

# Behavioral Characteristics of Auditory Processing Disorder and Attention-Deficit Hyperactivity Disorder: Predominantly Inattentive Type

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## Abstract

Auditory processing disorder (APD) and attention-deficit hyperactivity disorder (ADHD) present overlapping symptomatology. Previous research has demonstrated that professionals use different behavioral descriptors to characterize APD and ADHD combined and predominantly hyperactive-impulsive subtypes, which present with hyperactivity, impulsivity, and inattention. The present study extends this research by comparing audiologists' and pediatricians' rankings of 58 behavioral symptoms associated with APD and ADHD predominantly inattentive (PI) subtype, the ADHD subtype that presents without hyperactivity and impulsivity. Audiologists ranked the degree to which each symptom pertained to individuals with APD, and pediatricians ranked the same symptom as it relates to ADHD-PI. Item analysis revealed that respondents identified a reasonably exclusive set of behaviors characterizing APD and ADHD-PI. None of the four behaviors ranked 2 SD above the grand means (i.e., inattention, academic difficulties, asking for things to be repeated, and poor listening skills) was ranked in common.

**Key Words:** Attention-deficit disorder, auditory processing disorder, differential diagnosis

**Abbreviations:** ADHD = attention-deficit hyperactivity disorder; ADHD-C = attention-deficit hyperactivity disorder-combined type; ADHD-HI = attention-deficit hyperactivity disorder-predominantly hyperactive-impulsive type; ADHD-PI = attention-deficit hyperactivity disorder-predominantly inattentive type; APD = auditory processing disorder

## Sumario

El trastorno de procesamiento auditivo (*APD*) y el trastorno de deficiencia atencional e hiperactividad (*ADHD*) presentan sintomatología compartida. Investigaciones previas han demostrado que los profesionales utilizan diferentes descriptores conductuales para caracterizar el *APD* y el *ADHD* combinados, así como los subtipos predominantemente hiperactivos-impulsivos, que se caracterizan por hiperactividad, impulsividad y falta de atención. El presente estudio amplía esta investigación comparando clasificaciones audiológicas y pediátricas de 58 síntomas conductuales asociados a *APD* y a *ADHD* del subtipo de desatención predominante (*PI*), el subtipo de *ADHD* que se caracteriza por ausencia de hiperactividad e impulsividad. Los audiólogos estimaron el grado en que cada síntoma se relaciona con pacientes con *APD*, y los pediatras juzgaron los mismos síntomas en relación al *ADHD-PI*. El análisis por componentes reveló que los participantes identificaron un razonablemente exclusivo grupo de comportamientos que caracterizan el *APD* y el *ADHD-PI*. Ninguna de las cuatro conductas que se estimaron por encima de 2 SD sobre la gran media (ej. falta de atención, dificultades académicas, pedir repetición de las cosas, y pobres habilidades para escuchar) resultó común a ambas condiciones.

**Palabras Clave:** Trastorno de deficiencia atencional, trastorno de procesamiento auditivo, diagnóstico diferencial

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**Abreviaturas:** ADHD = trastornos de deficiencia atencional e hiperactividad; ADHD-C = trastorno de deficiencia atencional e hiperactividad de tipo combinado; ADHD-HI = trastorno de deficiencia atencional e hiperactividad de tipo predominantemente hiperactivo-impulsivo; ADHD-PI = trastorno de deficiencia atencional e hiperactividad de tipo de desatención predominante; APD = trastorno de procesamiento auditivo

**A**uditory processing disorder (APD) and attention-deficit hyperactivity disorder (ADHD) present overlapping symptomatology (Keller, 1992). A number of similar symptoms including attention and listening problems, distractibility, difficulty following instructions, and associated language and academic problems appear on checklists purportedly characterizing behaviors exhibited by individuals with APD and ADHD (Chermak et al, 1998). The observed association between attention deficit and performance on central auditory tests (Campbell and McNeil, 1985; Pillsbury et al, 1995) has led to speculation that APD and ADHD reflect a single development disorder (Gascon et al, 1986; Cook et al, 1993). Alternatively, APD and ADHD may be distinct yet comorbid (i.e., coexisting) conditions (Keith and Engineer, 1991; Keller, 1992; Riccio et al, 1993, 1994, 1996; Chermak et al, 1999). Central auditory performance deficits observed in individuals with ADHD may reflect the co-occurrence of APD rather than ADHD per se. Although attention deficits characterize both APD and ADHD, Chermak and colleagues (1999) argued that these attention deficits result from different sites of processing dysfunction and are modality specific in APD.

