

# VISUAL DISORDERS MISDIAGNOSED AS ADHD CASE STUDIES AND LITERATURE REVIEW

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## Abstract

*Attention Deficit/Hyperactivity Disorder (ADHD) is one of the most studied, and most controversial, of the mental health disorders seen in children. Three cases are presented which were, in hindsight, clearly misdiagnosed as ADHD when in fact the individuals had easily treatable visual dysfunctions. ADHD is often misdiagnosed and misunderstood by parents, teachers, eye care professionals, family practitioners, and pediatricians. In fact, some mental health professionals still disagree about the diagnostic criteria for this disorder, especially in young adults. However, almost all agree it is a legitimate disorder that, when diagnosed and managed with a rigorous approach, can be effectively treated. A complete visual evaluation by an eye care professional trained in the thorough testing and diagnosis of eye movements, accommodation, and binocular fusion is one critical step toward avoiding misdiagnosis.*

## Key Words

*Attention Deficit/Hyperactivity Disorder (ADHD), vision disorders, diagnostic errors, psychotropic drugs, interdisciplinary health team*

**A**ttention Deficit/Hyperactivity Disorder (ADHD) is one of the most commonly diagnosed mental disorders of childhood and certainly one of the most controversial. This controversy is based on the notion that many of the behaviors now characterized as a mental disorder are quite ordinary among most children and even many adults. In addition, there is a perception that ADHD is vastly over-diagnosed. This is based on reports of communities in which one out of every five Caucasian males from ages 6 to 14 are on some form of psychotropic medication<sup>1</sup> and that even some preschoolers are being medicated for ADHD.<sup>2</sup> However, some other studies suggest that the condition is still widely under-diagnosed.<sup>3</sup> Because many of the symptoms of ADHD are also symptoms of common binocular, accommodative, and ocular motor dysfunctions, it is imperative that optometrists understand this disorder and the visual conditions that could be confused with ADHD.

## CASE REPORTS

### Case 1

BJ, a 10-year-old female fifth grader, presented to the resident (JL) at the Southern College of Optometry for an annual visit related to her spectacle wear. The year before, she had been prescribed spectacles for simple hyperopic astigmatism. The parents had concerns about her poor degree of visual attention at that time. The record did not report any binocular or accommodative testing other than

stereopsis, which was reported as "30 seconds of arc/normal." For the examination by the resident, she had no visual complaints, but her father was concerned because of decreased working distance at the desk and obvious discomfort when looking at the board in the classroom, even with the spectacles. He was especially concerned about his daughter's difficulty sustaining attention during reading.

Health history revealed that BJ had been diagnosed with ADHD by a family practice physician 18 months before. The father maintained that she had been diagnosed with ADHD simply on the basis of her difficulty attending to nearpoint visual tasks, such as reading and homework. Despite her taking Adderall (a dextroamphetamine compound) during the 18 months prior to the visual examination, there was no noted improvement in her symptoms or her academic performance.

Upon examination, there was no evidence of external or internal ocular diseases or pathology, nor a visual field or pupillary dysfunction. The visual skills findings from BJ's evaluation are listed in Table 1. She was diagnosed with convergence insufficiency and accommodative dysfunction. Vision therapy was recommended. After nine visits, BJ saw a neurologist for a second opinion about the ADHD diagnosis on the recommendation of the resident and the father. The resident and neurologist both agreed that medication for ADHD was no longer appropriate.

BJ completed her vision therapy program in 20 office visits. Her father was

quite pleased with her progress at school and at home. After the mid-point of vision therapy, she had been receiving excellent reports from her teacher and her grades had improved markedly. The post-therapy visual findings are also given in Table 1.

### Case 2

MH was a 17-year-old senior in high school when she was referred to one author's (DAD) private office for a visual skills evaluation by her primary care optometrist. He had found convergence insufficiency and was concerned that it may have been the cause of inattentive behaviors at school that had been diagnosed as ADHD. MH was taking 10 mg of methylphenidate, twice daily on school days. She reported a mild abatement of symptoms but no significant academic improvement since she began taking the medication. Health history was otherwise unremarkable.

