GUIDELINES FOR THE EDUCATIONAL EVALUATION & INTERVENTION OF AUDITORY PROCESSING DEFICITS (APD)

REVISED OCTOBER 2024

Colorado Department of Education

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

This guidance document represents the culmination of collaborative efforts spanning several years. Throughout its development, numerous individuals have dedicated their expertise and commitment. It is important to acknowledge the past contributors whose groundwork significantly shaped this document's evolution. The completion of this document stands as a testament to the collective dedication and multidisciplinary collaboration of everyone involved. Sincere appreciation goes to all contributors for this comprehensive endeavor.

DOCUMENT AUTHORS & TASK FORCE MEMBERS:

- Lisa Lisowe, AuD *(Audiologist, Denver Public Schools/Audiology Coordinator, Colorado Department of Education)*
- Beth O'Brien, MA *(Audiologist, East Central BOCES/private practice)*
- Hanna Page, AuD *(Audiologist, Colorado Ears, LLC)*

LEADERSHIP ADVISORS

Shauna Moden	Supervisor, Deaf Education Consultant	Colorado Department of Education
Tami Cassel	Supervisor, Speech Language Pathology Specialist	Colorado Department of Education

APD AUDIOLOGIST TASK FORCE MEMBERS

Kelly Dermody	Audiologist	St. Vrain Valley School District
Debbie Feldewerth	Audiologist	Denver Public Schools
Tammy Fredrickson	Associate Clinical Professor	University of Colorado Boulder
Ann Forsberg	Audiologist	Montrose and Delta County Schools
Jodi Heimer	Audiologist	Douglas County School District
Amy Lears	Audiologist	Boulder Valley School District
Shelly Miller	Audiologist	Cherry Creek School District
Janelle Rogers	Audiologist	Jefferson County School District

MULTIDISCIPLINARY CONTRIBUTORS

Jody Dickerson	Brain Injury Specialist	Colorado Department of Education
Veronica Fiedler	Learning Disability Specialist	Colorado Department of Education
Phillip Gilley	Associate Professor	University of Colorado Boulder
Krista Klabo	School Psychology & Special Education Evaluation Specialist	Colorado Department of Education
Jennifer Marson Parker	Speech-Language Pathologist	University of Colorado Boulder
Shani O'Brien	Speech Language Pathology Specialist	Colorado Department of Education
Denise Rahe	Director of Special Education / School Psychologist	Colorado River BOCES
Amy Simmons	Speech-Language Pathologist	Cherry Creek School District

PAST CONTRIBUTORS

Nancy Alexander	Audiologist	Estes Park School District
Edith Burns	Audiologist	Mapleton Public Schools
Cheryl DeConde Johnson	Consultant	The ADE-vantage Consulting Services
Debra Draus	Audiologist	Littleton Public Schools
Debbie Gwinner	Audiologist	Cherry Creek School District
Sandy Johnston	Audiologist	Boulder Valley School District
Yoko Kodaira	School Psychologist	Poudre School District
Barbara Lambright	Audiologist	Cherry Creek School District
Donna Massine	Audiologist, SLP	Douglas County School District
Dan Ostergren	Audiologist	Poudre School District
Katherine Pike	Audiologist	Jefferson County School District
Shana Martinez	Audiologist	Mapleton Public Schools
Sandy Winthrop	Audiologist	Jefferson County School District

INTRODUCTION & PURPOSE OF GUIDELINES

The origin of these guidelines dates back to 1997 when a renewed interest in (central) auditory processing disorder (CAPD) necessitated a response in the form of practice guidelines for professionals in the school setting.

The Colorado Department of Education (CDE) facilitated a multidisciplinary Task Force to develop the first guidelines entitled *(Central) Auditory Processing Deficits: A Team Approach to Screening, Assessment & Intervention Practices*. These guidelines were subsequently revised in 2008 in conjunction with the introduction of response to intervention (RtI) and development of multi-tiered system of support (MTSS) for struggling students. The document has remained in place as a tool to help school professionals navigate the complex topic of auditory processing as it relates to school age children and youth in the educational setting.

This document has been updated to include current practices and recommendations and it is intended to supersede previous versions. A handful of other states have developed similar documents and a variety of national and international professional associations have published guidance documents that have each contributed to the revisions in this practice tool. **References** used in its development as well as a **glossary of terms** can be found at the end of this document.

The purpose of these guidelines is multifold and designed to be used by school professionals and teams to:

- understand auditory processing deficits and their role in contributing to listening and learning problems
- differentiate bottom-up and top-down auditory processing
- consider why assessment of auditory processing skills is valuable in the school setting
- outline specific supports and interventions for students with suspected and identified auditory processing challenges
- determine “when” and “why” to invite the educational audiologist to the team
- delineate the various roles and responsibilities of the multidisciplinary team
- develop an efficient and sensitive referral and evaluation process
- identify auditory processing domains, the audiological assessments used within each domain, and the criteria for identification of an educationally significant auditory processing deficit
- clarify special education eligibility processes and re-evaluation recommendations

DISCLAIMER

This guidance document is intended to serve as a resource to educational teams to assist with understanding current issues and best practices related to auditory processing deficits (APD). The information, concepts, assessments, and interventions provided in this document represent a theoretical model developed from many years of practice by professionals in the field. Some components of this document are designed to be fluid and evolving and certain links or information may have changed or been updated since publication.

The Individuals with Disabilities Education Act (IDEA) requires that the Colorado Department of Education (CDE) fully inform Administrative Units of Part B requirements and monitor the implementation of these requirements, with an emphasis on ensuring that all IDEA-eligible children in Colorado receive a free appropriate public education in the least restrictive environment. Pursuant to its responsibility for general supervision, the CDE provides this guidance to support Administrative Units in satisfying their obligations under the IDEA.

Administrative Units are encouraged to review their policies and procedures for alignment with this guidance and make changes, as needed. This guidance is not binding and should not be construed as legal advice. For legal advice, Administrative Units should consult their legal counsel.

APD: A CURRENT WORLD VIEW

Auditory processing disorder (APD), first formally discussed by Mykelbust in 1954, has been controversial since inception. While the content of the controversies has evolved with time, knowledge, and technological advances, the field has not yet come to complete agreement on diagnosis, assessment, and treatment of APD. Differing views on APD exist, in part, due to the variations of symptomatology, the lack of "gold standard" assessment procedures, and the intertwined relationship between auditory processing and a myriad of other brain-based disorders which are known to be frequently cooccurring conditions.

US & International APD Professional Guidance

Major professional organizations in the U.S. have published definitions of APD, but these are not consistent. These definitions were developed by task forces convened by the American Speech-Language-Hearing Association (1996, 2005a) and the American Academy of Audiology (2010) and have become the foundation for further work in the field of APD. The definitions provided by these groups are complex and may be difficult for professionals, teachers, and parents to understand. Even within the audiology profession, debates regarding auditory processing skills, assessments, and interventions continue. This becomes further complicated by the expansion of knowledge about brain structure, organization, and

function as well as by increased research in the field. The most current, accessible guidance is from the American Speech-Language-Hearing Association (ASHA), which maintains a professional practice portal for central auditory processing disorder (CAPD). This resource aims to provide the best available evidence, expertise, and resources to support audiologists and speech-language pathologists in their practice settings.

Other groups across the world have issued statements, guidelines and/or white papers on the subject of auditory processing. These include but are not limited to the British Society of Audiology (2018), the Canadian Interorganizational Steering Group for Speech-Pathology and Audiology (2012), the New Zealand Guidelines on Auditory Processing Disorder (2019).

Each of these documents, as well as others from countries across the globe, attempts to outline the known and accepted points of agreement and disagreement among researchers and clinicians. Each includes unique perspectives relevant to practices within their respective countries.

APD: A Recognized Diagnostic Entity

The World Health Organization's (WHO) International Classification of Diseases, Eleventh Revision (ICD-11) specifies diagnostic coding for central auditory processing disorder (CAPD). The Diagnostic and Statistical Manual - 5th Edition – Text Revision (DSM-5-TR), published by the American Psychiatric Association (2013) does not establish APD as a separate entity, however, practitioners in the US routinely utilize available billing/CPT codes under the category of language disorders.

Under the Individuals with Disabilities Education Act (IDEA), APD has historically been considered a type of specific learning disability (SLD) which is defined as a disorder that affects understanding or using spoken or written language that may manifest in the "imperfect ability to listen" or think, speak, read, or write.

A US circuit court (outside of Colorado jurisdiction) has ruled that students with CAPD may be considered eligible for services under the special education category of other health impairment (OHI).

Unchallenged Points of Agreement

- American professional audiology organizations recognize the validity of auditory processing and have topical resources on their professional websites.
- Terminology, though evolving, remains fluid. Central auditory processing disorder (CAPD) and auditory processing disorder (APD) refer to the same processes. The broader term listening difficulties (LiD) has been recently introduced and is being used more often.
- The auditory system consists of both peripheral and central components. These impact each other and are interdependent. Distinction between the two can be difficult to ascertain and therefore use of the term "central" may not be entirely representative.
- Auditory signals are transformed into neural signals within the central auditory nervous system (CANS). These neural impulses comprise the brain's mechanisms that preserve, refine, analyze, modify, organize and interpret these neural inputs. Some of these processes can be assessed using specific, behavioral measures to identify deficits in processing.
- The brain mechanisms which utilize auditory signals are critical to listening. These skills underlie communication, daily living, and learning. Deficits in these skills are often linked to a variety of learning difficulties and educational challenges.
- Interventions exist which have been shown to help develop and improve specific auditory processing skill deficits.

Points of Ongoing Controversies

- While the existence of APD is generally acknowledged, the specific criteria and processes for assessing and treating APD are not agreed upon. There is no gold standard in assessment, and protocols are not consistent across professionals.
- The defined scope and specific skills which are critical to an adequate APD assessment are not universally agreed upon and individual clinical practices are highly variable.
- Auditory processing skills are impacted by other brain-based fundamental processes such as attention, memory, language, and motivation. Evaluations which remove or allow separation of these factors do not clearly exist and therefore may compound clinical findings.
- Auditory processing deficits can coexist with or mimic other disorders. Differential diagnosis may be difficult or next to impossible according to some professionals.

THE NEED FOR EDUCATIONAL PRACTICE GUIDELINES

Educational audiologists have historically and consistently been involved in issues surrounding auditory processing deficits. Referrals in the school setting have grown steadily as more parents and educators learn about the impact of the auditory system on academic and social development. Professional practice guidelines on APD are numerous, however there remains a need for professional guidance specifically designed for professionals working with children and youth in the school setting.

Despite controversies that exist in the communication sciences and disorders field, the need for a team approach to APD is the single point of agreement. The educational system can lead the way in a team approach because of the fact that multidisciplinary assessment in schools is a recognized standard of practice. From the problem-solving process through identification and intervention, interdisciplinary practices within the school setting support an evidence-based model of addressing APD. The responsibility of identifying auditory processing deficits in children and youth remains the audiologist's, however a wide range of professionals and stakeholders are integral in supporting identification and intervention practices.

SECTION 1: AUDITORY PROCESSING EXPLAINED

Various definitions of auditory processing have been proposed by audiology researchers, clinicians, and professional organizations; however, a general lack of clarity persists.

> *While the term "processing disorder" does not exist in common diagnostic manuals, the term "processing" is widely used in the learning disorders community to refer to how the brain receives and interprets primarily sensory and linguistic information.*

Occupational therapists specialize in "sensory processing" while speech-language pathologists specialize in "language processing." Visual-spatial, phonological, and cognitive processing are all commonly assessed in the educational setting by a variety of specialists.

Everything that impacts learning is brain-based and understanding how the brain operates in the learning process is critical to supporting all learners. Frequent references are present in the scientific literature substantiating the need to incorporate neuroscience findings into the classroom and educational system (Jolles & Jolles, 2021). Neuroscience can and should help inform educators' understanding of how the brain learns, uses and integrates new information, processes inputs, and makes memories.

One framework for understanding the interrelatedness of these processes is depicted in Building Blocks of Brain Development. This graphic, adopted by the Colorado Brain Injury Steering Committee in 2016, was originally developed as a reference point for professionals working with students for whom a brain injury is known or suspected.

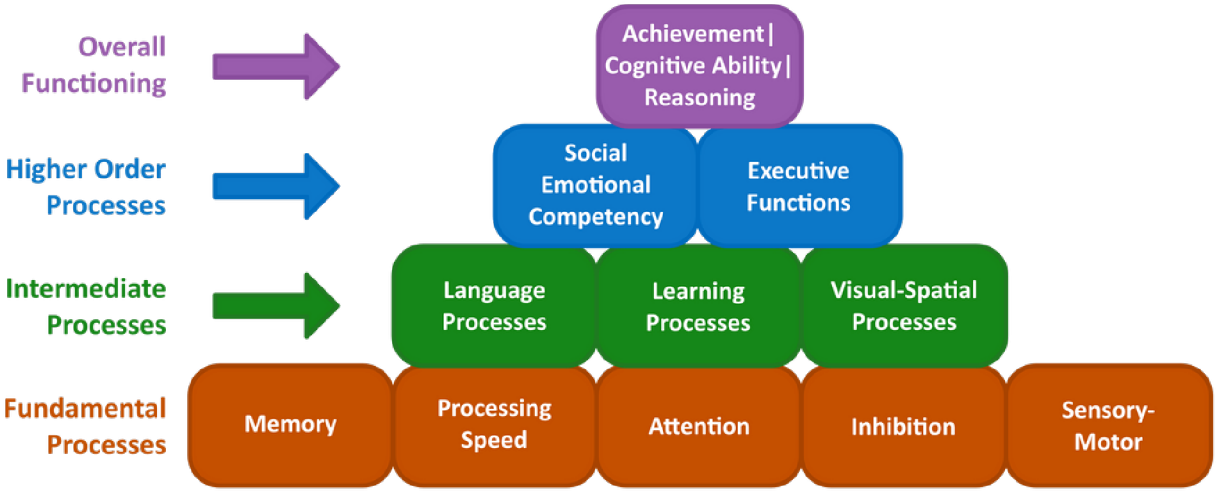


Figure 1: *The Hierarchy of Neurocognitive Function © created by Peter Thompson, PhD 2013, adapted from the works of Miller 2007; Reitan and Wolfson 2004; Hale and Fiorello 2004. The Building Blocks of Brain Development © adapted by the CO Brain Injury Steering Committee, 2016.*

It is also a highly valuable tool in understanding the neurocognitive processes as they progress from fundamentals (bottom-up) to higher order thinking skills (top-down) that impact overall functioning of an individual.