APD is defined as a sensory-perceptual deficit in the processing of information that is specific to the auditory modality (Jerger and Musiek, 2000). Individuals with APD present deficits in one or more of the following behaviors: sound localization/lateralization, auditory discrimination, auditory pattern recognition, temporal aspects of auditory processing, and performance deficits when the auditory signal is embedded in competing acoustic signals or when the auditory signal is degraded (ASHA, 1996). APD is associated with auditory selective and divided attention deficits that cause difficulty listening in competing message, noise or reverberant backgrounds and in understanding rapid or degraded speech, and with having difficulty following oral directions.

ADHD has been reconceptualized as a disorder of executive control and behavioral self-regulation rather than as an attention disorder (Barkley, 1990, 1997). ADHD results from deficits in rule-governed behavior that lead to problems initiating, inhibiting, sustaining, or shifting

responses to tasks or stimuli (Barkley, 1997). Nonetheless, inattentive behavior is observed in two of three ADHD subtypes described in the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)* (APA, 1994). The combined type (ADHD-C) reflects the classic ADHD category characterized by hyperactivity-impulsivity (i.e., behavioral regulation disorder) and inattention. The predominantly hyperactive-impulsive type (ADHD-HI) is considered a behavioral regulation disorder. ADHD-predominantly inattentive type (ADHD-PI) presents primary symptoms of inattention. It is this latter ADHD subtype (ADHD-PI) that appears most similar to APD.

Whereas inattention in ADHD-C may stem from executive control problems resulting in distractibility and lack of persistence (Achenbach, 1986; Lahey et al, 1988; Barkley, 1997), the inattention that characterizes ADHD-PI may result from a passive, sluggish cognitive tempo (Achenbach, 1986) that leads to multimodality or supramodal sustained attention deficits (i.e., vigilance). Children with ADHD-PI are often described as daydreamers or absentminded (Fargason et al, 1997), demonstrating carelessness, disorganization, difficulty sustaining mental effort, and forgetfulness, in addition to distractibility to extraneous stimuli, difficulties listening when spoken to, and difficulties sustaining attention. Table 1 lists symptoms of inattention in ADHD-PI as defined in the *DSM-IV* (1994). In contrast, selective and divided attention deficits in APD result from sensory-perceptual deficits in the processing of auditory information (Musiek and Chermak, 1995; Jerger and Musiek, 2000). ADHD-PI is a medical diagnosis rendered primarily by pediatricians or psychologists; APD is an audiologic diagnosis. There are no empirical markers that identify ADHD (Gordon, 1991; Reid et al, 1993; Taylor, 1986); therefore, ADHD subtypes are diagnosed on the basis of behaviors. APD is diagnosed on the basis of performance deficits on a battery of behavioral tests and, in some cases, by electrophysiologic indicators of central auditory function (Jerger and Musiek, 2000).

The present study was undertaken to expand upon the work of Chermak and colleagues (1998), who compared audiologists' and pediatricians' rankings of 41 behaviors associ-

**Table 1** *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Criteria for Diagnosis of Attention-Deficit Hyperactivity Disorder-Predominantly Inattentive Type*

*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 development level:*

- Often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities
- Often has difficulty sustaining attention in tasks or play activities
- Often does not seem to listen when spoken to directly
- Often does not follow through on instructions and fails to finish homework, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)
- Often has difficulty organizing tasks and activities
- Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)
- Often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)
- Often is easily distracted by extraneous stimuli
- Often is forgetful of daily activities

From American Psychiatric Association. (1994). *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed. Washington, DC: American Psychiatric Association, 63-65.

ated with ADHD (subtype unspecified but presumed to be ADHD-C or ADHD-HI) and APD. Item analysis revealed that pediatricians and audiologists consider ADHD and APD to be distinct disorders, with only two of the most frequently cited behaviors judged to be characteristic of both disorders. Pediatricians consider ADHD to be a behavioral regulation disorder characterized by inattentiveness, distractibility, and hyperactivity. Audiologists consider difficulty hearing in background noise, difficulty following directions, and poor listening skills to be characteristic of APD.

In the present study, pediatricians were asked to rate behaviors seen in ADHD-PI, the ADHD subtype most likely to present the greatest overlapping clinical profile with APD. Because checklists are still relied upon particularly to diagnose ADHD, but also to assist in formulating APD diagnostic and management strategies, this research sought to compare the salience of behavioral signs of APD and ADHD-PI between those who conventionally diagnose each disorder, that is, audiologists and pediatricians. Although clinical psychologists often evaluate children suspected to have APD and ADHD, pediatricians were polled because ADHD is a medical diagnosis and pediatricians are frequently called upon by parents to diagnose ADHD.