MH complained of symptoms of having to re-read paragraphs frequently, words running together, intermittent near and distance blur, and intermittent frontal headaches on a symptoms survey. She reported doing very well in school until her junior year in high school, when her reading load increased markedly, her symptoms increased, and her grades dropped to B's and C's.

Examination findings are reported in Table 1. There was no evidence of ocular diseases or pathology nor a visual field or pupillary dysfunction. She was diagnosed with convergence insufficiency with secondary accommodative dysfunction. Vision therapy was recommended. After thirteen office therapy visits, her symptoms had abated markedly and her visual skills findings improved (see Table 1). She discontinued the medication for ADHD under the advisement of her parents and doctor. She then went to college and at a subsequent evaluation reported receiving straight A's in her first semester.

### Case 3

GS was a 10-year-old fifth grader who was referred to the resident at SCO (KBS) for a visual perception evaluation because of school and parental concerns about falling grades over the previous two years. He

	Case 1 pre-VT	Case 1 post-VT	Case 2 pre-VT	Case 2 post-VT	Case 3
<b>Distance VA (OD, OS, OU)</b>	20/30+, 20/20-, 20/20	20/20, 20/20, 20/20	20/20, 20/20, 20/15	20/20, 20/20, 20/15	20/20, 20/20, 20/20
<b>Cover test (distance, near)</b>	5 XP, 15 XP	2 XP, 8 XP	Ortho, 5 XP	Ortho, 5 XP	n/a
<b>Stereopsis</b>	20 of arc	20	30	20	n/a
<b>Retinoscopy</b>	OD +0.50 -1.50 x180 OS +0.75 -1.00 x180	OD +0.50 -0.75 x180 OS +0.25 -0.75 x175	OD+0.75 -0.50 x085 OS+0.75 -0.25 x090	OD +1.00 sph OS +1.00 sph	OD +0.25 sph OS +0.25 sph
<b>Subjective</b>	OD +0.75 -1.25 x180 OS +1.00 -1.00 x180	OD +0.50 -0.75 x180 OS +0.25 -0.75 x175	OD+0.50 -0.50 x090 OS+0.75 -0.50 x090	OD +0.50 sph OS +0.75 sph	OD plano sph OS plano sph
<b>Distance phoria</b>	14 XP	16 XP	1 XP	1 XP	n/a
<b>Near phoria</b>	17 XP	16 XP	9 XP	7 XP	n/a
<b>BI at near</b>	x/24/08	X/36/24	x/22/15	x/20/18	x/13/06
<b>BO at near</b>	x/12/-18	X/36/32	x/12/-03	x/26/24	x/20/00
<b>NRA</b>	+2.25	+3.50	+2.00	+2.25	+1.75
<b>PRA</b>	-3.00	-3.75	-2.25	-2.50	-3.75
<b>Accommodative amplitudes (minus lens method, OD/OS)</b>	3D/3D	n/a	5D/5D	10D/10D	10D/10D
<b>Accommodative facility</b>	5 cpm	10 cpm	4 cpm	13 cpm	3.5 cpm
<b>MEM retinoscopy</b>	n/a	+0.50 sph	+0.25 sph	+0.75	+0.75*
<b>DEM (vertical/ratio)</b>	Average/average	n/a	Average/average	Average/average	Average/average

was receiving B's and C's at the time of the evaluation. He had been diagnosed two years before the visual evaluation with ADHD and co-morbid depression by his pediatrician. GS was taking 10 mg of Adderall and 10 mg of Paxil (paroxetine, a selective serotonin reuptake inhibitor) each day, as well as Periactin (cyproheptadine, an H1 antagonist) for appetite stimulation to counteract the appetite suppression effects of Paxil. The diagnosis of ADHD was made because of reports of daydreaming during deskwork by his third grade teacher, although his grades had not fallen at that time. (His grades were poorer in fourth grade, while he was on medication.) His health history was otherwise unremarkable.