While auditory processes are not specifically called out in this building block model, the auditory modality (listening/hearing) is implicitly present throughout each of the levels, especially the foundational "block" of sensory/motor. Although audition is a fundamental process, it is often overlooked, and these guidelines set forth to address the critical role that auditory processing plays in the cross-modality processes in brain development and functioning.

DEFINITION AND TERMINOLOGY

Central auditory processing disorder (CAPD) has a rich history in communication sciences and disorders. Audiologists, who specialize in all aspects related to the ear, including hearing and balance, have also specialized in studying the neural mechanisms of the central auditory nervous system (CANS). The CANS is a highly intricate set of neural pathways that carries a complex auditory signal detected by the peripheral structures of the hearing system to the cortical areas of the brain. **What the "brain does with what it hears" is a much-used and simplified definition of "auditory processing"** (Katz, 2007).

The utility of this definition is limited when actually put into practice because significant challenges exist in being able to separate the central auditory processes (bottom-up) from higher-order, cortical processes (top-down) that are involved in the full spectrum of processing auditory information.

Because of this challenge, a wider term of "listening difficulties" (abbreviated "LiD") is being used increasingly by experts in the field with a focus on identifying and remediating deficit-specific auditory weaknesses that are present despite normal hearing thresholds (Dillon & Cameron, 2021; Moore, 2018).

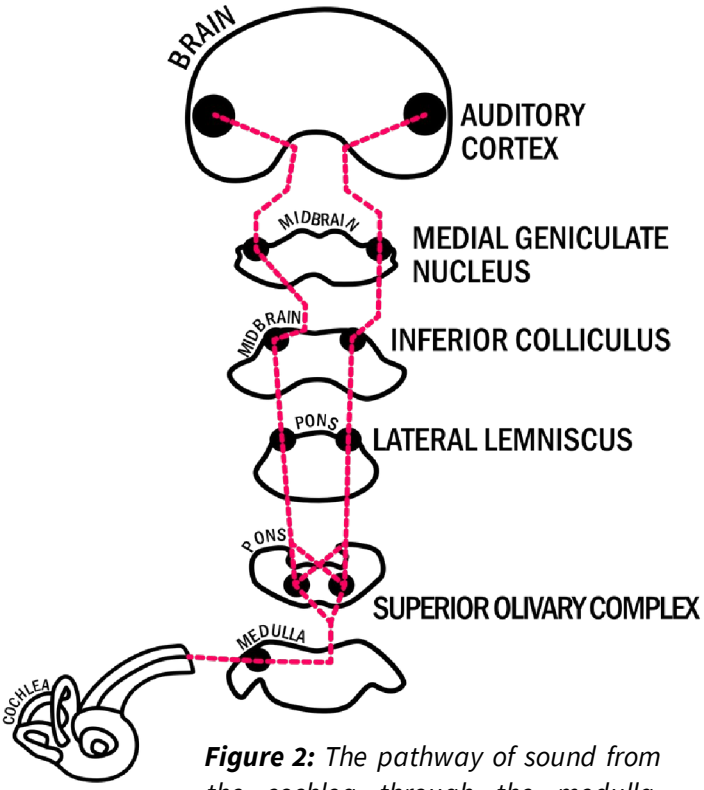


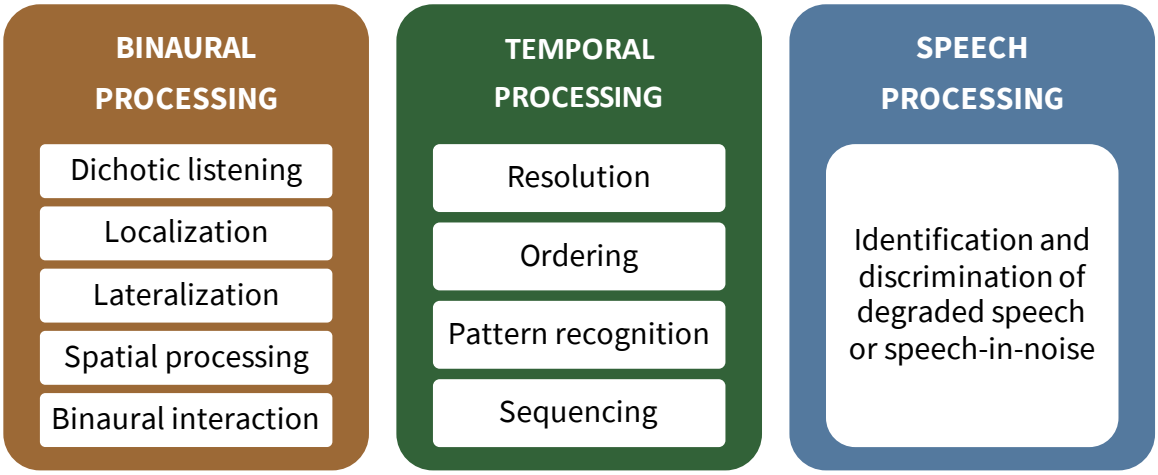
Figure 2: *The pathway of sound from the cochlea through the medulla, pons, midbrain, and the brain.*

In addition, the use of "central" auditory processing disorder, or CAPD, continues to be used interchangeably with auditory processing disorder, or "APD," among various sources including in the American Speech-Language-Hearing Association (ASHA) practice portal guidance for speech-language pathologists and audiologists. ***Terms are used synonymously throughout this document with an attempt to specify the top-down and bottom-up processes and clarify provider roles in assessment and intervention of APD.***

AUDIOLOGICAL PERSPECTIVE

When referring to auditory processing from a "bottom-up" perspective, the audiologist has the singular expertise in assessing and interpreting multiple, specific, acoustic-level skills.

The question to be asked is "what is happening to the acoustic signal while it is traveling from the ear through the brain?" **Central auditory processing includes bottom-up mechanisms and neural impulses responsible for:**



When one or more of these processes are found to be functioning outside of the typical age-level range, and peripheral hearing is intact, an auditory processing deficit (APD) may be identified. Sometimes students perform poorly on APD tests due to higher order linguistic or cognitive factors, and this can make differentiating an APD from other primary or global deficits quite challenging. While APDs can and often do exist alongside other disorders (such as ADHD and dyslexia), APD is understood to be specific to the auditory modality and not a result of other processing disorders. The list on the next page displays some common "look-fors" in children with suspected APD. This list is also included as a **handout** in the resources section, which can be shared with teachers and parents.

OBSERVED CHALLENGES	POSSIBLE SCHOOL-RELATED IMPACTS

▪ Behaves as if hearing loss is present, despite hearing levels within normal range
▪ Frequently requests repetitions (says "huh" or "what" often)
▪ Misunderstands spoken language
  ○ in noisy situations
  ○ in large, echo-y or reverberant rooms
  ○ when speech is fast or unclear (e.g. announcements, media recordings, unfamiliar accents)
  ○ when using listening only (without other supports such as visuals)
▪ Gives delayed, inconsistent, or inappropriate responses in oral communication situations
▪ Mishears words or confuses similar sounding words
▪ Acts confused, distracted, inattentive, or zoned out during listening activities
▪ Has difficulty figuring out where a sound is coming from (on a playground, near streets, etc.)
▪ Misunderstands messages that rely on tone of voice such as sarcasm or humor
	▪ Poor performance on auditory-based tasks (e.g. listening comprehension, discriminating sounds, phonology, or letter-sound association)
	▪ Associated academic difficulties in reading, spelling, and/or learning
	▪ Difficulty attending to long lectures or extended periods of listening
	▪ Inability to follow multi-step verbal directions
	▪ Trouble learning simple songs (e.g. nursery rhymes) or new languages
	▪ Problems socializing in large groups or in noisy environment

CAUSATIVE FACTORS

In school age children and youth, developmental and learning disabilities can be associated with a myriad of genetic, health, and environmental risk factors. Where a known medical or environmental event can be documented (e.g. traumatic brain injury or lesion) auditory processing deficits may be considered acquired and may be more easily identified. Various studies have shown that there is a high prevalence of APD in children with **traumatic brain injury** (TBI) (Bergemalm & Lyxell, 2005; Flood, et al., 2005). There is also a heavily researched link between **otitis media** and auditory processing abilities in children. **Otitis media with effusion** (OME), a very common condition in early childhood, can contribute to hearing

inconsistencies and auditory deprivation during the critical years of neurological and language development (Whitton & Polley, 2011; Borges, et. al., 2014; Tomlin & Rance, 2014).

Quite often there are no known causative factors for auditory processing and other neurodevelopmental disorders. Neurodevelopmental disorders (NDDs) are those medical or psychological disorders that meet three primary criteria: 1) have an onset during the developmental period, 2) are related to an impairment or delay in the development of functions that are part of neurobiological maturation, and 3) may improve over time but do not encompass the remissions and relapses characteristic of many mental disorders (Burns, 2021). For many children, difficulties in the auditory system will present alongside other developmental communication and related disorders and may improve or resolve as the student gets older, or they may continue into adulthood. Increasingly, research is demonstrating links between listening difficulties and learning disabilities, and the relationships between auditory processing and other cognitive skills. **For these reasons, a thorough case history (sample form included in Resources section) is recommended and the earlier interventions can begin, the better.**

EDUCATIONAL MODEL OF APD

In order to be inclusive of top-down and bottom-up auditory skills, these guidelines offer a paradigm for educational evaluation and management in the school setting in which auditory processing is viewed as a continuum. Several continuums of auditory processing have been proposed, most prominently by Dr. Gail Richard who lays out a linear continuum of auditory to linguistic processing, and an intersection between the two where phonemic processing occurs (Richard, 2013, 2017).

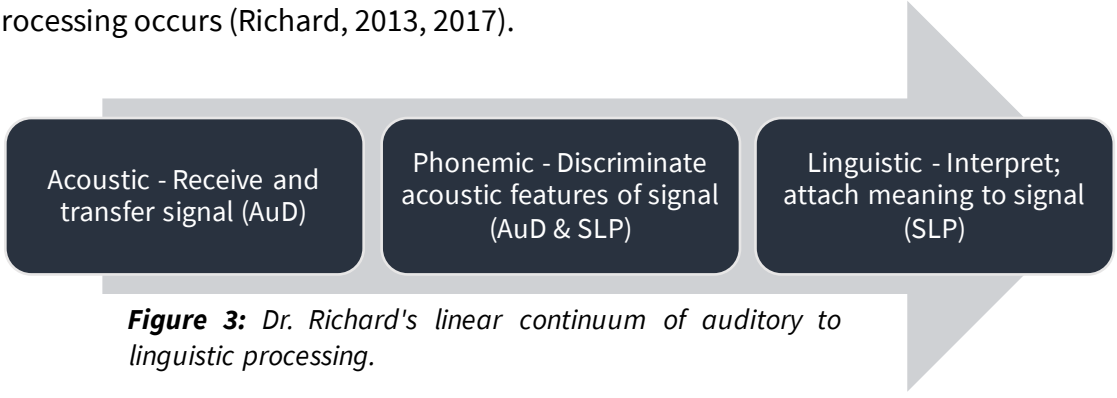


Figure 3: *Dr. Richard's linear continuum of auditory to linguistic processing.*

This approach to diagnosing and managing auditory processing problems helps to differentiate skill sets in processing as well as to define the role of the professionals, mainly speech-language pathologists and audiologists.

The **audiologist** is responsible for determining how the student processes the incoming acoustic signal. The **speech-language pathologist** is responsible for assessing the student's ability to manage the incoming linguistic code.

Phonemic processing, considered to be a building block of literacy, includes the **auditory skills of recognizing and being able to manipulate the sounds of language**.

The interconnectedness between auditory aspects of language, reading development, and bottom-up auditory processing skills is an area of ongoing research and at the heart of the challenge for school professionals as they attempt to identify and remediate difficulties in school-aged children and youth.

Educators "in the trenches" are trained to approach assessment and intervention from their own area of expertise, and each professional will bring a unique and different perspective of what they might consider to be "auditory processing." While individual analysis may yield a conclusion based on solid data points, the full picture of listening in the context of learning is much more complex and can only be derived from considering multiple vantage points.

Fortunately, in the school setting, a myriad of specialized support professionals is available to examine the whole child as they function in the educational setting where listening demands are intense. This Educational Model of auditory processing represents an interdisciplinary approach in which all members of the team understand their unique role in examining each of the skills involved in the full continuum of auditory processing from the bottom-up foundational skills to the top-down higher-order skills.

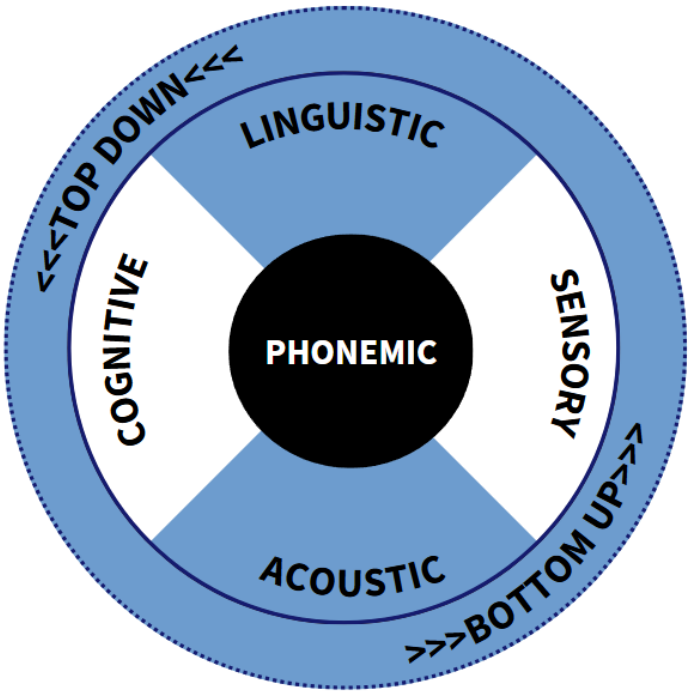


Figure 5: *Educational Model of Auditory Processing*

SECTION 2: APD PROGRAM AND REFERRAL CONSIDERATIONS

Many students demonstrate listening difficulties in the educational setting; however, not all should be referred for an audiological assessment of auditory processing. **Estimations of the occurrence of APD range from 2-7% however it may be higher depending on the criterion used to identify the deficit (Nagao, et.al., 2016, Wilson & Arnott, 2013).**

The prevalence of other childhood developmental, language, learning and behavioral disorders complicates the identification of APD because it often co-occurs with other diagnoses and thus increases the frequency of listening difficulties in the student population (Sharma, et al., 2009; Gokula, et al., 2019).