## METHOD

### Participants

The participants were 100 audiologists and 100 pediatricians randomly selected from national membership rosters of the American Academy of Audiology and the American Medical Association, respectively.

### Materials

A questionnaire was designed to address 58 behaviors, compiled from various checklists, that purportedly reflect APD or ADHD (Appendix). Each of the 58 behaviors was presented with a rating scale with numeric values ranging from 1 (never observed) to 5 (always observed), with an additional option for "don't know" (DK). Items were drawn from among the behaviors commonly noted to characterize these disorders (Fisher, 1976; Sloan, 1980; Willeford and Burleigh, 1985; Lahey et al, 1988; Barkley, 1990, 1994, 1999; Bornstein and Musiek, 1992; Keller, 1992; Silver, 1992; Gillet, 1993; APA, 1994; ASHA, 1996; Chermak and Musiek, 1997; Jerger and Musiek, 2000).

### Procedure

Questionnaires, cover letters, and stamped return envelopes were mailed to 100 audiologists and 100 pediatricians. Audiologists were asked to rate the behaviors on the basis of how frequently they were observed in children who had APD. Pediatricians were asked to rate the same behaviors on the frequency with which they were observed in children with ADHD-PI. Follow-up postcards requesting return of the survey were sent within 2 weeks of the initial mailing.

## RESULTS

Sixty-four (32%) of 200 surveys were returned by 26 pediatricians (26% of 100 pediatricians) and 38 audiologists (38% of 100 audiologists) for analysis. A total of 49 surveys (25%) were completed and available for analy-

**Table 2 Rank Order of Behavioral Means Greater than 1 and 2 SD Above the Respective Grand Mean**

<i>ADHD-PI</i>	<i>Average</i>	<i>C(APD)</i>	<i>Average</i>
Inattentive	4.45*	Asks for things to be repeated	4.39*
Academic difficulties	4.22*	Poor listening skills	4.39*
Daydreams	4.05	Difficulty following instructions given orally	4.33
Distracted	4.04	Difficulty hearing in background/ambient noise	4.28
Poor listening skills	3.86	Academic difficulties	4.22
Disorganized	3.82	Distracted	3.78
Asks for things to be repeated	3.70	Reduced rate of information processing	3.78
Auditory divided attention deficit	3.67	Auditory divided attention deficit	3.76
Difficulty hearing in background/ ambient noise	3.62	Auditory selective attention deficit	3.76
		Auditory sustained attention deficit	3.71
		Poor memory	3.67
		Difficulty discriminating speech	3.65
Grand mean	3.11	Grand mean	2.93
Standard deviation	0.50	Standard deviation	0.72

\*Greater than 1 and 2.50 above the respective grand mean.

ADHD-PI = attention-deficit hyperactivity disorder-predominantly inattentive type; C)APD = (central) auditory processing disorder.

sis; 26 (53%) of these completed surveys were from audiologists and 23 (47%) from pediatricians). The numeric scores (individual ratings for each behavior) for each behavioral characteristic were totaled and a mean was calculated to determine which behaviors were most frequently observed in each disorder by the respective professional group. From these means, grand means and standard deviations were calculated for all 58 items for each professional group. Items whose ranks fell greater than 1 or 2 SD above the respective grand mean were evaluated for overlap between the two disorders and groups of diagnosticians (Table 2, Appendix).

As seen in Table 2, pediatricians ranked nine behaviors at least 1 SD above their grand mean; two behaviors (i.e., inattentiveness and academic difficulties) were ranked 2 SD above the grand mean. Audiologists ranked 12 behaviors above their grand mean; two behaviors (i.e., poor listening skills and asking for things to be repeated) were ranked 2 SD above their grand mean.

Of the items ranked at least 1 SD above the mean, six behaviors (40% of the 15 behaviors that were ranked at least 1 SD above the grand mean by either professional group) were seen as common to both disorders, whereas nine differentiated the two disorders (see Table 2). Common to both APD and ADHD-PI were the following: academic difficulties, distraction, poor listening skills, asking for things to be repeated, auditory divided attention deficit, and difficulty

hearing in background/ambient noise. Neither of the two behaviors ranked by pediatricians as 2 SD above the mean (i.e., inattentiveness and academic difficulties) was found in common with the two behaviors ranked 2 SD above the mean by audiologists (i.e., asking for things to be repeated and poor listening skills).

