

## FM Candidacy Issues and the “Alphabet Soup”

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### Introduction

Children are referred to audiologists for assessment and treatment of behaviors attributed to the auditory system. Etiologies of these behaviors may include peripheral hearing loss, central auditory processing disorder (APD/CAPD), or a global sensory processing issue which is part of a larger developmental disorder, such as attention deficit disorder (ADD/ADHD). The ability to develop an appropriate differential diagnosis is based on knowledge of disorders that often present with similar types of observed behaviors at first glance; however a clear understanding of these disorders may assist in a diagnosis and certainly in appropriate treatment/management. The focus of this chapter is to provide the audiologist with an overview of several disorders which initially may present with similar types of behaviors but can be differentiated in terms of etiology. This information assists in understanding which children may be the strongest candidates for use of FM technology as part of treatment/management of the disorder.

“Alphabet soup” refers to the labels that professionals, educators, and parents use to identify sets of observed behaviors, some of which are attributed to the auditory system and others which would be considered more global sensory processes. For the purpose of this article, these disorders are auditory processing disorder (APD), attention deficit disorder with or without hyperactivity (ADD/ADHD), and autism spectrum disorder (ASD). Assumptions are made related to how behaviors for each of these disorders fall into discrete diagnostic categories and

when the lines of these categories are blurred, overlap among behaviors results and comorbidity of disorders is presumed. Because of similarities between behaviors and this overlap, establishing discrete diagnostic categories among these disorders is often difficult as it is challenging to “tease out” one category from another. A thorough diagnostic evaluation can provide insight into classifying behaviors, determining impact of these behaviors on listening and learning, the possible etiology of these behaviors, and a plan for effective treatment/management. It is presumed that each of the disorders addressed in this article are best assessed in an interdisciplinary manner with an audiologic assessment as a critical component of this evaluation.

One of the issues germane to the three disorders addressed in this article is the underlying assumption that improving the listening environment will alleviate behavioral difficulties that children in these categories experience. This improvement of the listening environment is most generally suggested through enhancing the signal-to-noise ratio, generally through the use of FM technology. Although this assumption may have good face validity, it is often based on anecdotal information rather than data from studies or even a carefully established trial of technology. Use of FM technology may be beneficial to some children that fall into the diagnostic categories described here. However, it is far from a panacea, and in some situations, use of this type of technology may be contraindicated.

Auditory processing disorders (APD), attention deficit/hyperactivity disorders (ADD/ADHD), autism spectrum disorders (ASD)/ pervasive developmental disorders (PDD) share many similarities. All are low incidence disorders within the general education environment. These are children who are different

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from their age peers in terms of “attending,” “focusing,” or being able to “cope” in less than optimal listening environments. There is a general perception that characteristics of these disorders are observable in the classroom environment and can be differentiated based on information gleaned from this “authentic assessment.” Although this authentic assessment can contribute to an overall assessment of a child, the observers experience with and understanding of each of these disorders can contribute to their ability to accurately identify these disorders.

In reality, observation of behaviors as a criterion for diagnosis of any of the disorders addressed in this article is problematic. The problem is summarized in a statement regarding attention deficit hyperactivity disorder (ADHD), however could be applied to any of the disorders in the “alphabet soup.”

Clinicians who diagnose this disorder have been criticized for merely taking a percentage of the normal population who have the most evidence of inattention and continuous activity and labeling them as having a disease. In fact, it is unclear whether the signs of ADHD represent a bimodal distribution in the population or one end of a continuum of characteristics. This is not unique to ADHD as other medical diagnoses, such as essential hypertension and hyperlipidemia, are continuous in the general population, yet the utility of diagnosis and treatment have been proven. (National Institutes of Health, 1998).

However, this National Institutes of Health Consensus Statement (1998) suggests the validity in the “. . . diagnosis of [the disorder] with broadly accepted symptoms and behavioral characteristics that define the disorder.”