Key questions to ask include: how effective are the current interventions and are they addressing the underlying "root cause" well enough for the student to make adequate progress in their educational program? If the answer is no, perhaps further examination of bottom-up auditory processes may be warranted.

PROGRAM CONSIDERATIONS

Most schools in Colorado are fortunate to employ educational audiologists as vital members of the educational team, however, large caseloads are the norm. Often one school audiologist may serve a population of 15,000 students or more and commute between many schools and over long distances. The request for an audiological assessment for APD needs to be carefully made and accompanied by data indicating an educational impact related to the student's ability to process auditory information.

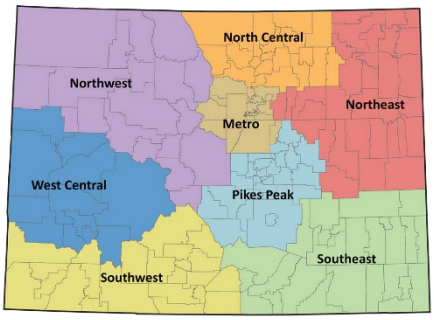


Figure 6: *Regions of Colorado*

Local administrative units (AUs) must each design and implement a referral and assessment system that makes sense for their local needs and resources. School audiologists in rural areas may need to employ a more streamlined model of screening and assessment before moving forward with a formal assessment. With the increasing availability of remote services, including APD testing and intervention, school districts who do not have access to in-person audiological services may wish to contract for remote services, which will provide additional expertise to their diagnostic and treatment array for students with possible APD.

When an AU is unable to access educational audiology services, the speech-language pathologist can be integral in the process of how best to assess and support auditory processing needs. The process, developed collaboratively among team members including administrators, must work within the capabilities of each school system and these guidelines are meant to assist with establishing this framework.

MTSS

Colorado's **Multi-Tiered System of Supports (**COMTSS**)**, which is a prevention-based framework for problem solving, ensures that students receive effective and equitable academic and behavioral support. Colorado school systems are all tasked with implementing this research-based, layered continuum of supports in order to support student outcomes. COMTSS guidance states that:

> *by systematically evaluating and analyzing student progress through ongoing universal screening and progress monitoring, educators can more efficiently use their available resources to improve student performance. Information yielded by these data sets allows teams to problem-solve less severe educational challenges in the general education environment and preserve additional resources for students who require more targeted and intensive instruction and intervention to achieve educational benchmarks (COMTSS, n.d.).*

Figure 7: *CDE MTSS Logo*

This MTSS approach should be prioritized, especially when APD is suspected. There are a variety of general strategies that can be implemented to address listening difficulties and improve access to the auditory signal.

The **list of general strategies** (found in Resources) can be used as a resource prior to and during the MTSS process to guide teachers and school staff in addressing three key factors:

- Environment
- Message
- Listener

When strategies to improve access to the auditory signal are implemented, mitigating many of the common reasons for listening difficulties, and students are still experiencing challenges, the team should reach out to the educational audiologist for a consultation about APD assessment.

MULTIDISCIPLINARY TEAM CONSIDERATIONS

The most important factor when proceeding with an audiological assessment of APD is recognizing the need for a multidisciplinary team effort to support the evaluation.

It is for this reason that students referred for APD assessment will typically be those students who are undergoing evaluation for special education services.

Exceptions to this may include students being evaluated for 504 Plans or students who have received an outside evaluation of APD. When caregivers have pursued an outside/independent evaluation of APD, school teams are obligated to consider the information contained in the report and its impact for the student in the classroom. In all cases, the need for multidisciplinary data, including functional classroom data, is critical to understanding the relevance and usefulness of the audiological APD assessment.

STUDENT APD REFERRAL CONSIDERATIONS

Prior to referring a student to the audiologist for an APD assessment, certain student factors need to be considered to determine whether the referral is appropriate or not. Below are student considerations referenced from Chapter 6 of the Educational Audiology Handbook (Johnson & Seaton, 2021). A **sample referral consideration form** that can be used for documenting student referrals to the audiologist can be found in the Resources section.

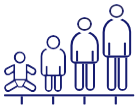
Key factors for appropriate referral include: peripheral hearing acuity, the age of the student, language competency, speech intelligibility problems, cognitive deficits, presence of co-existing conditions, such as ADD/ADHD, language disorders, learning disabilities, and autism spectrum disorder.

KEY FACTORS FOR APPROPRIATE REFERRAL

PERIPHERAL HEARING ACUITY

Peripheral hearing acuity must be within the typical hearing range, or the child must be cleared by an audiologist prior to considering testing for auditory processing. Some APD tests do allow for accommodations for hearing loss; however, in general, loss of audibility in the form of reduced peripheral hearing will confound the already complex task of identification of APD in children and may not result in added value to an intervention plan.

AGE OF THE STUDENT



The **age of the student** is important to consider as there is a strong maturational aspect of brain development and resulting auditory abilities of the child. Research is clear that myelination is key and that the maturational timeframe of the central auditory nervous system, or CANS, and other brain structures continues well into adolescence. This contributes to variability in test results for children under 7. While there are APD assessments available for younger ages, interpretation of the results may be challenging due to lack of developmentally appropriate, multidisciplinary data available for this age group. Therefore, screening instruments or observation tools may be more appropriate for young children (ages 3 to 6 years) and may inform the use of intervention strategies and future assessment recommendations.

LANGUAGE COMPETENCY

Language competency can significantly impact performance on auditory processing assessments, particularly those which involve linguistically-loaded test items. Results must be interpreted carefully, and extra caution is recommended with nonnative English-speaking students.

SPEECH INTELLIGIBILITY

Significant speech intelligibility problems can affect administration and interpretation of auditory processing test results. If reasonable accommodations cannot be implemented, auditory processing assessment may not be appropriate until a later time.

COGNITIVE DEFICITS

APD assessments impose varying degrees of cognitive load during the testing (e.g. on working memory and attention). Students suspected of having certain **cognitive deficits** may be considered candidates for an auditory processing assessment after careful consideration by the audiologist. In order to rule out or to identify scattered weaknesses, a cognitive assessment is strongly recommended prior to the consideration of an APD referral.

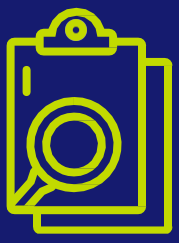
COEXISTING CONDITIONS

Auditory processing deficits share many behavioral characteristics with other conditions, particularly **ADD/ADHD, language disorders, and learning disabilities**. While these **conditions may coexist**, the auditory processing problem is not the result of these problems (ASHA, 2005). It is important to try to differentiate behaviors associated with various conditions so that interventions can be targeted to the specific underlying problem and maximized for the greatest impact.

AUTISM SPECTRUM DISORDER (ASD)

Students with **autism spectrum disorder (ASD)** may show considerable difficulties responding to auditory stimuli. This population of students often have language-based disorders and may also demonstrate sound "sensitivities" and other difficulties with sensory stimuli. If the student's ASD presents with milder linguistic, cognitive and/or behavioral impacts, and auditory symptoms can be reliably separated from the ASD, certain students may be appropriate candidates for an AP assessment.

SECTION 3: INTERDISCIPLINARY ASSESSMENT OF APD



There is agreement among the multidisciplinary community that **audiologists are the professionals responsible for diagnosing central auditory processing problems.**

There is also general agreement that **audiologists should not assess for and diagnose auditory processing problems in the absence of a comprehensive, interdisciplinary assessment that includes the top-down skills involved in processing auditory information.**

The overall goal of an auditory processing assessment is to identify and differentiate an acoustic-level problem, originating in the auditory system, from other potential factors contributing to a student's listening difficulties. When this is accomplished successfully, the knowledge gained is powerful.

Students, teachers, and caregivers have information that validates reported difficulties and new and targeted interventions can assist with managing and remediating those difficulties. Since listening difficulties can be the result of a myriad of underlying causes, there must be a coordinated effort and process for APD assessment.

The APD Process Flowchart on the next page outlines a rigorous set of steps and questions to consider for a transdisciplinary APD assessment. When APD is suspected, the educational audiologist joins the team, reviews the referral concerns and existing data collected, and determines what additional information may be helpful.

At minimum, data should be collected on the student's linguistic and cognitive abilities including receptive language, working memory, and processing speed. Formal evaluations are recommended but not necessarily required, and abbreviated assessments or subtests may be used. Cross-discipline analysis of data is key to identifying the underlying issues and designing targeted interventions for the student.

APD PROCESS FLOWCHART

School-based problem-solving team (MTSS/IEP/ETC) reviews student data

- Has student lacked adequate **reading or language progress** with universal or targeted interventions?
- Does the data indicate **listening difficulties**?
- Is there a **specific request or concern** for APD testing (e.g., by parent)?
- Auditory **questionnaires** or APD **screening** conducted?
- **Referral considerations**/ form completed (follow district APD referral process)

SUSPECTED APD

Is further assessment by the audiologist indicated?

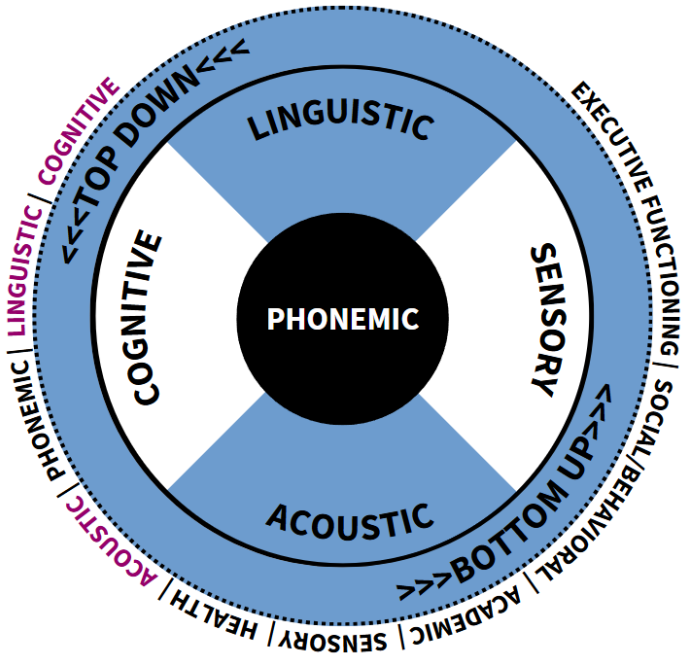
Consultation with audiologist *(critical when parent specifically requests APD or an outside APD assessment is presented)*

YES **NO**

- Not a necessary /appropriate referral
- Team will **monitor** concerns and student progress
- General **strategies** may be implemented

Interdisciplinary Auditory Processing Assessment

Determination of **testing protocol** based on referral concerns (minimum suggested: **acoustic**, **linguistic**, and **cognitive**)



Evaluation Review

- **Audiological results** analyzed in conduction with multidisciplinary data
- **Auditory processing deficit needs** identified or ruled out
- **Deficit-specific interventions** recommended in conjunction with **services plan** (IEP or 504)

Intervention Plan

- Are **auditory-specific goals** appropriate? If so, who will provide direct services?
- What **accommodations** does the student need?
- Determine **involvement of audiologist**: Is hearing technology recommended? Audiology consultation services?

Progress Monitoring

- Annual monitoring of goals and/or accommodations on IEP or 504 plan
- 3-year reevaluation for IEP eligibility including repeat APD assessment
- Include audiologist as service provider if APD is identified (indirect, direct, etc.)

ROLES & RESPONSIBILITIES

While the audiologist's and the speech-language pathologist's role in auditory processing are defined by the American Speech-Language-Hearing Association (ASHA Practice Portal: Roles), other members of the multidisciplinary team are less well-defined. Each professional has much to contribute from their own area of expertise.

Take the following scenario. The MTSS team at a school is presented with a case involving a 3rd grader referred by his teacher. According to the teacher, the student:

- is having trouble following directions;
- is distracted in noisy backgrounds;
- takes a long time to answer a question;
- often responds inappropriately; and
- has trouble paying attention during instruction.

The student often asks "huh" or "what" and appears not to have heard or understood what was said. In addition, the student is struggling in reading and showing signs of negative behaviors in the classroom that are disruptive to fellow learners.

The MTSS team is tasked with problem-solving and recommending appropriate interventions. As a first order priority, the team should confirm with the school nurse that this student has passed a recent hearing and vision screening as these sensory problems can often go unidentified and contribute to difficulty functioning in the classroom.

SPEECH-LANGUAGE PATHOLOGIST

The speech-language pathologist (SLP) approaches the case with a linguistic "hat" on. What is the student's grasp of language and how are they using it in everyday settings?

The SLP may participate in the MTSS process and provide strategies for the classroom teacher to try. If a referral for an eligibility meeting has been made, they may start with a language screener and then perhaps dig deeper with a comprehensive receptive and expressive language assessment.

Another area the SLP may assess is phonological processing skills. These may include phonemic and phonological awareness. The speech-language pathologist is ultimately looking through the lens of language processing skills. We know that speech and language skills develop according to a hierarchy which assumes typical hearing abilities with early foundations dependent upon listening to the language in order to associate and attach meaning to those sounds. The SLP will ask the question: is this student's listening difficulty due to an underlying problem with phonological awareness or language?