GS's visual skills findings are reported in Table 1. There was no evidence of ocular diseases or pathology nor a visual field or pupillary dysfunction. On his perceptual evaluation he performed at or above age level on the Monroe Visual III,<sup>a</sup> the Wold Sentence Copy,<sup>a</sup> the Test of Auditory Perceptual Skills,<sup>b</sup> and the Test of Visual Perceptual Skills,<sup>b</sup> although he performed slightly below average on the Test of Visual Motor Skills.<sup>b</sup>

GS was diagnosed with accommodative infacility and binocular instability. Vision therapy was recommended. The parents discussed this option with the pediatrician. He objected because he was of the opinion that vision therapy would be too costly, take too long, and has not been scientifically proven to have any effect on ADHD. He recommended a costly neurological evaluation and the patient was subsequently lost to follow-up.

## DISCUSSION

### The nature of ADHD

ADHD is a very common behavioral disorder of childhood.<sup>4</sup> It has been found in every culture that has been studied.<sup>5</sup> The most commonly accepted definition of the disorder is found in the American Psychiatric Association's (APA) *Diagnostic and Statistical Manual, 4<sup>th</sup> edition* (DSM-IV).<sup>6</sup> The DSM-IV definition allows for "typing" of the disorder, with three different expressions of the condition: attention deficit hyperactivity disorder, predominantly impulsive type (ADHD-I), attention deficit hyperactivity disorder, predominantly hyperactive type (ADHD-H), and attention deficit hyperac-

**Table 2. Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Clinical Criteria for Diagnosis of Attention-Deficit/Hyperactivity Disorder**

The person must show at least six of the symptoms in one or the other of the categories for at least six months. If the person shows at least six symptoms in each of the categories, then the combined type is considered the appropriate diagnosis.

Symptoms of inattention	Symptoms of hyperactivity-impulsivity
Often fails to give close attention to details or makes careless errors	Often fidgets with hands or feet or squirms in seat
Often has difficulty sustaining attention in tasks or play activities	Often leaves seat in classroom or in other situations in which remaining in seat is expected
Often does not seem to listen when spoken to directly	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)
Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)	Often has difficulty playing or engaging in leisure activities quietly
Often has difficulty organizing tasks and activities	Is often "on the go" or often acts as if "driven by a motor"
Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)	Often talks excessively
Often loses things necessary for tasks or activities (toys, school assignments, pencils, books, tools, etc.)	Often blurts out answers before questions have been completed
Is often easily distracted by extraneous stimuli	Often has difficulty awaiting turn
Is often forgetful in daily activities	Often interrupts or intrudes on others (butts into conversations or games, etc.)

tivity disorder, combined type (ADHD-C). Most children are diagnosed with either ADHD-C or ADHD-I.

The DSM-IV definition emphasizes several points:

- some symptoms of the disorder must have existed before age seven,
- there must be evidence of clinically significant impairment in functioning,
- the symptoms and the impairment from the symptoms must occur in at least two settings and often occur in most settings,
- the symptoms are most likely to occur in group settings and least likely to appear in one-on-one situations,
- the symptoms are often absent in novel settings or when rewarded frequently for appropriate behavior
- this overall variability in the appearance of symptoms often leads to resentment and antagonism in family and other relationships.

As seen in Table 2, ADHD should be diagnosed when there is the presence of at least six symptoms of the disorder at a level that is inappropriate for the person's age.

There are a number of physiological or physical markers that have been connected to ADHD. Among them are:

anomalous activation patterns in the right pre-frontal cortex, which interestingly involves decreased activation in boys diagnosed with ADHD and increased activation in girls;<sup>5,7</sup> on EEG testing, increased theta wave frequency levels in all ages and decreased beta wave frequency levels that become more normal as the child gets older;<sup>8</sup> decreased dopamine and noradrenaline transmission from the vermis of the cerebellum and the basal ganglia;<sup>5,9</sup> decreased P2 and N2 latencies and increased P3 latencies in event-related potentials (ERPs).<sup>10,11</sup>

The etiology of ADHD remains unknown, but it is most commonly considered to be familial in nature. ADHD has also been associated with lead poisoning, chronic otitis media, fetal alcohol syndrome, iron deficiency anemia, maternal drug use during pregnancy.<sup>12</sup> It has also been seen to develop secondary to injury of the right putamen.<sup>13</sup> Other theories on the etiology of ADHD include impaired immunological function, an anomalous reaction to a

vaccination, a nutritive disorder, or a reaction to common food additives. Most of these etiological theories consider ADHD to be part of a spectrum of developmental disorders that includes pervasive developmental disorder (PDD) and autism.<sup>14</sup>