An underlying premise is that as a disorder is diagnosed based on its behavioral characteristics, treatment approaches can be developed from these observations. Thus, if auditory behaviors can be observed and quantified in a systematic manner, they can be effectively managed and/or treated. It is as presumed that child with auditory issues may benefit from a number of treatment options and management strategies to address the underlying behaviors, with one of these options including use of technology which improves the listening environment. As will be noted, the literature reviewed in this article supports that ONLY a disorder that is primarily an auditory disorder will benefit from this type of approach. By

virtue of this fact, a disorder resulting from the auditory system should be addressed in a manner which is different from the other disorders discussed in this article.

All children, by virtue of their age, language abilities, and auditory developmental skills, require a more favorable listening environment than adults. The role of room acoustics in the listening and learning abilities of all children has been well established (Rosenberg, Blake-Rahter, Heavner, et al., 1999). However, beyond this statement, questions arise regarding evidence that children with any of the disorders addressed in this article demonstrate improved performance (academic, behavioral, etc.) from an enhanced signal-to-noise ratio that would be obtained from the use of FM technology.

## Disorders in the “Alphabet Soup”

An overview of each disorder in the alphabet soup is provided here. Auditory processing may be simply classified as “what we do with what we hear.” (Katz, 1992) Auditory processes are mechanisms and processes which are responsible for the following behaviors:

- Sound localization
- Auditory discrimination
- Temporal aspects of audition
- Auditory performance decrements with competing acoustic signals
- Auditory performance decrements with degraded acoustic signal (American Speech-Language-Hearing Association, 1995)

Sound localization is an early auditory behavior observed in infants and has a significant role of listening in the presence of background noise. Auditory discrimination refers to both gross and fine differences in sound, both environmental and speech, including phonemes. Temporal aspects of auditory skills include temporal resolution, temporal masking, temporal integration, and temporal ordering and these aspects of the auditory system being able to address “timing” is important in terms of many skills, including reading, auditory memory, and sequencing of auditory information. Auditory performance decrements with competing acoustic signals addresses what is most commonly thought of as related to auditory processing, which is the ability to listen effectively in the

presence of background noise. Auditory performance decrements with degraded acoustic signal may be most easily illustrated by the auditory system's ability to be "flexible" in filling in missing information, such as when comprehending speech produced in a different dialect than that of the listener.

An auditory processing disorder (APD), which may also be referred to as CAPD-central auditory processing disorder, is defined as a deficit in the processing of information in the auditory modality. (Jerger and Musiek, 2000) Although auditory processing disorders may demonstrate comorbidity with other disorders, the behaviors identified as constituting auditory processing disorders (APD) are generally NOT the result of a global sensory processing issue, but rather thought to be specific to the auditory system. These disorders are AUDITORY in nature, which put them on the continuum of hearing loss. In addition, although these are a heterogeneous set of disorders, they are often situation-specific rather than global in nature. If APD is going to be ruled in, a number of relevant listener variables must be considered in assessing auditory processing disorders, including:

- Attention
- Auditory neuropathy
- Fatigue
- Hearing sensitivity
- Intellectual and developmental age
- Medications
- Motivation
- Motor skills
- Native language, language experience, language age
- Visual acuity (Jerger and Musiek, 2000)

In contrast to auditory processing disorders, an attention deficit disorder with or without hyperactivity (ADD/ADHD) can be described as a cognitive deficit that limits an individual's ability to pay attention and stay focused on a task; may involve restlessness, distractibility, and hyperactivity (Mendel, Danhauer, and Singh, 1999). ADD/ADHD is the most commonly diagnosed behavioral disorder of childhood and estimated to affect 3 to 5 percent of school-age children. Core symptoms including developmentally inappropriate levels of attention, concentration, activity, distractibility, and impulsivity. Children with ADD/ADHD demonstrate functional impairment across multiple settings including home, school, and peer

relationships, with long-term adverse effects on academic performance, vocational success, and social-emotional development. (National Institutes of Health, 1998). Therefore, ADD/ADHD is often considered to be a global deficit rather than situation specific.

Assumptions have been made that behaviors are similar between APD and ADD/ADHD, which has lead to the presumption that these clinical entities cannot be differentiated in terms of observation or diagnostic assessment. These assumptions are made based on the view that APD and ADHD have considerable overlap in symptomology. Behaviors considered to be characteristic of both included attention and listening problems, maladaptive behavior, distractibility, instruction-following difficulty, and increased time required to complete tasks. Chermak, Somers, and Seikel (1998) analyzed a list of frequency of report from a list of forty-one characteristics applied to children with the diagnosis of APD OR ADHD. In this analysis, only inattention and distractibility were listed as characteristics of both disorders, with these being the least frequently reported characteristics of children with APD and the most frequently reported characteristics of children with ADHD. Based on this analysis, the authors concluded that "the majority of frequently cited behaviors were not seen as common to ADHD and [C]APD."