SCHOOL PSYCHOLOGIST

Trouble paying attention or being easily distracted is a sign that the school psychologist should be involved in assessing the student for possible attention deficits. A question the psychologist may ask is: are the behaviors occurring when the student is being asked to listen or are they present in multiple modalities? School psychologists have a variety of assessment tools which are critical to the differential diagnosis of APD. Learning disabilities are complicated because they are based on brain behavior and often require a deeper dive to understand the root cause of a student's difficulties. While formal cognitive assessments can be helpful to understand intellectual functioning, more often they provide a glimpse into inner workings of the brain and give the insight necessary for the team to complete a full picture of a student's unique learning abilities.

OTHER TEAM MEMBERS

Difficulty reading requires that the learning specialist or special educator (and sometimes the speech-language pathologist) conduct a thorough evaluation of these difficulties. Reading has its foundations in auditory development through phonological processing. Are the reading issues caused by an underlying inability to "hear" the sounds of speech or to comprehend the information being read? Signs of negative behavior in the classroom indicate social-emotional difficulties which may warrant further evaluation from the mental health or behavioral specialist.

Challenges listening in background noise could indicate an auditory processing deficit (cue the audiologist) or a more generalized sensory processing problem (cue the occupational therapist). So many of these learning processes include listening and it is only through a comprehensive, transdisciplinary approach that differentiation can be made and effective interventions can be applied.

AUDIOLOGIST

The primary purpose of referral to the audiologist for an auditory processing assessment is to further assist in the differentiation of the top-down and bottom-up skills that contribute to listening and learning. By doing this, teams are better able to develop targeted, deficit-specific, effective interventions for each learner. If the team, or members of the team including the SLP or parent, suspects that an underlying auditory processing deficit is present then referral to the audiologist to assess acoustic-level auditory processing skills may be of great benefit in understanding the student's learning needs.

TRANSDISCIPLINARY CONTINUUM OF AUDITORY PROCESSING

As outlined in the table below depicting a **transdisciplinary continuum of auditory processing**, each professional's role on the team includes various aspects of processing auditory information. It is possible that one or more of these areas, rather than bottom-up auditory processing, is the root cause. Therefore, assessment of auditory processing needs to be conducted in a manner that moves beyond traditional, individual disciplines and results in a collective evaluation addressing the holistic needs of the student.

EXECUTIVE FUNCTIONING	
SCHOOL PSYCHOLOGIST/ MENTAL HEALTH TEAM	Umbrella term for functions of self-control, major traits: flexibility, planning, organization, self-monitoring
COMMON LOOK FORS	Poor organization, inflexible thinking, difficulty initiating tasks, behavior problems
LANGUAGE PROCESSING	
SPEECH-LANGUAGE PATHOLOGIST	Vehicle for communication and thinking; essential integration of multiple brain functions
COMMON LOOK FORS	Poor understanding, confused, slow responses, hard time expressing, poor reading
PHONEMIC PROCESSING	
SPEECH-LANGUAGE PATHOLOGIST/ AUDIOLOGIST/ OTHER TEAM MEMBERS	Bridge between auditory and language processes
COMMON LOOK FORS	Mishears sounds, confuses words, mispronounces words, struggles with complex words, delayed literacy skills
SENSORY: AUDITORY (ACOUSTIC) PROCESSING	
AUDIOLOGIST	Auditory perceptual abilities
COMMON LOOK FORS	Mishears despite normal hearing, difficulty following verbal directions, highly distracted in noisy situations

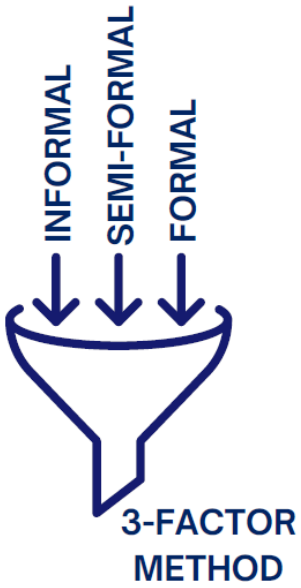
***Table 1a**: Transdisciplinary continuum of auditory processing describing the common look-fors and formal assessment roles of each processing level.*

SENSORY: VISUAL/MOTOR	
OCCUPATIONAL THERAPIST	Visual perceptual abilities and motor functions
COMMON LOOK FORS	Over or under stimulation of senses, sensory seeking/avoiding, messy, poor handwriting, overwhelmed
PROCESSING SPEED	
SCHOOL PSYCHOLOGIST/ MULTIDISCIPLINARY	Speed at which information comes into the brain, is processed, store, and outputted
COMMON LOOK FORS	Difficulties with rapid naming, timed tasks, fluency tasks
MEMORY	
SCHOOL PSYCHOLOGIST/ MULTIDISCIPLINARY	Storage room for experience and knowledge
COMMON LOOK FORS	Cannot repeat what was heard, gets lost, forgets things, poor spelling, splintered learning
INHIBITION & BEHAVIOR	
SCHOOL PSYCHOLOGIST/ MENTAL HEALTH TEAM	Behavioral and emotional control; linked strongly to attention and executive function
COMMON LOOK FORS	Impulsivity, fidgety, poor social boundaries, unsafe behaviors
ATTENTION	
SCHOOL PSYCHOLOGIST/ MENTAL HEALTH TEAM	The ability to orient and focus on a task for other processes to work; first step in all learning
COMMON LOOK FORS	Memory problems, inconsistent work, discipline issues, poor handwriting

Table 1b: *Transdisciplinary continuum of auditory processing describing the common look fors and formal assessment roles of each processing level.*

AUDIOLOGICAL ASSESSMENT OF APD

Audiologists may utilize a menu of services including education or training, consultation, and screening in order to ensure referrals are appropriate and manageable. Various referral forms or preliminary screening questionnaires may be used to streamline processes or gather initial data. School providers should consult their local administrative unit regarding policies and procedures around screening students as part of the data-based problem-solving process.



Audiological assessment of APD should follow the **"3-Factor Method"** of assessment as is recommended in several CDE guidance documents (Thompson & Sousa, 2017). Using the 3-Factor Method ensures that a complete body of evidence has been collected about the student's listening abilities. **Measures should incorporate informal, semi-formal, and formal measures of auditory functioning.**

Informal data on auditory or listening concerns can be gathered from a variety of sources including teacher, parent and/or student reports. A thorough case history, including medical risk factors and other diagnoses should be taken

Semi-formal methods bridge the gap between informal and formal methods. They allow multiple voices to be heard in a systematic way such as through the use of qualitative questionnaires and rating scales.

These tools play an important role in helping to examine functional abilities of the student and quantifying their impact. Most are readily available from sources online and care should be taken to include those that are research-based and specific to the age of the child and the concerns reported.

They can be completed by one or more teachers, by parents and caregivers, as well as by the student to document self-perceptions of auditory and listening abilities. See **Auditory-Focused Questionnaires** for a list and descriptions. The table on the next page lists the commonly utilized questionnaires organized by age evaluated.

QUESTIONNAIRE	AGE RANGE															
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	+
Preschool SIFTER	3-5																
The Listening Inventory		4-17															
Fisher's Auditory Problems Checklist			5-11														
SIFTER: Screening Instrument for Targeting Educational Risk			5-11														
Evaluation of Children's Listening and Processing Skills				6-11													
Listening Inventory for Education (Teacher LIFE-R)				6+													
Scale of Auditory Behaviors (SAB)					7-14												
Auditory Processing Domains Questionnaire (APDQ)					7-18												
Children's Auditory Performance Scale (CHAPS)					7+												
Listening Inventory for Education (Student LIFE-R)						8+											
University of Cincinnati Auditory Processing Inventory										12+							
Secondary SIFTER										12+							

***Table 2**: Commonly utilized auditory questionnaires organized by the age range that they evaluate.*

Formal

audiological assessments provide norm-referenced or standardized assessments specific to the various functions of the auditory system. **Formal audiological assessment of APD should always begin with a thorough audiometric assessment** including:

- Pure tone audiometry (including 3000 and 6000 Hz)
- Age-appropriate word recognition in quiet
- Tympanometry

If available, distortion product otoacoustic emissions (DPOAEs) and acoustic reflexes (ipsilateral and contralateral) should also be conducted.

Besides detecting peripheral hearing issues, in rare cases, abnormal results on these could indicate central auditory pathology warranting further medical assessment. It should be noted that a viable assessment practice for APD includes electrophysiological tests of auditory function, including auditory evoked responses (AER's). These types of tests may provide information about the integrity of the central auditory nervous system (CANS), however their use outside of research and medical settings is rare.

There are few generally agreed upon behavioral protocols for APD assessment that are straightforward and that are deficit driven. Many of the available and often recommended tests are single recordings which may be purchased separately and that must be administered in a sound booth with a two-channel audiometer.

EDUCATIONAL AUDIOLOGISTS DO NOT ALWAYS HAVE EASY ACCESS TO ALL CLINICAL TOOLS AND HAVING STUDENTS TRANSPORTED TO A SOUND BOOTH MANY MILES AWAY IS NOT PRACTICAL OR NECESSARY.

CLINICAL TOOLS | A number of APD assessment batteries are available in digitally recorded format and do not require a sound booth administration. These batteries may be administered on site with equipment such as a laptop, CD player, and/or iPad. It is for this reason that the common audiological APD tests (table below and continued on next page) leans heavily on these types of assessments. Administration and scoring of these test batteries can be fairly quick and efficient. Most include one or more tests in each of the three APD processing domains discussed in this document. Assessments listed and **assessment resources** provided in this document are not exhaustive. There are numerous other valid tests available as well as others which will no doubt be released after publication of this document.

BINAURAL PROCESSING TESTS		
TEST TYPE	**TEST NAME**	**AGE**
Dichotic Sounds	Competing Environmental Sounds Test (Precision Acoustics, Inc)	4 to 12
	Feather Squadron Subtest: Animal Dichotic Double Sounds (Acoustic Pioneer)	8 and up
	Feather Squadron Subtest: Animal Dichotic Single Sounds (Acoustic Pioneer)	5 to 7
Dichotic CVs	Dichotic Consonant Vowel Test (Auditec)	5 and up
Dichotic Digits	Dichotic Digits Test (Auditec)	7 and up
	DSTP Subtest A: Dichotic Digits (Pro-Ed)	6 to 12
	Feather Squadron Subtest: Double Dichotic Digits (Acoustic Pioneer)	8 and up
	MAPA-2 Subtest 5: Dichotic Digits (ATP Assessments)	7 to 14
Dichotic Words	Dichotic Word Listening Test (Auditec)	5 and up
	Feather Squadron Subtest: Dichotic Words (Acoustic Pioneer)	5 to 7
	SCAN-3: Competing Words Free Recall and Directed Ear Tests (Pearson Assessments)	5 and up
	Staggered Spondaic Words "SSW" (Precision Acoustics, Inc)	5 and up
Dichotic Sentences	Competing Sentences Test (Auditec)	5 and up
	Dichotic Sentence Identification Test (Auditec)	11 and up
	MAPA-2 Subtest 6: Competing Sentences (ATP Assessments)	7 to 14
	SCAN-3: Competing Sentences Test (Pearson Assessments)	5 and up
Interaction	Masking Level Difference "MLD" (Auditec)	7 and up
Lateralization	Feather Squadron Subtest: Screening and Lateralization (Acoustic Pioneer)	8 and up
Localization	Feather Squadron Subtest: Speech in Noise with Localization Cues (Acoustic Pioneer)	5 and up
Spatial	Listening in Spatialized Noise–Sentences Test "LiSN-S" (Sound Scouts)	6 and up

Table 3: *Common audiological APD tests for binaural processing.*

TEMPORAL PROCESSING TESTS		
TEST TYPE	**TEST NAME**	**AGE**
Gap Detection	Feather Squadron Subtest: Rapid Tones (Acoustic Pioneer)	8 and up
	Gaps in Noise (Auditec)	7 and up
	MAPA-2 Subtest 3: Tap Test (ATP Assessments)	7 to 14
	MAPA-2 Subtest 7: Gap Detection Test (ATP Assessments)	7 to 14
	Random Gap Detection Test (Auditec)	5 and up
	SCAN-3 Screening Test: Gap Detection (Pearson Assessment)	8 and up
Frequency Patterns	DSTP Subtest B: Temporal Patterning (Pro-Ed)	6 to 12
	Feather Squadron Subtest: Tonal-Patterns (Acoustic Pioneer)	8 and up
	Frequency Pattern (Auditec)	8 and up
	MAPA-2 Subtest 4: Pitch Pattern Test (ATP Assessments)	7 to 14
Duration Patterns	Duration Patterns Test (Auditec)	11 and up
	MAPA-2 Subtest 7: Duration Pattern Test (ATP Assessments)	7 to 14
SPEECH PROCESSING TESTS		
TEST TYPE	**TEST NAME**	**AGE**
Figure-Ground	BKB-SIN (Etymotic)	5 and up
	DSTP Subtest C: Auditory Discrimination (Pro-Ed)	6 to 12
	Feather Squadron Subtest: Speech-in-Noise (Acoustic Pioneer)	5 and up
	MAPA-2 Subtest 1: Monaural Selective Attention Test "MSAAT" (ATP Assessments)	7 to 14
	MAPA-2 Subtest 2: Speech in Noise for Children "SINCA" (ATP Assessments)	6 to 12
	Pediatric Speech Intelligibility Test “PSI” (Auditec)	3 to 6
	SCAN 3: Auditory Figure Ground Tests (0, 8, 12 dB) (Pearson Assessments)	5 and up
	Selective Auditory Attention Test “SAAT” (Auditec)	4 to 9
	Speech in Noise Test (Precision Acoustics, Inc)	5 and up
Filtered Speech	NU-6 Low Pass Filtered Speech 750Hz and 1000Hz Tests (Auditec)	7 and up
	SCAN 3: Low Pass Filtered Speech (Pearson Assessments)	5 and up

Table 4: *Common audiological APD tests for temporal processing and speech processing domains.*

TEST SELECTION | The choice of which APD tests to administer is entirely up to the audiologist, who may choose to start with a particular battery such as mentioned above, or select individual subtests as appropriate. To confirm the presence of an educationally significant APD, the audiologist will aim to administer at least two tests in each processing domain.