Audiologists identified six behaviors as highly characteristic of APD that did not appear on the pediatricians' highly ranked behaviors. These behaviors were auditory sustained attention deficit, auditory selective attention deficit, difficulty following instructions given orally, reduced rate of information processing, poor memory, and difficulty discriminating speech. In contrast, pediatricians identified three behaviors as highly characteristic of ADHD-PI that were not ranked at least 1 SD above the mean by audiologists as characteristic of APD: inattentiveness, daydreaming, and disorganization.

## DISCUSSION

Respondents identified a reasonably exclusive set of behaviors that most highly characterize APD and ADHD-PI. None of the four behaviors ranked 2 SD above the grand means (i.e., inattentiveness, academic difficulties, asking for things to be repeated, and poor listening skills) was so ranked in common. The global behavior inattentiveness fell within 1 SD of the audiologists' grand mean, indicating that the audiologists did not consider inattentiveness to be particularly descriptive of APD. The disor-

ganized and daydreaming behaviors were judged uniquely descriptive of ADHD-PI. Similarly, reduced rate of information processing, poor memory, and difficulty discriminating speech remained uniquely descriptive of APD. The pediatricians responding to this survey view ADHD-PI as a cognitive disorder, one of a pervasive inattentiveness (marked by daydreaming and disorganization) and academic difficulties. Audiologists view APD as a sensory-perceptual disorder resulting in listening problems (i.e., poor listening skills, the need to have things repeated, difficulty discriminating speech, and difficulty maintaining auditory attention in quiet and in competition).

There is almost complete correspondence between the most frequently observed behaviors in APD noted by audiologists across this study and that reported by Chermak and colleagues (1998). In contrast, but not surprisingly, only two behaviors (i.e., inattentiveness and distraction) appeared on the pediatricians' list of most salient characteristics of ADHD and ADHD-PI across the two studies. Whereas pediatricians considered inattention to be the number one characteristic of both ADHD and ADHD-PI, they ranked behaviors indicative of hyperactivity and impulsivity as characteristic of ADHD (unspecified). Pediatricians in the present study considered ADHD-PI to be a rather pervasive attention (cognitive) problem with associated executive control problems and associated listening deficits. They ranked behaviors more characteristic of cognitive disorientation, sluggish cognitive tempo, and poor executive control (e.g., daydreaming, disorganization), as well as behaviors typifying poor auditory function (e.g., poor listening, difficulty hearing in background noise, auditory divided attention deficit, asking for repetitions) as characteristic of ADHD-PI.

Not surprisingly, defiance, aggression, socially inappropriate behaviors, destructiveness, and hostility, which are more closely associated with ADHD-C or ADHD-HI, were ranked rather low by both groups of professionals. Also not unexpected was audiologists' assignment of DK to engaging in dangerous activities, losing things, and stealing or telling lies. These behaviors are much more characteristic of ADHD than of APD.

Interestingly, visual attention problems were not identified by pediatricians as highly characteristic of ADHD-PI, in contrast to the suggestion of pervasive, supramodal, or multimodality attention deficits, as has been posited by Chermak and colleagues (1999) and others.

The absence of visual attention deficits among the pediatricians' highly ranked behaviors is also surprising since sustained visual attention deficits (as measured by visual continuous performance tests) are frequently used to diagnose ADHD (Barkley, 1990). Also surprising is the absence of other behaviors (i.e., sluggish, socially withdrawn, and anxious) from the pediatricians' list of highly ranked behaviors as these behaviors are reported in the literature to be typical of ADHD-PI (Lahey et al, 1988; Dykman and Ackerman, 1993).

It was surprising to find DK responses from audiologists for pattern processing deficits and auditory selective attention deficits since these deficits are frequently cited as characteristic of APD and often assessed in the basic APD test battery (Chermak and Musiek, 1997). Audiologists' assignment of DK to visual attention deficits was not unexpected as audiologists do not typically administer tests in the visual modality, although some consider this to be inherently problematic to the APD diagnosis (McFarland and Cacace, 1995).

## CONCLUSIONS

Despite rather marked differences in pediatricians' and audiologists' rankings of behaviors characteristic of APD and ADHD-PI, there was some degree of overlap across the disorders. Whereas both disorders are associated with auditory attention deficits, poor listening skills, and academic difficulties, the source of these deficits appears to differ. These deficits are associated with a cognitive disorder involving disorganization and executive dysfunction (i.e., dysfunction in general control processes that regulate behavior) in ADHD-PI. In contrast, these difficulties are due to a perceptual disorder in APD, which causes deficits in processing information through the auditory modality and associated speech discrimination difficulties.