Further contrast of behaviors that characterize [C]APD and ADHD provide differentiation in these disorders. Behaviors observed in children diagnosed with APD include, in order of most often reported, difficulty hearing in background noise, difficulty following oral instructions, poor listening skills, academic difficulties, poor auditory association skills, distractibility, and inattention (Chermak et al., 1998). Those behaviors reported as characteristic of ADHD, in order of frequency, are inattentiveness, distractibility, hyperactivity, restlessness, impulsivity or hastiness, and interrupting others (Chermak et al., 1998). More recently, Chermak and Tucker (2002) characterized an exclusive set of behaviors that may differentiate APD and ADHD of the predominantly inattentive type. Four behaviors--inattention, academic difficulties, asking for things to be repeated, and poor listening skills--were ranked as most significant in these disorders, however there were no overlap between the two groups. These findings are again consistent with the fact that these clinical entities are two discrete disorders with little overlap in clinical presentation.

The issue of comorbidity must be considered, as it may be the case that a small number of children present with both APD and ADD/ADHD. An overlap in some of the language skills and behaviors noted in both disorders has been noted by some researchers, however this literature again supports the necessity of an interdisciplinary assessment performed by a team of individuals with experience in working with children with APD and ADD/ADHD (Riccio, Hynd, Cohen, Hall, and Molt, 1994). Potential relationships and issues of comorbidity between APD and ADD/ADHD certainly require further investigation. Recently, a higher incidence of absent P300 responses was noted in the ADHD population when compared to the non-ADHD population, suggesting possible underlying auditory involvement with ADHD. However, a major variable appeared to be medication state, suggesting that medication rather than an underlying disorder has the major impact on the P300 response (Schochat, Scheuer, and Andrade, 2002).

APD and ADD/ADHD can be clearly categorized as different clinical entities, with APD involving behaviors specific to the auditory system and ADD/ADHD involving global issues of attending and processing. A third clinical entity, autism spectrum disorder (ASD), adds another clinical entity that has received much attention in relation to a possible underlying auditory mechanism. Autism spectrum disorder (ASD) can be defined by abnormalities of social interaction, impairments in verbal and non-verbal communication, and a restricted repertoire of interests and activities, all present from early childhood (World Health Organization, 1992; American Psychiatric Association, 1994). However, the boundaries of the disorder are often unclear, and as in many other clinical entities, some behaviors observed in people with autism also observed in those without autism (Willemssen-Swinkesl and Buitelaar, 2002). Clearly, many of the behaviors thought to be characteristic of ASD are on a continuum and the severity or pervasiveness of these behaviors helps to define this disorder. Other terms that may be used in relation to ASD include pervasive developmental disorders, Asperger's syndrome, and childhood disintegrative disorder.

Auditory system disorders have long been suggested as a contributing factor in ASD based on clinical observation. Review of older studies performed in the ASD population, prior to widespread use of electrophysiologic measures, indicated that many

children with the diagnosis of autism had an initial suspicion of a peripheral hearing loss (Dunning, 2003). However, these children were often classified as "difficult to assess," based on their behaviors, and audiologic results obtained were often noted to be "equivocal."

A review of the literature suggests a number of behaviors noted in children with ASD which might be classified as "auditory" in nature. These behaviors include difficulty in the presence of background noise (Khalfa, Bruenau, Roge, et al, 2001), difficulty "processing" auditory information (Wetherby, Kroger, and Mendel, 1981), hypersensitivity and/or hyposensitivity to auditory stimuli (Katznell and Segal, 2001), and the presence of middle ear anomalies (Smith et al, 1988). However, these observations are often based on anecdotal information, studies published in non-referred journals, and/or citations from local conferences. In addition, even studies which utilized appropriate design and scientific rigor in addressing auditory behaviors in children with ASD were confounded by a lack of knowledge of peripheral hearing status of the subjects (Wong and Wong, 1991).