The behaviors associated with ADHD that the DSM-IV defines and most rating scales attempt to quantify are typically characterized as signs of defects in executive functions. These executive functions include:

- use of working memory to remember past difficulties and to predict consequences;<sup>5,15</sup>
- internalization of self-directed speech;<sup>14</sup>
- control of state of arousal,<sup>14</sup> emotion, and motivation; and
- reconstitution (the ability to observe others' behaviors and learn how to pattern one's own behavior in new situations based on those observations).<sup>5</sup>

Because of their impaired executive functions, individuals with ADHD manifest many different behaviors which result in difficulty within the classroom and without. These individuals are often aggressive and have an abnormal level of emotion lability<sup>12</sup> and intensity of actions (ADHD-C) or are abnormally passive<sup>16</sup> (ADHD-I). In both types of ADHD, one of the hallmarks is social difficulty. Because they can't control their emotions and don't learn from past mistakes, they often are ostracized by their classmates. They may make friends fairly easily, but they have difficulty maintaining relationships. Although females with ADHD are typically less aggressive and less fidgety, it has been shown that their social problems are often just as severe.<sup>17</sup>

Children with ADHD often have difficulty sitting still even during television viewing. When they do sit still for a movie or other programming, it has been shown that they do not attend as well as and certainly do not recall the story lines as well as their non-impaired peers.<sup>18</sup> They have also been shown to delay visual-motor integration skills relative to their peers, independently of any other co-morbid perceptual delays they may have.<sup>19</sup>

### Diagnostic dilemmas

Because of these symptoms, and the devastating effects they can have on the academic and social life of a child, most experts in ADHD agree that children with

ADHD have difficulties in almost every aspect of their lives, often from a very young age. Difficulties with diagnosis arise from three key problems:

Inattentive behaviors occur in all individuals. The capacity to attend to various tasks and exert self-control has a normal distribution and individuals with ADHD (about 3-5% of the general population) are on the tail of that bell curve.

Many general practitioners, and too often some teachers, do not fully understand the disorder and assume that any inattentive behaviors, especially in the classroom or workplace, must be ADHD.<sup>20</sup>

The most studied age group for ADHD are elementary school children. The disorder is still poorly defined for preschoolers<sup>21</sup> and post-adolescents.

In fact, there is a group of mental health professionals who strongly believe that ADHD is woefully under-diagnosed in young adults and adults. These professionals believe that almost any sign of inattention in college students or adults is diagnostic for ADHD, and one of them has devised a new rating scale that is so broad in the scope of its questions that other experts in ADHD have felt compelled to criticize it for its tendency to ignore any other possible mental or physical disorders that might be causing the same symptom patterns.<sup>19,22</sup> This confusion has happened in part because the disorder has not been as well studied in adults and the DSM-IV criteria are clearly geared toward children. The APA is currently reviewing those criteria in order to make a more appropriate set for adults.

### Management controversies

There are also a number of controversies with regard to the management of ADHD. It is generally conceded in the literature that the current medications relieve only some symptoms of the disorder and have not been shown to improve school performance or general behaviors in the long term.<sup>12</sup> In fact, some studies have indicated that even children without ADHD can improve their level of attention when taking a central nervous system stimulant,<sup>23</sup> even if the investigators had anticipated that methylphenidate would make symptoms worse because of co-morbid conditions.<sup>24</sup> This makes the placebo trials that are commonly used be-

fore prescription of a stimulant medication problematic.

Many of the medications used to manage ADHD, including methylphenidate,<sup>25</sup> clonidine (used off-label for ADHD),<sup>26</sup> and the tricyclic antidepressants,<sup>27</sup> have been reported to cause blurred vision, impair accommodation, or both. One of the authors (DAD) has seen this effect very frequently in children who appear to have been misdiagnosed with ADHD, less often in children who appear to have been correctly diagnosed with the disorder. This could be a direct effect of the medication on these children or their inattentiveness could have been due primarily to the accommodative dysfunction. It is certainly a relationship that requires further study.