TEST MODIFICATIONS | Because many students referred for or undergoing an APD assessment have coexisting conditions, it is appropriate for an audiological APD assessment to include strategies that minimize the effects of other known difficulties. The audiologist can incorporate breaks and extra encouragement, or conduct testing in two sessions versus one to ensure attention is maintained and the student is motivated and engaged during the assessment. A student's ability to participate with fidelity in an APD assessment is paramount so that results can be reliably obtained and interpreted. Pertinent student behaviors noticed during the evaluation are important to include and consider when reporting and interpreting test results.

AGE | A majority of tests are designed for those age 7 and over. There are a handful of tests for use starting at age 5, and for younger students referred for APD testing, the audiologist may utilize a combination of screening or other functional tests in order to analyze a student's auditory skills. Identification of an educationally significant auditory processing deficit (APD) should be made with caution in younger students with strong attention paid to other developmental needs that may take priority.

LANGUAGE | Most formal APD batteries and tests are recorded in English with U.S. accented speech. For many of the non-verbal APD tests, language is not an issue. For audiologists who are fluent in other languages, especially Spanish, test recordings in other languages are available. Most of these are available from Auditec, however Acoustic Pioneer is developing a Spanish version of the Feather Squadron test battery and the Central Test Battery from Precision Acoustics, Inc. is also being translated into additional languages. In all cases, when evaluating multilingual students, audiologists must take care to choose an appropriate test battery and interpret test findings with caution.

SUPPLEMENTAL TESTS | There are a variety of supplemental tests that examine functional auditory skills for students of all ages. These additional tests may be helpful in complex cases where multiple diagnoses and delays are suspected or known. In the case of very young children, the **Auditory Skills Assessment (ASA)** is a quickly administered tool that can identify deficits in early auditory and literacy skills. For students where attention deficits may be suspected, the **Auditory Continuous Performance Test (ACPT)** has been used to examine auditory vigilance. Finally, the **TAPS-4: A Language Processing Skills Assessment** provides additional data along the auditory processing continuum and includes auditory memory subtests as well as phonological processing and listening comprehension. These and other formal assessments can be extremely valuable in an APD assessment and may be administered by the educational audiologist, speech-language pathologist or other provider.

EXAMPLE AUDIOLOGICAL APD PROTOCOLS USING THE 3-FACTOR © METHOD

On the following pages are example APD data-collection protocols for three age ranges based upon the **3-Factor Method ©** of assessment (Thompson & Sousa, 2021). These are **sample** protocols only. They should not be considered all-inclusive and in some cases fewer tools may be used to gather a body of evidence or additional assessments may be administered to thoroughly understand the individual's needs and strengths.

To increase efficiency of the assessment, the example protocols include the use of popular subtests from easy to administer test batteries such as the SCAN-3, MAPA-2 and Feather Squadron. These assessments do not require the use of a sound booth and contain subtests examining each of the three domains of auditory processing. These example protocols also highlight the importance of informal, semi-formal, and formal data when selecting appropriate evaluation measures.

A **protocol template** is included in the Resources section for audiologists to use when selecting tests for an APD assessment.

PRESCHOOL/KINDER (AGES 3-6) EXAMPLE APD PROTOCOL

TYPICAL AGE GROUP CONCERNS

- Expressive or receptive language delays, possibly including articulation errors
- Highly distracted by noise
- Difficulty sitting in circle time, or group activities, better in 1:1 interaction
- Mispronunciation of words
- Difficulty following auditory directions (age-appropriate)
- May enjoy music but have greater than typical difficulty learning the words or singing the words correctly
- Reduced tolerance to noise, or sound sensitivities
- May tune out or appear to be in their own world
- Poor listening skills

INFORMAL

Documented parent and/or teacher concerns, thorough case history, optional classroom observation

SEMI-FORMAL

THE LISTENING INVENTORY

Parent and teacher checklist to differentiate observed processing behaviors (ages 4-17)

PRESCHOOL SIFTER

Completed by preschool or kindergarten classroom teacher or school providers to ascertain educational risk due to hearing problems

FORMAL APD TEST BY DOMAIN

BINAURAL

SCAN 3:C

- Competing Words (5+)
- Competing Sentences (5+)

Feather Squadron

- Animal Dichotic Sounds (5-7)

TEMPORAL

RANDOM GAP DETECTION TEST (5+)

SPEECH

SCAN 3:C

- Auditory Figure Ground (5+)
- Filtered Words (5+)

Feather Squadron

- Speech-in-Noise (5+)
- Rapid Speech (5+)

Pediatric Speech Intelligibility Test "PSI" (3- 6)

SUPPLEMENTAL

AUDITORY SKILLS ASSESSMENT (ASA)

Quick screener to measure auditory skills in young children (ages 3.5-6)

ELEMENTARY (AGES 7-11) EXAMPLE APD PROTOCOL

TYPICAL AGE GROUP CONCERNS

- Acts as if they have a hearing loss, despite passing hearing screening
- Says 'huh' or 'what' often
- Distracted by, or bothered by, noise
- Observable differences in skills in quiet vs. noisy environments
- May say they don't hear
- Difficulty remembering or following verbal directions
- May watch other students before getting started on tasks/assignments
- May have poor reading, spelling or writing skills; skills are acquired slower than peers
- Slow responses to questions, or may respond with off-target words/concepts
- May tell teacher/parent, "I don't understand", "I don't remember" frequently

INFORMAL

Documented parent and/or teacher concerns, thorough case history, optional classroom observation

SEMI-FORMAL

MAPA-2 SCALE OF AUDITORY BEHAVIORS (SAB)
Short teacher or parent rating scale for at-risk listening behaviors

CHILDREN'S AUDITORY PERFORMANCE SCALE (CHAPS)
Teacher questionnaire to rate classroom listening behaviors compared to peers (ages 7+)

DIFFERENTIAL SCREENING TEST FOR PROCESSING (DSTP)
Screening to differentiate acoustic from linguistic processing difficulties (ages 6-12)

FORMAL APD TEST BY DOMAIN

BINAURAL

FEATHER SQUADRON
- Dichotic Single & Double Sounds
- Dichotic Words & Digits

MAPA-2
- Dichotic Digits
- Competing Sentences

TEMPORAL

FEATHER SQUADRON
- Rapid Tones (8+)
- Tonal Patterns (8+)

MAPA-2
- Tap Test
- Pitch Patterns
- Duration Patterns
- Gap Detection Test

SPEECH

FEATHER SQUADRON
- Speech-in-Noise
- Rapid Speech

MAPA-2
- Speech-in-Noise for Children (SINCA)
- Monaural Selective Attention Test

BKB-SIN

SUPPLEMENTAL

AUDITORY CONTINUOUS PERFORMANCE TEST (ACPT)
A test of auditory vigilance to differentiate APD from attention deficits

TAPS-4: A LANGUAGE PROCESSING SKILLS TEST
A standardized assessment to examine auditory skills including phonological processing, auditory memory, and listening comprehension (ages 5-21)

SECONDARY (AGES 12 AND UP) EXAMPLE APD PROTOCOL

TYPICAL AGE GROUP CONCERNS

- May act as if they have a hearing loss, despite passing hearing screening
- Says "huh" or "what" often
- Difficulty remembering verbal instructions or understanding verbal assignments
- Doesn't understand sarcasm or humor
- Distracted by noise and may 'zone-out' or appear to daydream
- Needs frequent repetition
- Difficulty with timed tasks
- Poor note-taking
- More fatigued than peers, greater at the end of the day

INFORMAL

Documented parent and/or teacher concerns, thorough case history, optional classroom observation

SEMI-FORMAL

CHILDREN'S AUDITORY PERFORMANCE SCALE (CHAPS)
Teacher questionnaire to rate classroom listening behaviors compared to peers (ages 7+)

AUDITORY PROCESSING DOMAINS QUESTIONNAIRE (APDQ)
Thorough questionnaire which can be completed by student, teacher, parents that can assist with differentiating auditory problems from deficits of attention and language (ages 4-17)

LIFE-R: STUDENT APPRAISAL OF LISTENING DIFFICULTY
Student questionnaire to rate perceived classroom listening difficulties

FORMAL APD TEST BY DOMAIN

BINAURAL

SCAN 3:A
- Competing Words
- Competing Sentences

DICHOTIC DIGITS TEST (DDT)
COMPETING SENTENCES TEST (CST)

TEMPORAL

SCAN 3:A
- Gap Detection Screening

PITCH PATTERN TEST (PPT)
DURATION PATTERN TEST (DPT)
RANDOM GAP DETECTION TEST (RGDT)
GAPS IN NOISE (GIN)

SPEECH

SCAN-3:A
- Filtered Words
- Auditory Figure Ground
- Time Compressed Sentences

NU-6 LOW PASS FILTERED SPEECH
BKB-SIN

SUPPLEMENTAL

TAPS-4: A LANGUAGE PROCESSING SKILLS TEST
A standardized assessment to examine auditory skills including phonological processing, auditory memory, and listening comprehension (ages 5-21)

CROSS-DISCIPLINE INTERPRETATION OF APD ASSESSMENT

Audiological APD test results should be interpreted and integrated with other multidisciplinary assessments as well as with the observed functional difficulties of the student. A number of APD researchers have proposed a myriad of theoretical frameworks (e.g. Bellis-Ferre, Buffalo, Lucker, Medwetsky, etc.) in an attempt to classify individuals with APD into various subtypes.

In Colorado's educational model of APD, the goal is to connect auditory strengths and weaknesses with corresponding functional, academic, and behavioral difficulties experienced by students in the school setting.

Educational difficulties such as listening in large groups, following directions, learning to read, and developing social skills all rely on intact auditory functioning. APD assessment results yield a "glimpse" into the workings of the central auditory nervous system (CANS) and auditory weaknesses often occur in patterns which can be linked to specific difficulties that students may demonstrate in the classroom. See the table below which outlines some commonly linked educational difficulties to the three auditory processing domains.

BINAURAL	TEMPORAL	SPEECH
Difficulties in the binaural domain most often present as dichotic listening challenges. Dichotic listening involves the ability to integrate and separate different information being heard by each ear. Widely used test batteries thoroughly examine dichotic listening and compare performance differences between right and left ears. Test stimuli have varying degrees of linguistic load in order to understand real-world impact. Other binaural skills, with limited tests available but of growing interest and recognition, include localization and spatialized hearing which are critical for listening in complex environments.	Tests in the temporal domain typically use nonspeech stimuli in order to assess the listener's ability to identify, discriminate, and analyze timing, patterns, and other non-verbal aspects of sounds. These skills are foundational to the ability to perceive acoustic subtleties of spoken language such as rhythm, stress, intonation and other prosodic aspects. They are also foundational to phonological awareness and processing in early literacy development.	Difficulties processing speech in poor or degraded listening environments is a "hallmark" of auditory processing problems. The ability to perceive speech in background noise (auditory figure-ground) and to use context and language knowledge to fill in the gaps where information is missing (auditory closure) can be compromised. This may be due to challenges inherent in the auditory system or to other cognitive and brain-based functions such as attention, memory and linguistic competence.

Table 5: *Auditory processing skills assessed by domain.*

COMMONLY LINKED EDUCATIONAL DIFFICULTIES		
BINAURAL	**TEMPORAL**	**SPEECH**
▪ Easily distracted by noise or multiple speakers ▪ Sensitive to background noises, especially loud sounds ▪ Difficulty with multi-modal inputs ▪ May demonstrate complex sensory profile ▪ Poor sound-symbol association ▪ Developmental delays ▪ Non-verbal learning difficulties ▪ Visual processing/integration difficulties ▪ Short-term memory deficits	▪ Phonological processing difficulties ▪ Poor spelling ▪ Difficulty sequencing ▪ Pragmatic, social/peer communication difficulties ▪ Delayed responses to verbal messages ▪ Reading disorders	▪ Mishears or misunderstands especially in noisy environments ▪ Receptive language delay ▪ Difficulties discriminating speech sounds ▪ Strengths in non-verbal and math skills ▪ Auditory fatigue ▪ ADHD/ADD

Table 6: *Some commonly linked educational difficulties to the three auditory processing domains.*

By using cross-discipline analysis with other student data, educational audiologists can offer special education and student support teams an added picture on how the brain is functioning in terms of auditory abilities. From this added data, intervention plans may be more specific and tailored to the needs of the student. The **Auditory Processing Profile** resource is a useful tool in visually analyzing multidisciplinary assessment data.

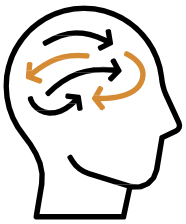
While weaknesses in auditory processing may not fully explain the depth of the student's listening challenges, a high correlation can often be found. When a student performs poorly on all or most of the APD tests, the team should suspect an underlying global processing or learning difficulty rather than APD.

Signs of declining motivation or fatigue toward the end of an evaluation could result in poor performance on APD tests, so these factors must be considered when interpreting results as well.

In these less straightforward cases, APD results are best interpreted with caution and prioritized according to the full picture of the student's learning needs.

NEURODIVERSITY

The concept of neurodiversity is important to recognize in complex evaluations involving brain functioning. Neurodiversity implies there are natural differences in the human brain and that there is no single way of thinking, learning, problem solving, or behaving that is 'normal' or typical.



Historically these differences were viewed as deficits, but within a framework of neurodiversity, some differences in skills may actually reflect differences in brain structure and wiring rather than specific deficits. Certain neurodevelopmental or neurodiverse conditions, such as autism spectrum disorders (ASD), have known variations in processing, communicating, and learning.

APD may co-exist with ASD, but not all individuals with ASD will have auditory processing disorder. The same goes for other neurodiverse conditions such as attention deficit and executive dysfunction disorders, dyslexia and dyscalculia. Auditory difficulties may coexist but not be due to underlying central auditory processing deficits. Recognizing the spectrum of neurodiversity and neurodevelopmental processes will be imperative in sorting through the multidisciplinary data collected.

