD in the children of such families. Instead, the research suggests that children with ADHD can create stress for their parents and cause some disruption of family life. In cases where poor parenting and disruptive family life have some influence on children, it seems to be one of contributing to aggressive and defiant child behavior, not to ADHD (Barlow, 2000, p. 81)."

What Are the Behavioral Characteristics of Persons with ADHD?

As we noted earlier, most authorities point to impairment in behavioral inhibition as the main characteristic of persons with ADHD. Behavioral inhibition is composed of three elements — the ability to:

1. Delay a response
2. Interrupt an ongoing response, if one detects that the response is inappropriate
3. Protect a response from distracting or competing stimuli (Lawrence et al., 2002).

Problems with behavioral inhibition, thus, can lead to a number of difficulties that interfere with performance, such as being able to wait one's turn, to delay immediate gratification in order to work for longer-term goals, to stop pursuing a faulty line of performance in order to switch to a new strategy, or to resist distraction in order to meet one's goals. See the Effective Practices box on page 278 for strategies one can use to address the problems these individuals often have with task switching.

Barlow's Model of ADHD: Behavioral Inhibition and Time Awareness and Management

Russell Barkley (1997, 1998, 2000a, b) has been instrumental in conceptualizing ADHD as primarily a problem in behavioral inhibition, which then leads to a
Task-Switching: Preparing Students with ADHD for Change

What the Research Says

Many researchers contend that the primary deficit of students with attention deficit hyperactivity disorder (ADHD) is deficient behavioral inhibition. In other words, once students with ADHD begin a task, it is difficult for them to stop and switch to a new activity. Researchers hypothesize that the deficit in executive function's ability to "start up" the new task makes it difficult for students with ADHD compared to students without ADHD.

Research Study

A group of researchers examined the task-switching ability of students 'with and without ADHD (Cepeda, Cecena, & Kramer, 2000). Results from this study indicate that clear performance deficits exist for students with ADHD in the first trial after a task switch, even when the tasks were considered compatible. Such as both tasks involving number. All students with ADHD showed significant "improvements" in performance. Significant improvements were seen in the "increased response time" when the new task was incompatible with the old task (e.g., switching from a number identification task to a word identification task). This type of switch requires the inhibition of thinking about numbers and the preparation for thinking about letters and sounds. The findings suggest that differences exist between students with and without ADHD in the ability to efficiently and effectively task-switch.

Applying the Research to Teaching

Studies such as the one presented here indicate the need to support students with ADHD as they transition from one activity to another. Cognitive support for such transitions can include:

- Allowing for time between asking a student to do any something and expecting the response (e.g., a pressing key task)
- Reducing or eliminating a student's working memory (Barley, Murphy, & Lyansky, 1996) by limiting the number of steps or sequence of procedures a student must keep in working memory by providing a visual aid for students, if necessary
- Creating targeted procedures for daily transitions
- Preparing students for the type of response that will be required when taking a test
- Dividing instruction into consistent, predictable sequences throughout the day
- Instructing students to "catch up" in their own way

faulty sense of time awareness and management. And for Barkley, it is the deficit in time awareness and management that is the most detrimental for persons with ADHD.

Understanding time and how we organize our own behavior within and toward it is a major key to the mystery of understanding ADHD. . . . Now believe that the awareness of ourselves across time is the ultimate yet nearly invisible disability afflicting those with ADHD (Barkley, 2000a, p. 30)

Barkley notes that persons with ADHD have difficulties with executive functions. Executive functions involve a number of self-directed behaviors, such as working memory, inner speech, and self-regulation of emotions. Working memory, which we discussed in Chapter 8, is the ability to hold things in mind while also engaging in other cognitive tasks. Problems in working memory can affect the ability of the person with ADHD to have hindsight and foresight (Barkley, 2000a). Hind- sight enables us to learn from prior experiences, which we can then apply when formulating plans for new experiences. Foresight allows us to "see" ahead and anticipate events, so that they may guide our behavior. Together, hindsight and foresight create a window on time (past, present, and future) of which the individual is aware. The temporal opening of that window probably increases across development, at least up to about 10 years. This might suggest that across child and adolescent development, the individual comes to organize and direct behavior toward events that lie increasingly distant in the future (Barkley, 2000a, p. 21)

 Inner speech, another executive function, develops in young children and helps them regulate their behavior. Inner speech is the inner "voice" we use to "talk" to ourselves when faced with difficult problems. This speech may start out as talking out loud and then become internalized over time. Very young children, for example, often talk aloud when playing or concentrating on tasks. For most of us, this speech has become internalized by the teenage years, even though as adults we may find ourselves talking out loud when faced with very complex problems. For those with ADHD, however, the almost seamless border between inner speech and thought fails to occur naturally, and this interferes, among other things, with their ability to follow rules or instructions.