The current view of ASD is that it is a disorder of complex information processing that does not involve visual-spatial processing. ASD is not consistent with the presence of a single primary deficit, but with a multiple primary deficit model in which the deficit pattern within and across domains is reflective of the complexity of the information processing demands. (Minshew, Goldstein, and Siegel, 1997). This definition along with current research in the area of ASD suggests that ASD is a global information processing deficit which may include difficulty processing information from the auditory modality (Cacace and McFarland, 1995; Dunning, 2003).

Based on published peer-reviewed research available at this time, ASD is a global processing deficit and not primarily related to auditory processing of information, despite recent emphasis on therapeutic approaches that would suggest this, such as Auditory Integration Therapy (AIT) (American Speech-Language-Hearing Association, 2004). Although additional research is needed, at this time it appears that children with ASD would NOT appear benefit any more from improved acoustic signals than their typically developing peers. Again, it is critical to state that all children benefit from good room acoustics, based on research, however there is no evidence to support improving acoustics as an approach for

addressing the primary educational need of children with ASD. Remediation that focuses on improving global communication skills and intent may have the greatest benefit in the long run for children with ASD (New York Department of Health, 1999).

It is important to note that all of the "alphabet soup" disorders addressed in this article can benefit from a systematic remediation approach, although this approach will differ based on the disorder. These remediation approaches will go beyond the use of assistive listening technology or modifications to the listening environment. However, the appropriateness of using assistive listening technology, such as an FM system, which can improve the listening environment is a focus here. It should be noted that the auditory system is sensitive to contrast, generally in a positive way. Contrast enhances comprehension and as contrast is enhanced or even exaggerated, children with APD often receive benefit. However, children with ASD are often sensitive to contrast, in a negative way, thus as contrast is enhanced, their ability to make use of the information decreases. These behaviors are often noted based on anecdotal reports of hyperacuity and reports of increased distractibility with the use of a personal FM system in children with an ASD diagnosis. In situations where children with ASD have utilized FM technology, many anecdotal reports related to behaviors not related to signal-to-noise ratio enhancement have been reported. These reports include distraction with headphones or ear-level devices that override possible acoustic benefits from an FM system, disturbance by acoustic feedback from the system, and concurrence with other treatment programs, such as AIT.

Based on current evidence in refereed, peer-reviewed journals and data from controlled clinical observations, the use of FM technology as a means to address the "alphabet soup" disorders is only indicated for children with APD, and even so, the heterogeneous nature of APD suggests that this approach may be of benefit to a subpopulation of children identified with APD. In addition, use of FM technology is not a panacea that addresses all behavioral issues related to APD but rather is one aspect of the treatment/management process (Johnson, 2000). As has been noted by Jerger (1998), APD "... appears to derive from at least two analogies of auditory perception--loss in the ability to separate auditory foreground from auditory background and failure of the fine temporal resolution necessary to the analysis of speech." Use of FM technology with this population

addresses the loss of ability to separate foreground from auditory background.

As noted previously, the acoustical conditions in a given listening environment can present a challenge for any listener, but most remarkably for those with auditory-based disorders, such as peripheral hearing loss and auditory processing disorders. The ability to enhance the signal-to-noise ratio in these situations is often beneficial and the effectiveness of use of FM technology in individuals with APD has been documented (Stach, et al, 1987; American Speech-Language-Hearing Association, 2002a; Stein, 1998). However, success with these devices is predicated on selecting appropriate technology, providing an appropriate trial period, and providing time and support to understand user needs and expectations. Critical in this process are the considerations for listeners with normal peripheral hearing acuity who may be using a personal FM system, with the goal to be a "transparent" fit, which is verified, as in the fitting protocol provided by the American Speech-Language-Hearing Association (2002b). In addition, training with all involved in use of the system (e.g. child, classroom teacher, speech-language pathologist) is critical to the overall success with this system. In addition to a clinical verification, authenticate assessment with the system should be performed in order to assess benefit. Use of an observational questionnaire, such as the Listening Inventory for Education (LIFE), is of benefit in developing a situational verification of benefit (Anderson and Smaldino, 1998).

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