SOUND SENSITIVITY DISORDERS

Audiologists are often consulted about students who show decreased tolerance of and increased sensitivity to certain sounds. Sound sensitivity disorders such as hyperacusis and misophonia are conditions characterized by an abnormal perception of sound and they are highly individualized and subjective.

There are few formal assessments to diagnose these conditions; however, a growing body of research and attention has resulted in the availability of various questionnaires that can be used to quantify and describe their impacts.

Tinnitus, or perceived sounds heard in the ears in the absence of external sound, is a related auditory condition sometimes reported by children and youth. Increasing evidence suggests that each of these auditory disorders may at least partially result from malfunctions within the central auditory nervous system (CANS) (Sanjay, et al., 2023; Świerniak, et al., 2017; Diges, et al., 2017).

While not technically considered auditory processing deficits (APDs) these sound sensitivity issues may interact or coincide with APD, and educational audiologists should be consulted when they are reported.

AUDIOLOGICAL CRITERIA FOR IDENTIFYING APD

When formal audiological APD assessments are organized and analyzed according to the three auditory processing domains: binaural, temporal, and speech, then clear deficit patterns can emerge or APD deficits can be ruled out. The current (ASHA, practice portal) and previous (CDE) guidance on what scores constitute an APD diagnosis have been repeatedly questioned, especially when discussing school-age populations (Ahmmed & Ahmmed, 2016; Moore, et. al, 2018).

In an effort to align better with multidisciplinary assessment practices in Colorado, the Colorado APD Task Force is making a new recommendation for audiological cut-off scores to diagnose the presence of an auditory processing deficit that significantly impacts or interferes with listening and learning.

Identification of APD is made when performance deficits of at least 1.5 standard deviations below the mean are found on two or more formal audiological APD tests in the same processing domain.

In addition to formal audiological assessment, data from informal and semi-formal sources should support the adverse educational impact of reduced auditory functioning. In this context, diagnostic assessment is not referring to assessment for the purpose of "diagnosing" a disability.

APD is not a disability category and all APD assessment data should be a part of a comprehensive evaluation collected by normative assessment, observational information, family and teacher input, curriculum-based measures, and other qualitative or quantitative data that demonstrate how the disability impacts the child's ability to access general education.

SECTION 4: EDUCATIONAL IMPLICATIONS & MANAGEMENT

School teams must consider the overall educational impact of a student's learning challenges and whether or not the student may be eligible for a 504 Plan or Individualized Education Program (IEP). While auditory processing "disorder" may be considered a medical diagnosis in some settings, in the school setting all medically diagnosed conditions are held to the same standard which presents the question **"Is there evidence of adverse educational impact contributing to a qualifying educational disability that prevents the student from receiving reasonable benefit from general education?"**

SPECIAL EDUCATION ELIGIBILITY

An auditory processing deficit (APD) is identified through a multidisciplinary body of evidence which includes a comprehensive audiological assessment of auditory processing (AP). The AP assessment, whether conducted by a school audiologist or an outside clinical audiologist, is not sufficient to determine eligibility for special education. A diagnosis is not required to meet the criteria for special education eligibility for any category in the state of Colorado. Likewise, a diagnosis does not necessarily mean a student will automatically meet or will automatically not meet the criteria for special education eligibility for any category. The Colorado Department of Education (CDE) has a technical assistance document that addresses clinical diagnoses.

Colorado's rules under the Exceptional Children's Education Act (ECEA) (under IDEA) define the categories for special education eligibility. Auditory processing deficits can fall under several special education categories, however the criteria as defined in each category must still be met, and there must be a need for specially designed instruction (SDI) in order to qualify to receive an individualized education program (IEP). Determination of special education eligibility is an IEP team decision. While a student with APD may appropriately qualify under various disability categories, they are entitled to receive a free and appropriate public education (FAPE) designed to address their unique needs regardless of the eligibility label.

SPEECH LANGUAGE IMPAIRMENT (SLI)

An auditory processing deficit may be considered part of a larger body of evidence for students to be eligible for services for a **speech or language impairment (SLI)**. The mechanisms associated with hearing and auditory processing, namely the structures of the ear, the central auditory nervous system (CANS), and the primary auditory cortex are often overlooked with regard to the role they play in language development. As experts in

language development, SLPs must have working knowledge of how various auditory skills lay the foundation and progress in a hierarchical manner to support appropriate linguistic development. Language disorders, particularly receptive language disorders, may have underlying auditory processing deficits that speech-language pathologists can remediate through direct services and interventions. When an SLP has questions about underlying auditory skills, consultation with the audiologist is recommended.

In Colorado, *a child with a Speech or Language Impairment shall have a communicative disorder which prevents the child from receiving reasonable educational benefit from general education* ***ECEA 2.08(9)****. A Speech or Language Impairment may be classified under the headings of articulation, fluency, voice, functional communication or delayed language development and there must be evidence of dysfunction in one or more of the following criteria: (check all that apply)* ***ECEA 2.08(9)(a)****:*

Providers are sometimes confused by the **two auditory aspects of language called out in the Colorado SLI criteria**. SLPs and audiologists have questioned the meaning and intent behind these criteria and especially which ones to check when assessments yield certain results. Confusion stems from the fact that the terminology reflects long standing ECEA rules. In recent years, however, terms have evolved and changed when describing the fundamental characteristics of language. The discussion that follows is an attempt to clarify the two areas.

- *Receptive and expressive language (oral and written) difficulties including syntax (word order, word form, developmental level)*
- *Semantics (vocabulary, concepts and word finding)*
- *Pragmatics (purposes and uses of language)*
- ***Auditory processing, including sensation (acuity), perception (discrimination, sequencing, analysis and synthesis) association, auditory attention***
- *Deficiency of structure and function of oral peripheral mechanism*
- *Articulation including substitutions, omissions, distortions or additions of sound*
- *Voice, including deviation of respiration, phonation (pitch, intensity, quality), resonance*
- *Fluency, including hesitant speech, stuttering, cluttering and related disorders*
- ***Problems in auditory perception such as discrimination and memory.***

The first listed is: **Auditory processing, including sensation (acuity), perception (discrimination, sequencing, analysis and synthesis), association and auditory attention.** While the term "auditory processing" is used here, the skills listed involve a broad spectrum of auditory and language skills. Most will recognize the skills of perception (discrimination, sequencing, analysis and synthesis) as those involved in phonemic and phonological processing, which is considered the intersection of auditory and linguistic processing. Auditory association and attention are distinct from sensation and perception in

that they involve more comprehensive linguistic and cognitive processes, and are best described using data from multiple disciplines. The second auditory criterion listed is: **Problems in auditory perception such as discrimination and memory.** While the term "processing" is not used in this description, this is the auditory indicator to consider selecting when significant deficits are identified in the audiological assessment of central auditory processing abilities. If there is no APD assessment indicating significant deficits, the SLP can assess speech discrimination and memory through receptive and expressive language assessments, or phonological processing assessments. If these assessments reveal a significant deficit in discrimination and memory, it would be appropriate to mark this indicator. This addresses the linguistic concern rather than the CANS pathway.

Further discussion on SLI eligibility can be found on the CDE website. In addition, Table 1 in the Colorado Communication Rating Scales (CCRS)- Receptive Language Scale addresses specific auditory skills commonly evaluated by the speech-language pathologist. The Receptive Language CCRS provides speech-language pathologists with a structure to summarize and identify the severity of auditory processing and auditory perception concerns described by the multidisciplinary evaluation team.

SPECIFIC LEARNING DISABILITY (SLD)

In Colorado, **a *Specific Learning Disability (SLD)*** *means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in the imperfect ability to listen, think, speak, read, write, spell or do mathematical calculations, including conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. Specific learning disability does not include learning problems that are primarily the result of: visual, hearing, or motor disabilities; intellectual disability; serious emotional disability; cultural factors; environmental or economic disadvantage; or limited English proficiency.* ***ECEA 2.08(8)***

The student is determined to have a Specific Learning Disability that prevents the child from receiving reasonable educational benefit from general education if a body of evidence demonstrates the following criteria are met: ***IDEA 34 C.F.R. § 300.309; ECEA 2.08(8)(b)****:*

- *the child does not achieve adequately for the child's age or to meet state-approved grade-level standards and exhibits significant academic skill deficit(s) in one or more of the areas identified below (see rule) when provided with learning experiences and instruction appropriate for the child's age or state-approved grade-level standards,*
- ***AND*** *the child does not make sufficient progress to meet age or state-approved grade level standards in the area(s) identified when using a process based on the child's response to scientific, research-based intervention.*

Students identified with auditory processing deficits (APD), and who demonstrate significant **listening comprehension** and/or **reading delays**, may qualify under SLD. The APD evaluation is considered one data point in a larger body of evidence that supports the identification of SLD. Further guidance on SLD identification and on SLD in Colorado is available on the CDE website.

OTHER DISABILITY CATEGORIES

Students identified with APD less often may fall into a number of other educational disability categories. IEP teams may decide that students with concurrent attentional deficits such as ADHD and/or who meet the specific criteria for **Other Health Impairment (OHI)** may be best-served under this category.

The prevalence of auditory processing deficits due to traumatic brain injury (TBI) has been found to be approximately 50% (Bergemalm & Lyxell, 2005; Flood, Dumas, & Haley, 2005), therefore some students with APD may qualify for special education services under the **Traumatic Brain Injury (TBI)** category. For a select few younger students, APD may be a contributing factor to qualifying with a **Developmental Delay (DD)**. Some students with **Autism Spectrum Disorder (ASD)** may also demonstrate deficits in auditory processing.

In each of these instances, as in all circumstances when it comes to auditory processing deficits, students must meet the explicit criteria for the qualifying disability in order to be eligible for and receive special education services. In all cases, these decisions are entirely the responsibility of the multidisciplinary eligibility team which must include qualified professionals and the student's parent/caregiver.

OUTSIDE OR CLINICAL DIAGNOSIS OF APD

As previously mentioned, **clinical and/or medical diagnoses obtained outside of the school setting do not automatically infer that students have an educational disability**. Parents have a right to bring forth an outside evaluation and to participate with school eligibility teams (IEP and 504) to meaningfully consider it within the larger body of evidence or data collected. When an outside audiological APD assessment is provided for school consideration, the team should bring in their educational audiologist for consultation and then carefully consider the evaluation and whether it meets recommended standards of assessment. Clinical audiological APD evaluations are often conducted in isolation, without multidisciplinary or functional data, and weigh heavily on caregiver case history report. Sometimes the diagnostic assessments used do not meet recognized, professional best-practices or align with the educational impact being seen at school. Reports often include a general list of recommendations too numerous and impractical for schools to consider, and also may not be specific to the student's needs within an educational setting. The team must document these considerations and determine whether to accept the findings or whether to possibly conduct further assessment for APD.

INTERVENTION

Students with APD are a diverse group, and most will have multiple areas of need in addition to auditory processing. When designing an intervention plan, the team must consider the entire auditory processing continuum and prioritize the student's needs accordingly.

Because listening difficulties can originate from and manifest within both bottom-up (acoustic level) and top-down (higher-order cognitive or linguistic) levels, interventions must also be considered from both perspectives (Moore, 2012).

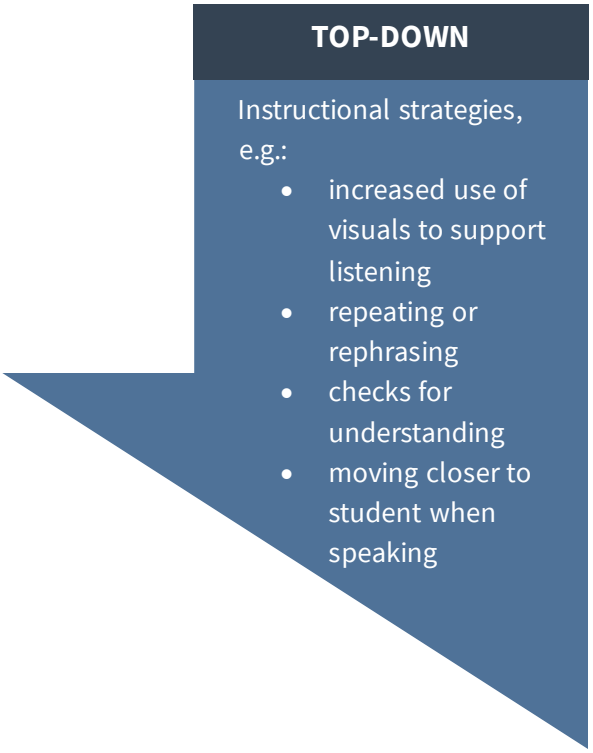
Most student interventions will be implemented via a formal plan (IEP or 504), therefore it is important to include the educational audiologist at this phase of the process to assist with development of the intervention plan.

Management of APD should be multifold and at minimum include instructional and environmental strategies, or indirect services, designed to support increased auditory access in the classroom. Direct services, including specially designed instruction (SDI), also need to be considered based on the skill gaps identified in the comprehensive evaluation.

Speech and language-based interventions which focus on auditory skills are most often provided by the speech-language pathologist (SLP) while academic interventions are provided by the special educator or learning disabilities specialist. In some cases, educational audiologists may provide direct intervention for auditory or listening goals. Service providers will vary based on the district's practices and the individual needs of the student. As with all intervention plans, effectiveness of interventions must be monitored through typical progress monitoring practices and it is recommended that three-year reevaluations include a repeat APD assessment by the audiologist in the specific AP area of deficit.

INDIRECT INTERVENTIONS

Indirect interventions include those APD management strategies that are ordinarily categorized under **accommodations** in the instructional and learning environment. It is best if accommodations are deficit-specific and tailored to the student needs as much as possible, but in practice they often tend to be more generalized and implemented and monitored by a variety of school providers. Teams are encouraged to identify and select accommodations that address both top-down and bottom-up listening skill deficits.