Self-regulation of emotions also presents problems for many students with ADHD. They often overreact to emotionally charged situations. For example, Shannon's parents and teachers have commented on her inability to modulate her emotions. Shannon's mother, for example, recounts:

Shannon's always had a problem with either very positive or very negative news. Her father and I have learned that we can't just surprise her with good news. For example, last month when we were in New York attending a nice restaurant, I wanted to tell her that I had found out that afternoon that her best friend, Marcia, was inviting her over for a sleep-over the upcoming weekend. I knew I couldn't tell her while we were eating because she would likely explode with joy and embarrassment all over. So, I waited until we were home and then told her. And of course, we all got to be the recipients of her ear-splitting shouts of joy.

And she also overreacts to bad news. Shannon's temper can really flare up if she thinks you've omitted her in any way.

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Shannon's friend, Shannon's mother

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Barley hypothesizes that such problems in regulating emotions contribute to motivational problems for individuals with ADHD. They are unable to channel their emotions to help them persist in the pursuit of future goals. Having learning disabilities in combination with ADHD makes it even more difficult to maintain motivation in the face of failure. As one adult with ADHD and learning disabilities has put it:

I can see how easy it is for someone with LD and ADHD to give up. It hurts so much to try hard every day, sometimes relearning what you learned the day before because you forgot it all, and comparing yourself to others and realizing you are different! If you fail, then you don't have to push on. Others can feel sorry for you—take care of you; it's easier, at least it seems so. But what happens when we give up is that we try to find other avenues to make up for what we lost. Often, those avenues are devastatingly more painful than struggling to get what we need to be independent. Giving up our independence, giving up our dream, is like dying. The key is not to give up but to be realistic, to be optimistic, and to find the support one needs. Then, apply the hard work. Though it may take a lifetime, it is time well spent.

(Crawford, 2002, pp. 159-160)

What Educational Methods Are Used with Students with ADHD?

There are several educational approaches for attention problems. Classroom interventions can be categorized under five general headings: stimulus reduction, structure, functional behavioral assessment, contingency-based self-management, and self-monitoring of attention. These approaches should not be viewed as competing; professionals often recommend a combination of them, as well as medication.

Stimulus Reduction

As noted earlier in the chapter, Cruickshank, expanding on the prior work of Werner and Strauss, made educational recommendations for hyperactive and inattentive students. Believing that being distracted by extraneous stimulation was the major problem for hyperactive children, Cruickshank developed a program that emphasizes the reduction of 'inessential' stimuli and the enhancement of stimuli essential for learning. In addition, his program is highly structured—that is, highly teacher directed (Cruickshank, Bentzen, Ratzeburg, & Tanhauser, 1961).

Cruickshank recommended placing students who are distractible in a classroom that is as devoid as possible of extraneous environmental stimuli. Recommended classroom modifications include soundproofed walls and ceilings, carpeting, enclosed bookcases and cupboards, limited use of colorful bulletin boards, and cubicles and three-sided work areas. To contrast with the blandness of those aspects of the environment not involved in the teaching activity itself, the material directly necessary for instruction should be designed to draw the student's attention to it. For example, in the early stages of reading, the teacher would present the child with only a few words per page, and these would be in bold colors. This modification differs from the more common reading text in which a page of print usually contains many words and thus is visually and mentally confusing.

Russell Barley, too, advocates the use of highly salient cues in the environment of the student with ADHD. Noting that students with ADHD are deficient in executive functions, which are largely internal operations, he recommends externalizing these for the student. For example, he says the goal is to "beat the environment at its own game," by minimizing distractions and highlighting cues and prompts for performance, such as classroom rules (Barley, 2000).

Structure

Cruickshank reasoned that because students who are distractible are so much at the mercy of their impulses, their educational program should be heavily structured. He proposed that these students, being unable to provide their own structure, may become disoriented in a classroom that promotes the idea of having students make their own decisions. Thus, Cruickshank and colleagues (1961) advocated that the teacher establish a tightly prescribed schedule of educational activities for the students so that they would have very little opportunity to engage in nonproductive behaviors.

Even today, the notion of a highly structured classroom is still the heart-and-soul of many educators’ recommendations for students with ADHD:

All children, and particularly, those with ADHD, benefit from clear, predictable, uncomplicated routine and structure. It helps if the day is divided into broad units of time and if this pattern is repeated daily. Within each block of lesson time there should be a similar breaking down of tasks and activities into subtasks/activities. . . .

An important goal should be to create a simple overarching daily routine that the student will eventually learn by heart. The number of tasks should be kept small and tight timelines should be avoided. Complexities of timetabling and working structures merely confound students with ADHD, because a major difficulty that goes with this condition is a poorly developed ability to differentiate between and organize different bits of information. This clearly makes the formal curriculum difficult to manage; without having to struggle with the organizational arrangements that surround the curriculum. Once a workable daily timetable has been established that should be publically displayed and/or taped to the student's desk or inside his or her homework diary (Cooper, 1999, p. 146).