There is also controversy about the effectiveness of behavioral therapy in the management of ADHD. One large study, the Multimodal Treatment Study (MTA study), found that either medication therapy or combination therapy (medication and behavioral therapy) worked better over a 14-month period than either behavioral therapy alone or standard community care.<sup>28</sup> However, a critical analysis of the study indicates that its design "predisposed the study in favor of a differentially positive outcome for pharmacological relative to behavioural treatment." Nevertheless, the study measured outcome four to six months after the most intensive phase of behavioral therapy and indeed after the therapy visits had ended but during the most intensive phase of medication therapy.<sup>29</sup> The debate still continues. Part of the rationale is that it is widely accepted that the effectiveness of medication for symptoms of the disorder in the short term is fairly well established but that the efficacy of medication in the long term (longer than 14 months) or for academic or social disturbances related to ADHD has not yet been established.

The problems in the diagnosis and management of ADHD are sometimes blamed on the proliferation of managed care. The argument is that managed care insurers are much less likely to pay for specialist care, such as with a neurologist or a neuro-developmental psychologist, despite the fact that some studies indicate a strong tendency for primary care practitioners to mismanage this condition.<sup>30</sup> Managed care organizations are also less likely to pay for the long-term behavioral therapies that are recommended on pack-

age inserts for specific ADHD medications and in most of the literature on the disorder.<sup>25</sup> However, it should be remembered that there are many other difficulties that play a large role in the misdiagnosis and mismanagement of ADHD, difficulties that would be much easier to overcome.

### Differential diagnoses

This difficulty making differential diagnoses or identifying co-morbid conditions is also in much of the literature on ADHD. Oppositional-defiant disorder (ODD), depression, reading disability (reading disorder), mathematics disorder, conduct disorder, and even psychosis have all been or have a strong potential to be misdiagnosed as ADHD.<sup>31</sup> Some of the ratings scales make almost no distinction between ADHD and other, sometimes much more serious, mental disorders.<sup>19</sup> Co-morbid or deceptive sensory disorders have even more potential to be misdiagnosed as ADHD. This is because most mental health professionals are not as familiar with the symptoms of these disorders and general health care professionals often assume that if audiological and visual screenings in their offices are normal, then there are no sensory disorders. There is, for example, some concern in the literature about the potential for central auditory processing disorders to be misdiagnosed as ADHD.<sup>32</sup> and the three cases presented here certainly highlight the strong possibility that common visual disorders are being misdiagnosed as ADHD. In fact, ophthalmology has recently weighed in on the subject with a study reporting that a sample of children with ADHD had an incidence of convergence insufficiency that was three times the incidence in the general population.<sup>33</sup> It has been recently noted that children with convergence insufficiency score significantly higher on one of the most popular of the ADHD ratings scales, the Conners' Rating Scale for Parents, than children with normal binocular vision.<sup>34</sup> This greatly increases the likelihood of misdiagnosis if a family practitioner or pediatrician relies solely on this scale for the diagnosis of ADHD. In fact, at least one major text on pediatric medicine<sup>12</sup> does not even discuss the role sensory impairments might have in the differential diagnosis of ADHD.

## Indications for further study

There is much that still needs to be studied about the relationship of vision to the child with ADHD. The possible impact of central nervous system stimulants and tricyclic antidepressants on accommodative function needs to be more completely documented. The overlap between visually inattentive behaviors and those behaviors listed in the more popular ratings scales needs to be explored more fully, especially in the classroom setting. Comprehensive visual evaluations of children who have been diagnosed with ADHD should be undertaken in a multi-center setting. It should also be determined what impact ADHD has on visual evaluative methods.

Optometrists often find themselves in the role of patient advocacy. It is therefore absolutely essential that optometry understand this clinical condition and the many possible differential diagnoses, including the visual disorders, such as latent hyperopia, ocular-motor dysfunctions, accommodative dysfunctions, vergence dysfunctions, and visual-perceptual delays, that can negatively impact attention. A careful history and thorough evaluation of all aspects of the patient's visual system is key to providing the patient and his or her family with advice about the appropriateness of the diagnosis and the best way to manage the visual side effects that often result from medical management of ADHD.

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