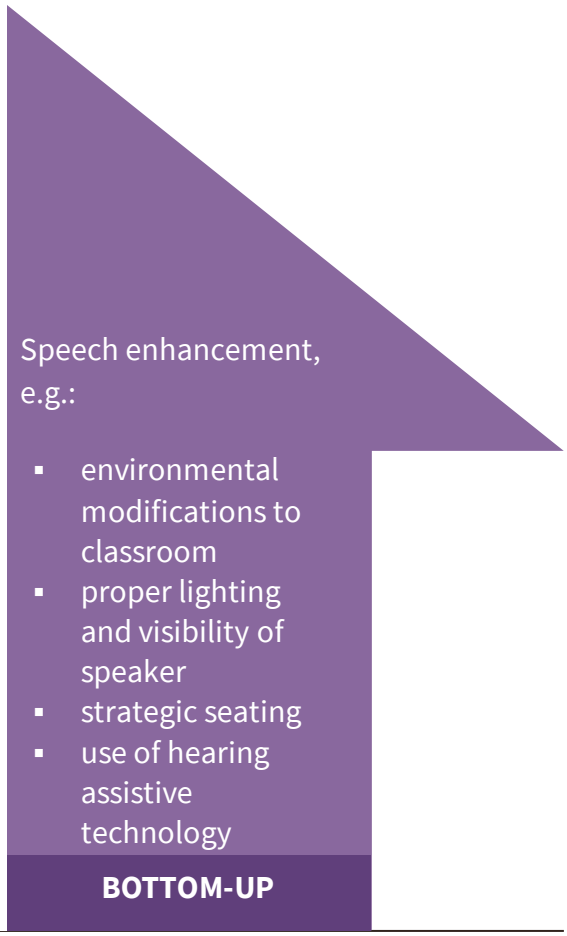
INDIRECT | TOP-DOWN | Instructional strategies are considered top-down and primarily delivered by the classroom teacher to increase accessibility to the verbal message.

Depending on the age of the student and the instructional style of the classroom, certain teaching techniques can be quite effective when implemented consistently. IEP teams are encouraged to be strategic and limit the number of recommendations to teachers, when possible, in order to focus on those that truly help the student.

Figuring out which ones to use may necessitate some trial and error.

INDIRECT | BOTTOM-UP | Speech enhancement includes bottom-up methods with the same purpose - to increase auditory access to speech in the classroom. Noise is a common culprit that interferes with effective listening for both students and teachers. A critical point to consider is the signal-to-noise ratio (SNR), or the relationship of the instructional speech signal to the unwanted noise in the classroom.

Noise, defined as any auditory disturbance that interferes with what a listener needs or wants to hear, negatively affects the listening and learning process for all. **Research has shown that young, typical listeners need a signal-to-noise ratio (SNR) of plus 15 decibels (dB)** - meaning the signal should be 15dB above the background noise in order to adequately perceive speech (Crandell & Smaldino, 2000).



The quieter the listening environment, the better for all students, especially those with listening challenges associated with APD, hearing loss, multilingual learning, or attention difficulties. Efforts to manage noise in the classroom can go a long way.

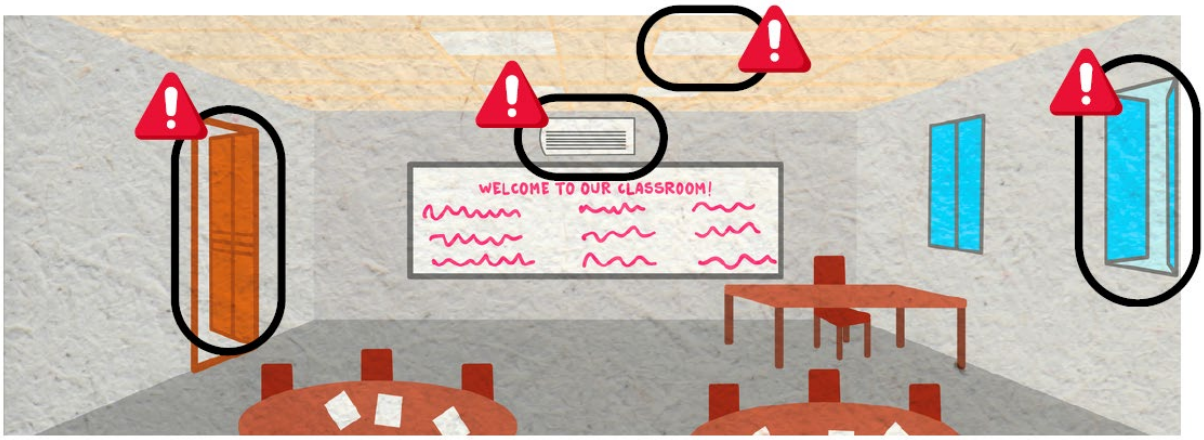


Figure 8: *Common causes of noise in a classroom can include open doorways to public areas, open windows, HVAC systems, and more.*

Noise is typically caused by factors such as **HVAC systems or classroom placement/concept (open)** which can be more challenging to control, or by more controllable variables such as **open doors or windows** which can be closed. Poor acoustical environments that are **reverberant** or large will exacerbate the noise problem. Environmental modifications to reduce the noise and to mitigate poor acoustics can be helpful for students with APD and for all students.

The educational audiologist can assist with evaluating the classroom environment and making recommendations to improve the situation. Visual characteristics of the classroom are equally important to consider when examining auditory access. **Poor lighting or visual distractions** may reduce access to important visual cues listeners rely on. Environmental management should also include physical arrangement of the room and strategic student seating to better hear or see the teacher and/or to reduce auditory or visual distractions.

When environmental or seating strategies are not enough, one of the best ways to effectively manage a poor SNR is through the use of remote microphone hearing assistive technology (RM-HAT). Previously referred to as "FM systems," **RM systems are an evidence-based management strategy to improve auditory access in the classroom (Reynolds, et al., 2016; Smart, et al., 2018).** A wireless remote microphone transmitter is worn by the teacher or handheld by other students to increase access to spoken information. RM-HAT comes in both personal (student worn) and classroom (speaker) systems and is primarily managed and maintained for the district or AU by the audiologist. A major role of the educational audiologist is to provide HAT services including selecting, implementing and monitoring of the equipment. A good implementation plan will begin with a trial period of a minimum of

4-8 weeks to determine benefit and to figure out the logistics of classroom use. **Semi-formal questionnaires** can be used during this process and as ongoing progress monitoring tools. RM-HAT systems are not practical or effective in all settings but may offer a viable solution to support students with APD.

In addition to RM technology, hearing aids with low-gain (that also include RM tech) have been gaining attention as a potential treatment for individuals with auditory processing deficits. Research is currently underway to help determine the effectiveness of hearing aids along with remote microphones in supporting better listening for people with central auditory processing disorders (Kuk, et al., 2008; Keith & Purdy, 2014; Stavrinos, et al., 2020). The outcomes of this research will definitely impact the use of hearing technologies in the future

DIRECT INTERVENTIONS

Direct interventions for APD include remediation services delivered directly to students in order to improve auditory and listening skills.

In the school setting, services may be provided one-to-one or in small groups and may approach student needs from both **bottom-up** and **top-down** perspectives. Some skill building activities can be offered informally through accommodations and services on a 504 Plan, and sometimes through computer-based apps that can be employed during free time or at home.

Most often direct services are administered through specially designed instruction (SDI) in an IEP. Providers of SDI may be speech-language pathologists, special education teachers, and/or related service providers including educational audiologists. However delivered, their goal is to target those APD and related skill deficits identified in the comprehensive evaluation in order to support overall effective communication and learning.

DIRECT | BOTTOM-UP | Auditory training, which addresses student needs from a bottom-up perspective, includes skill-building activities focused on strengthening auditory-specific processing weaknesses identified on the APD evaluation. Auditory training is based on the premise of brain plasticity and research indicates that when delivered effectively, can improve listening, language and reading skills (Weihing, et al., 2015). Auditory training has historically been a powerful tool for rehabilitation of children with hearing loss and school providers can implement these techniques in a manner that addresses both functional auditory deficits and academic standards.

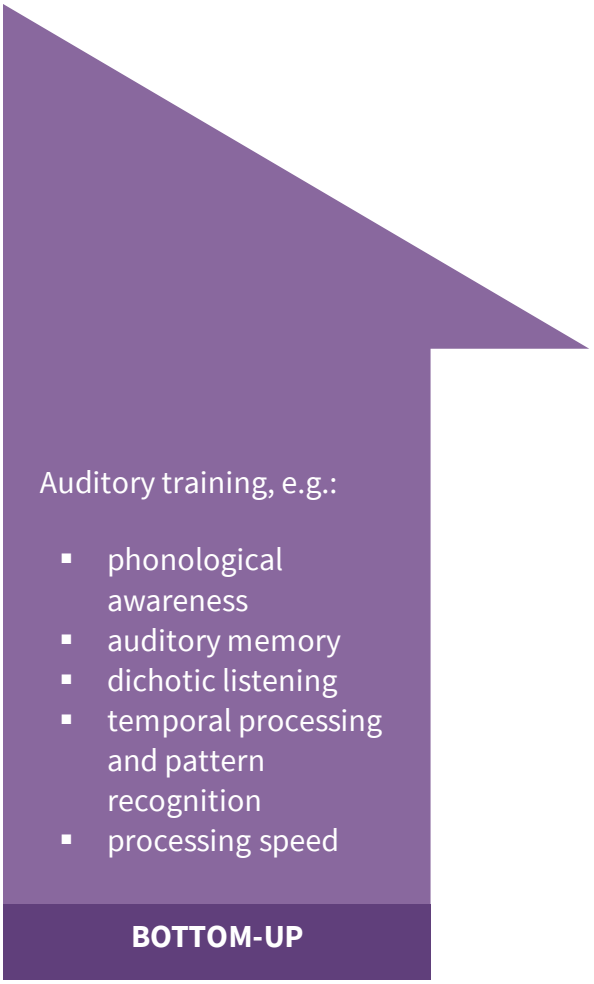
For remediation of deficit-specific auditory processing skills, auditory training is best delivered using acoustically controlled, adaptive technology applications (apps).

Computer-based auditory training apps, which use digitally recorded stimuli, have been used for many years both in and outside of school settings to focus on listening activities important for language and literacy (Loo, et al., 2010).

The interactive, game-based, stimulus-response mode of these programs ensures that students are engaged and motivated, while strengthening their auditory skills.

The availability of computers and tablets in the school setting means these programs offer great potential for students with auditory processing difficulties. Available as apps and designed according to auditory development hierarchies, they target specific auditory skills which are foundational to language and literacy.

A **list of several popular, computer-based auditory training programs** is included for reference.



DIRECT | TOP-DOWN | To address auditory processing deficits from the top-down, students will benefit from direct interventions that focus on other learning needs identified in their evaluation. According to the ASHA practice portal on auditory processing "Compensatory strategies (e.g., metalinguistic and metacognitive) are designed to minimize the impact of CAPD on language, cognition, and academics. They focus on strengthening higher order central resources (e.g., language, memory, attention) to enhance listening skills, communication, social skills, and learning outcomes." Supporting students' compensatory skills through direct instruction either through SDI or other methods (study skills or resource classes) will greatly assist their ability to listen and learn in the classroom.

A holistic approach to managing auditory processing deficits is imperative considering the variability and nature of listening difficulties in the school setting. Not all strategies will work for all students.

TOP-DOWN

Metalinguistic and metacognitive strategies suggested in the ASHA practice portal include:

- schema induction (i.e., predicting elements in a message) and discourse cohesion devices (i.e., grammatical means to link and establish relationships between sentences and paragraphs)
- use of graphic organizers (e.g., problem–solution map, story map, semantic network tree)
- use of context to understand and build vocabulary
- phonological awareness
- semantic network expansion
- active listening
- self-instruction
- organization skills
- metamemory techniques (e.g., mnemonics, mind mapping)
- problem solving
- assertiveness training

Therefore, interventions must be monitored closely and in collaboration with all team members, including the educational audiologist, teachers, parents, service providers, and students. Incorporating bottom-up and top-down strategies ensures that all aspects of listening along the auditory processing continuum are supported.

On the following page is a broad list of APD interventions according to the categories just discussed. It is not an exhaustive list; however, it is designed to assist teams in identifying and selecting those specific strategies which target the identified needs of students. The **list of interventions** is also included in the **Resources** section as a quick reference.

APD DEFICIT SPECIFIC INTERVENTIONS

KEY B BINAURAL S SPEECH T TEMPORAL

COMPUTER BASED AUDITORY SKILLS

- ☐ Acoustic Pioneer: Zoo Caper Sky Scraper B
- ☐ Acoustic Pioneer: Insane Airplane T
- ☐ Acoustic Pioneer: Elephant Memory Training
- ☐ Brain Train B T S
- ☐ CAPDOTS B
- ☐ Fast ForWord B T S
- ☐ HearBuilders T
- ☐ Sound Storm B
- ☐ LACE B T S
- ☐ BrainHQ B T S

COMPENSATORY SKILLS

- ☐ Active listening
- ☐ Self-advocacy
- ☐ Organization
- ☐ Visualization
- ☐ Repair of communication breakdown
- ☐ Subvocalization
- ☐ Chunking
- ☐ Use of note-taker (peer or automated)

INSTRUCTIONAL ACCOMODATIONS

- ☐ Cue student to look and listen
- ☐ Check for understanding B T S
- ☐ Use visuals to support auditory information
- ☐ Multisensory instruction B T S
- ☐ Decrease distance from student
- ☐ Obtain student attention prior to engaging
- ☐ Monitor listening fatigue & provide listening breaks
- ☐ Assign peer partners
- ☐ Mark transitions between activities
- ☐ Repeat information B T S
- ☐ Rephrase information B T S
- ☐ Reduce multisensory interaction B T S
- ☐ Allow wait time
- ☐ Identify key words and summarize key points frequently S
- ☐ Avoid divided attention B
- ☐ Give adequate response time
- ☐ Encourage self-advocacy

SPEECH-LANGUAGE & LITERACY SKILLS

- ☐ Phonemic & phonological awareness training
- ☐ Vocabulary building
- ☐ Listening comprehension
- ☐ Active listening
- ☐ Auditory closure S
- ☐ Auditory discrimination S
- ☐ Speech reading
- ☐ Following directions
- ☐ Key word identification
- ☐ Answering questions
- ☐ Asking questions
- ☐ Auditory memory
- ☐ Sequencing activities
- ☐ Story recall
- ☐ Identifying semantic absurdities
- ☐ Inferencing from stories
- ☐ Recalling details
- ☐ Multiple meaning words
- ☐ Identifying heteronyms
- ☐ Role playing/charades
- ☐ Phoneme sequencing and sound blending
- ☐ Pattern identification T
- ☐ Speech in noise training S
- ☐ Speech in noise training - directed ear B
- ☐ Sound localization training B
- ☐ Dichotic listening training B
- ☐ Music training T
- ☐ Noise desensitization training S

ENVIRONMENTAL & HAT ACCOMODATIONS

- ☐ Strategic, flexible seating
- ☐ Quiet study area S
- ☐ Use of earmuffs
- ☐ Assign peer note-taker or provide teacher notes
- ☐ Remote microphone hearing assistive technology S
- ☐ Improve room acoustics
- ☐ Reduce background noise
- ☐ Record lessons
- ☐ Use captioning
- ☐ Low gain personal hearing aids

SUMMARY

Processing of auditory information occurs along a complex continuum with multiple sensory, language, and cognitive processes involved. Because every single school day is heavily weighted with listening activities, and because so much of learning requires effective listening skills, all students can benefit from methods to enhance auditory access to their education.