Functional Behavioral Assessment

Authorities advocate the use of functional behavioral assessment for many kinds of behavioral and learning problems, including those associated with ADHD (DuPaul, Eckert, & McGloey, 1997). Functional behavioral assessment (FBA) centers on the purpose that behaviors serve for individuals. Using it, the teacher tries to determine which events trigger target behaviors (e.g., inattention) and which factors
maintain them (Hornet, 1994; Kratochwill & McGivern, 1996). For example, many students with both learning disabilities and ADHD may use their propensity to be inattentive to avoid work. And some may use it because they have learned that it elicits attention from adults or peers.

After the FBA, the teacher can develop an intervention that changes the factors triggering and/or maintaining the undesirable behavior. Several studies have found FBA effective in reducing inattentive behavior in students with ADHD. For example, in one study,

the intervention for one student involved altering the nature of the task (i.e., requiring assignments to be completed on a computer rather than in writing) because this student’s off-task behavior appeared to be motivated by escape from written tasks. Alternatively, the intervention for a second student involved providing peer attention contingent on the display of on-task behavior given that such off-task activities appeared to be an attempt to gain peer attention. In both cases, the interventions were effective. (DuPaul et al., 1997, p. 376)

Contingency-Based Self-Management

Contingency-based self-management involves individuals keeping track of their own behavior and then receiving consequences based on the behavior. For all students, especially those with ADHD, it is highly recommended that the consequences be positive rewards rather than punishment whenever possible (Davies & Wine, 2000; Shapiro, DuPaul, & Bradley-Klag, 1998).

Elementary or secondary teachers can use a combination of FBA and contingency-based self-management techniques to increase appropriate behavior of students with ADHD (DuPaul, Eckert, & Mc coy, 1997; Ervin, DuPaul, Kern, & Friman, 1998; Shapiro et al., 1998). In one study at the secondary level, for instance, a combination of FBA and contingency-based self-management increased the on-task behavior of two adolescents with ADHD. For one of the students, interviews with the teacher and observations in the classroom (FBA phase) revealed that the boy’s disruptive behavior was a function of gaining peer attention (Ervin et al., 1998). Therefore, the researchers set up a contingency-based self-management phase whereby the student evaluated his own off-task behavior on a five-point scale (0 = unacceptable to 5 = excellent) at the end of each math class. The teacher also rated his behavior, and the student was awarded points based on how closely the ratings matched. During writing class, the teacher awarded negative or positive points to members of the class depending on whether or not they responded to attention-seeking behaviors from any member of the class. In both classes, students could turn in the points for privileges.

Self-Monitoring of Attention

Self-monitoring is another self-management technique highly recommended for students with ADHD (Reis, 2002). Self-monitoring involves two components: (1) self-evaluation and (2) self-recording of performance. Although teachers have used it successfully when academic performance is the target of the monitoring, here we focus on its use when attention is the focus. Although self-monitoring can be coupled with some kind of contingency-based procedures, it has often been used successfully without the use of external reinforcement. Some have speculated that self-monitoring of attention is successful because it helps students become more aware of and in control of their attention (Hallahan & Hudson, 2002).

Self-monitoring involves students asking themselves the question “Was I paying attention?” and recording a “yes” or “no” on a score sheet every time they hear a tone on a tape recorder. (The time between tones varies randomly.) The following is a set of sample instructions:

"Johnny, you know how paying attention to your work has been a problem for you. You've heard teachers tell you, 'Pay attention.' Go to work. "What are you supposed to be doing?" and things like that. Well, today we're going to start something that will help you help yourself pay attention better. First we need to make sure that you know what paying attention means. This is what I mean by paying attention. (Teacher models immediate and sustained attention to task.) "And this is what I mean by not paying attention." (Teacher models inattentive behaviors such as glancing around and playing with objects.) "Now you tell me if I was paying attention." (Teacher models attentive and inattentive behaviors and requires the student to categorize them.)

"Okay, now let me show you what we're going to do. While you're working, this tape recorder will be turned on. Every once in a while, you'll hear a little sound like this. (Teacher plays tone on tape.) "And when you hear that tone, quietly ask yourself, 'Was I paying attention?' If you answer 'yes,' put a check in this box. If you answer 'no,' put a check in this box. Then go right back to work. When you hear the sound again, ask the question, answer it, mark your answer, and go back to work. Now, let me show you how it works. (Teacher models the entire procedure.)"