Additional research is needed to further differentiate the presumed, cognitively based ADHD-PI attention deficit from the auditory perceptual deficits characterizing APD. The presence of auditory deficits across ADHD-PI and APD challenges professionals to collaborate in carefully and comprehensively assessing children suspected of having these disorders to ensure accurate diagnosis and effective intervention.

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## APPENDIX

Item Analysis for All Survey Items: Rank Order of Ratings by Professionals for ADHD-PI  
(Pediatricians) and APD (Audiologists)

<i>ADHD-PI</i>	<i>Mean</i>	<i>C(APD)</i>	<i>Mean</i>
Inattentive	4.45*	Asks for things to be repeated	4.39*
Academic difficulties	4.22*	Poor listening skills	4.39*
Daydreams	4.05*	Difficulty following instructions given orally	4.33*
Distracted	4.04*	Difficulty hearing in background/ambient noise	4.28*
Poor listening skills	3.86*	Academic difficulties	4.22*
Disorganized	3.82*	Distracted	3.78*
Asks for things to be repeated	3.70*	Reduced rate of information processing	3.78*
Auditory divided attention deficit	3.67*	Auditory divided attention deficit	3.76*
Difficulty hearing in background/ambient noise	3.62*	Auditory selective attention deficit	3.76*
Difficulty following instructions given orally	3.57	Auditory sustained attention deficit	3.71*
Auditory selective attention deficit	3.56	Poor memory	3.67*
Auditory sustained attention deficit	3.56	Difficult discriminating speech	3.65*
Easily frustrated	3.55	Inattentive	3.61
Shifts from one uncompleted task to another	3.55	Poor auditory association skills	3.56
Lacks persistence	3.43	Poor language skills	3.47
Hasty or impulsive	3.41	Daydreams	3.39
Poor self-control	3.38	Poor problem-solving skills	3.33
Interrupts/intrudes	3.36	Shifts from one uncompleted task to another	3.31
Fidgety/restless	3.30	Disorganized	3.25
Reduced rate of information processing	3.29	Temporal processing deficits	3.25
Poor auditory association skills	3.27	Easily frustrated	3.17
Poor memory	3.20	Gives wrong answers to simple questions	3.17
Loses things	3.19	Anxious	3.11
Poor problem-solving skills	3.14	Fidgety/restless	3.06
Talkative	3.09	Multimodality attention deficits (e.g., auditory and visual)	3.00
Visual sustained attention deficit	3.08	Pattern processing deficits	3.00
Temporal processing deficits	3.07	Conduct problems	2.94
Gives wrong answers to simple questions	3.05	Hyperactive	2.94
Anxious	3.04	Interrupts/intrudes	2.89
Difficulty playing quietly	3.04	Talkative	2.88
Fails to consider consequences	3.00	Visual divided attention deficit	2.83
Hyperactive	3.00	Visual sustained attention deficit	2.82
Moody	3.00	Overly sensitive	2.81
Multimodality attention deficits (e.g., auditory and visual)	3.00	Lacks persistence	2.75
Visual divided attention deficit	3.00	Hasty or impulsive	2.72
Overly sensitive	2.95	Shy	2.71
Pattern processing deficits	2.93	Depressed	2.69
Conduct problems	2.91	Visual selective attention deficit	2.58
Socially inappropriate	2.91	Withdrawn	2.53
Shy	2.90	Socially inappropriate	2.47
Visual selective attention deficit	2.87	Aggressive	2.44
Depressed	2.82	Defiant	2.41
Accident prone	2.78	Emotionally unstable	2.38
Poor language skills	2.76	Poor coordination	2.31
Difficult discriminating speech	2.70	Loses things	2.27
Aggressive	2.70	Fearful	2.25
Defiant	2.70	Poor self-control	2.25
Emotionally unstable	2.61	Uncooperative	2.24
Quarrelsome	2.59	Fails to consider consequences	2.14
Uncooperative	2.55	Moody	2.13
Withdrawn	2.52	Hostile	2.12
Destructive	2.48	Sluggish	2.07
Poor coordination	2.48	Destructive	1.94
Sluggish	2.45	Difficulty playing quietly	1.94
Engages in dangerous activities	2.43	Accident prone	1.92
Fearful	2.39	Quarrelsome	1.88
Hostile	2.36	Steals or lies	1.73
Steals or lies	2.14	Engages in dangerous activities	1.67
Grand mean	3.11	Grand mean	2.93
Standard deviation	0.50	Standard deviation	0.72

\*Indicates ratings greater than 1 SD above the mean ratings.

ADHD-PI = attention-deficit hyperactivity disorder-predominantly inattentive type; (C)APD = (central) auditory processing disorder.