"Now, Johnny, I bet you can do this. You've shown me how to do it. Tell me what you're going to do every time you hear a tone. . . . Correct! Ask yourself, 'Was I paying attention?' Let's try it. I'll start the tape and you work on these papers." (Teacher observes student's implementation of the entire procedure, praises its correct use, and gradually withdraws his or her presence.) (Hallahan & Hudson, 2002, pp. 8-9)

Research has demonstrated the effectiveness of self-monitoring of attention in increasing on-task behavior and academic productivity. This technique has been used with students ranging from the elementary (Hallahan, Lloyd, Kosiewicz, Kauffman, & Graves, 1979; Harra et al., 1994; Mathes & Bender, 1977) to the secondary grades (Praat, Joy, Chilman, Tempel, & Miller, 1991). Researchers have also found that adding the component of having students graph the results of their assessments is beneficial (DiGangi, Maag, & Ruthardt, 1991).

When Shannon was in sixth grade, Mr. Martens, her special education teacher, recommended that Ms. Robinson, Shannon's regular education teacher, have Shannon self-monitor her attention while doing math seat work. Ms. Robinson also had Shannon graph her on-task behavior and the number of math problems solved correctly each day. (The teacher gave her an answer sheet at the end of
What Is the Role of Medication for Persons with ADHD?

Medication has become the most common method of treating children with ADHD. And the use of medication for adults with ADHD is also on the rise. Psychoactive stimulants that are most frequently used are methylphenidate, a medication known as Ritalin. These medications stimulate or activate neurological functioning; the most common type of psychoactive stimulant used for ADHD is Ritalin, or methylphenidate. Although it may seem counterintuitive that stimulants would be used for persons who exhibit inattention and hyperactivity, what actually happens is that Ritalin stimulates those parts of the brain responsible for inhibiting. Ritalin helps in the release of the neurotransmitter dopamine, thus enabling the brain's executive functions to operate more normally (Solanto, 2002).

For most persons, it takes about one hour for Ritalin to take effect, with the optimal effect occurring at about two hours and the effects wearing off after about four hours. However, the effects can vary from one person to another, so it is important that the physician, teacher, parents, and child work together to arrive at the proper dose and timing of medication.

Another psychoactive stimulant that is gaining popularity is Adderall. Researchers have found Adderall to be as effective as Ritalin, and its effects are longer lasting, meaning that it does not have to be administered as often (Faraone, Pliszka, Olvera, Skolnik, & Biederman, 2001; Manos, Short, & Finding, 1999; Pliszka, Brown, Olvera, & Wynne, 2000).

Side Effects

Side effects are relatively common with psychoactive stimulants. However, most side effects are not serious and can be dealt with without much trouble. The most common side effects are insomnia and diminished appetite. These can usually be controlled if one is careful with respect to when the doses are administered (e.g., not too close to mealtimes or bedtimes). Less common side effects are abdominal pain, headaches, and irritability. There is also speculative evidence that in a very small number of cases, Ritalin may heighten one's susceptibility to have tics or increase their intensity in those already having a tic disorder, such as Tourette's syndrome.

Negative Publicity Regarding Ritalin

Ritalin has had more than its share of negative publicity in the popular media. For example, several critics of its use have appeared on high-profile TV shows, such as "Oprah," "Geraldo," and "20/20." Many of the critics have claimed that parents and teachers are too impatient with the behavioral deviations and turn to drugs to make children more docile and compliant. Many have also claimed that prescribing Ritalin for children in the early years somehow teaches them or encourages them to turn to illicit drugs, such as marijuana or cocaine, in the teenage years. Although there is a higher incidence of illicit drug use among teenagers with ADHD, there is no evidence that this is the result of using Ritalin (Barkley, 1998). In fact, there is some evidence suggesting that just the opposite is true—those who take Ritalin are less likely to abuse other drugs later (Biederman, Wilens, Mick, Spencer, & Faraone, 1999).

Research on the Effectiveness of Medication

Over the past twenty to thirty years, there have been dozens, if not hundreds, of studies on the effectiveness of psychoactive stimulants for ADHD. The results have been overwhelmingly positive with respect to their effectiveness for improving inhibition and executive functions. For example, in one large-scale, 14-month study, funded by the National Institute of Mental Health, medication was found to be more effective than behavior management. However, what was most effective was when medication was combined with behavior management techniques (Pelham, 1981; Swanson & Sachse-Lee, 2001).

Even though psychoactive stimulants can be highly effective for many persons with ADHD, there are some for whom the medication does not appear to be effective. Research is not conclusive, but perhaps as many as 30 percent do not respond favorably to the drug (Spencer et al., 1996).

Cautions Regarding Ritalin

Even though Ritalin is so highly effective, there are many very important cautions regarding its use:

- Ritalin should not be prescribed at the first sign of a behavioral problem. Only after careful analysis of the student's behavior and environment should Ritalin be considered.
- Although research has demonstrated the effectiveness of Ritalin on behavioral inhibition and executive functions, the results for academic outcomes have not been as dramatic. Although important academic measures, such as