For students who demonstrate significant auditory and listening difficulties in the school setting, the problem-solving process to identify and support the underlying cause of their difficulties can be quite a challenge. Bottom-up, acoustic aspects of auditory processing can be assessed by the educational audiologist, but it takes a multidisciplinary team to evaluate all of the top-down factors that contribute to effective listening in the classroom. Supporting students with APD is best approached through a transdisciplinary partnership that looks beyond individual disciplines to address the needs of the whole student.

SECTION 5: RESOURCES

The following section provides various resources that are designed to be shared and adapted to the needs of individual districts and administrative units. Some of these resources are fillable forms, allowing for easy input of information directly. In addition, these forms can be printed and shared with relevant parties.

Consider sharing these materials with families, staff, and other relevant parties to ensure that everyone involved has access to the necessary information and tools.

Resources:

- APD Look Fors in Children & Youth
- General Strategies for Students with Listening Difficulties
- APD FAQs
- APD Assessment Referral Consideration Form
- APD Case History
- Auditory-Focused Questionnaires
- APD Assessment Resources
- APD Protocol Template
- APD Assessment Profile Sample Template | APD Assessment Profile Example
- Deficit Specific Interventions
- Computer Based Auditory Training Programs
- Glossary of Terms

AUDITORY PROCESSING DEFICITS: LOOK FORS IN CHILDREN & YOUTH

OBSERVED CHALLENGES

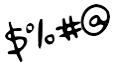
Behaves as if hearing loss is present, despite hearing levels within normal range

Frequently requests repetitions (says "huh" or "what" often)

Misunderstanding spoken language

- in noisy situations
- in large, echo-y or reverberant rooms
- when speech is fast or unclear (e.g. announcements, media recordings, unfamiliar accents)
- when using listening only (without other supports such as visuals)

Gives delayed, inconsistent, or inappropriate responses in oral communication situations



Mishears words or confuses similar sounding words

Acts confused, distracted, inattentive, or zoned out during listening activities

Has difficulty figuring out where a sound is coming from (on a playground, near streets, etc.)

Misunderstands messages that rely on tone of voice such as sarcasm or humor

POSSIBLE SCHOOL-RELATED IMPACTS

Poor performance on auditory-based tasks (e.g. listening comprehension, discriminating sounds, phonology, or letter-sound association)

Associated academic difficulties in reading, spelling, and/or learning

Difficulty attending to long lectures or extended periods of listening

Inability to follow multi-step verbal directions

Trouble learning simple songs (e.g. nursery rhymes) or new languages

Problems socializing in large groups or in noisy environment

GENERAL STRATEGIES FOR STUDENTS WITH LISTENING DIFFICULTIES

Students with listening difficulties (LiD) in the classroom present a myriad of underlying causative factors. Listening to comprehend and then acting on what is heard is a complex process which depends on numerous variables. Regardless of the root cause of a student's listening difficulties, many strategies can be used to improve their access to auditory information in the learning environment. Enhancements to the **environment**, to the **message**, and to the **listener** should all be considered to ensure auditory access.

ENVIRONMENT

TYPICAL ENVIRONMENTAL LISTENING BARRIERS

- Poor room acoustics
- Noisy distractions including ambient noises or excess student noises
- Inadequate access to visual information including teacher's face (not directed toward students) or poor room lighting

STRATEGIES

▪ Close the door(s) and windows of the learning environment	→ Reduces external noise from sources such as hallways, playground, and traffic
▪ Place carpet or rugs on floors; put rubber tips on the bottom of table and chair legs	→ Reduces noise created when students move their chairs or tables to minimize auditory distractions during instruction
▪ Locate noise sources such as pencil sharpeners, aquariums, printers, etc. in one part of the room that is away from primary instructional areas	→ Minimizes impact of noise interruptions
▪ Divide room into smaller spaces using bookshelves or other furniture	→ Creates smaller learning spaces
▪ Cover walls with sound absorbing material such as heavy fabric and bulletin boards; some rooms may require strategically placed acoustical panels on walls	→ Improves room acoustics through increased absorptive wall surfaces that reduce noise level and reverberation
▪ Use classroom audio distribution system (CADS)	→ Improves signal-to-noise ratio by distributing teacher and student voices throughout the room
▪ Provide earmuffs or quiet study areas that are free from visual distractions during independent work time	→ Helps to minimize problems with auditory and visual distractions in the environment to improve concentration and productivity
▪ Ensure adequate lighting	→ Improves access for visual learners who rely on visual cues for learning
▪ Decrease distance and obtain eye contact while redirecting	→ Improves audibility, gains auditory attention
▪ Seat student near the teacher or speaker with full face-to-face view	→ Provides louder, less reverberant signal; provides advantage of visual instruction aids including visual spoken language; maintains attention and interest to task

MESSAGE

TYPICAL BARRIERS TO EFFECTIVE MESSAGING

- Message is presented too softly or from too far away from intended audience
- Message is presented with a monotonous tone
- Content of the lesson is not interesting to audience
- Overestimation of auditory attention abilities for their age and developmental levels
- Too much verbal information without supporting visual or multisensory cues

STRATEGIES

- Provide multisensory instruction including increased use of visuals → Supplements verbal instruction with multiple learning modalities
- Assign peer note-taker or utilize automated note taking → Supplements verbal instruction with lecture notes
- Use **SPEECH** for a consistent instructional format → Provides a mnemonic device for highlighting strategies dealing with attention, memory, receptive language, and listening deficits

S = state the topic to be discussed
P = pace your conversation at a moderate speed with occasional pauses to permit comprehension
E = enunciate clearly, without exaggerated lip movements
E = enthusiastically communicate, using body language and natural gestures
CH = check comprehension before changing topics

LISTENER

TYPICAL BARRIERS TO EFFECTIVE LISTENING

- Possible hearing loss (fluid from recent cold; undiagnosed permanent loss)
- Boredom because work is too easy
- Overwhelmed because the work is too hard
- Basic needs overriding instruction (hungry, tired, worried, or not feeling well)
- Too much sitting and needs to move around
- Limited school experience or limited experience listening in groups
- Multilingual learner factors
- Medication side effects

STRATEGIES

- Cue students to "look and listen" → Improves students' comprehension by watching person who is speaking
- Check students' comprehension of verbal information by asking open-ended questions → Determines students' level of understanding information; identifies information that needs to be restated; verifies when students are ready to move into new material
- Obtain student's attention through visual, auditory, or tactile cues as appropriate → Prepares student for listening
- Monitor student for fatigue and length of attending time, providing breaks when necessary → Permits student to have "downtime" and then redirects attention

AUDITORY PROCESSING DEFICITS: FREQUENTLY ASKED QUESTIONS

WHAT IS CENTRAL AUDITORY PROCESSING?

Simply stated, auditory processing can be defined as "what the brain does with what the ears hear" (Katz, 2007). Terms that refer to these deficits can include: central auditory processing disorder (CAPD), auditory processing disorder (APD) or even (central) auditory processing disorder (C)APD. These terms are all correct and are all used to mean the same thing.

Auditory processing deficits (APDs) reflect brain-based functions that require the individual to recognize, understand and use the sounds coming in through the individual's hearing mechanisms. Having an auditory processing disorder or deficit is not the same as having a hearing loss.

Hearing is a process that consists not only of the ability to detect sound, but also the ability to extract meaningful information from that sound. Hearing allows individuals to make sense of the multiple sounds in the world, determine which sounds are important for that moment in time, and even recognize familiar and unique sounds as they occur.

Individuals experiencing difficulties with auditory processing are able to hear the incoming signal yet may struggle to decipher the incoming message. Students demonstrating apparent auditory processing deficits (APD) often behave in a similar manner to children with hearing loss, even though audiometric testing indicates hearing within the normal range.

WHAT ARE THE "LOOK FORS" FOR APD?

There are many different auditory processing skills and these often impact functional behaviors. Auditory processing deficits are very individual and can look different from person to person and in different environments. Some common behaviors associated with APD are:

- Says 'huh' or 'what' frequently
- Needs more repetition of information than typical
- Difficulty remembering auditory information
- Mishears words (such as cat for cap, or sell for self)
- Reading, spelling, learning difficulties
- Distractible, particularly in noisy situations
- Slow response to auditory information
- Difficulty following auditory directions/better with visual
- Doesn't always understand sarcasm or humor

Auditory processing deficits and other disorders can look similar. Differential diagnosis is important!

Students with auditory and listening difficulties present with a wide range of behaviors of varying severity. Many of these challenges are also seen in other disorders. Student support teams should include an audiologist early in the problem-solving process to help determine whether auditory processing deficits are a primary cause of learning or behavioral issues. Other disorders which can look like APD include:

- Attentional disorders such as ADHD
- Language disorders
- Autism or other neurodevelopmental disorders

- Learning disabilities
- Anxiety, depression or other mental health issues

WHAT CAUSES AUDITORY PROCESSING DEFICITS/DISORDERS?

Ongoing research has helped professionals better understand the roots of brain-based learning problems. However, there is still much to learn and many factors that cause listening problems are still unknown. A partial list of possible causes includes:

- A history of frequent or chronic early ear infections
- A genetic history, often called inherited factors, of developmental, reading or learning difficulties in the extended family
- Traumatic brain injury or other neurological impairment
- Some medications, particularly those used in chemotherapy

HOW IS AN AUDITORY PROCESSING DISORDER DIAGNOSED?

An audiologist, with expertise in auditory processing, is the professional responsible for diagnosing auditory processing deficits. However, auditory processing evaluations need to include additional assessments from other professionals. Listening and understanding requires language skills, cognitive (thinking) skills, processing speed and even memory skills so it is important that the evaluation looks at the 'whole' child and considers the multiple factors that can impact the processing of sound. In the educational system, this is called an *interdisciplinary* approach and is part of the special education evaluation process. Parents are critical participants in the evaluation process and can offer information that is vital to an accurate assessment of a child's strengths and needs. Speech-language pathologists, psychologists, and teachers may all have a valuable role in the diagnosis process.

WILL MY CHILD ALWAYS HAVE APD?

APD is considered to be a lifelong disorder, however, the behaviors or symptoms of auditory processing can improve as the child's neurological system matures, and/or with appropriate interventions.

WHAT THERAPIES ARE HELPFUL FOR APD? ARE HEARING AIDS THE ANSWER?

The type of therapy that will help improve auditory processing skills will be determined by the specific skill weaknesses/deficits identified in the evaluation. There is no "one-size fits all" method to intervention and it's important that the therapy be geared towards the child's profile.

The use of hearing aids in the treatment of APD is still relatively new and controversial among audiologists. Hearing aids are one way to amplify and modify incoming sound. School audiologists have access to other hearing assistive technologies such as personal or classroom remote microphone (RM) systems. Like all technology, hearing aids and amplification devices are changing and improving rapidly as global technology advances. Research is currently underway to help determine the effectiveness of hearing aids in supporting better listening for people with APD.

DO MEDICATIONS HELP APD?

At the current time, there are no medications which have been proven improve the 'symptoms' of APD.

AUDITORY PROCESSING ASSESSMENT: REFERRAL CONSIDERATION FORM

Student's Name:	Date of Birth (Age): ( )
Name, role, and contact info of person completing this form:	Today's date:
Current School/Grade:	Teacher/Case Manager's Name:
Parent/Guardian Name(s):	
Preferred method of contact (email/text/phone):	
Who **specifically** is requesting an auditory processing evaluation (i.e. parent, IEP team, SLP)?	
Please state specific reason for referral and summarize concerns:	
It is **strongly recommended that preliminary data be collected on auditory abilities** of student. **Please attach screening or other documentation** that suggests APD as a concern. *(Example Questionnaires, screenings, etc: CHAPS, Listening Inventory, Fishers, APDQ, etc)*	

STUDENT REFERRAL CONSIDERATIONS

Has this student passed a hearing screening within the past year?	☐ Yes ☐ No
Is English the student's primary language?	☐ Yes ☐ No, specify primary:
Current concerns: ☐ academic ☐ speech/language ☐ motor ☐ social/emotional ☐ processing speed	
Is an IEP or 504 in place? ☐ Yes ☐ No	
Is speech intelligible to an unfamiliar listener? ☐ Yes ☐ No	
Are student's cognitive abilities suspected within average range? ☐ Yes ☐ No, describe:	
Has Parent signed consent for evaluation? ☐ Yes ☐ No	
If you answered NO to any of the questions above, please explain answer:	

ADHD/ADD STATUS

☐ Diagnosed	☐ Not diagnosed or suspected	☐ Suspected but not diagnosed	☐ Previously assessed, not diagnosed

If applicable: Date of diagnosis:	Type: ☐ Inattentive ☐ Hyperactive
By whom:	
Current medications if any:	

MULTIDISCIPLINARY ASSESSMENT DATA (within the past 3 years)						
Please attach all data to this referral or indicate where to obtain (IEP database, etc.)						
Speech-Language	☐	Completed	☐	In process	☐	Other, describe:
Cognitive	☐	Completed	☐	In process	☐	Other, describe:
Academic	☐	Completed	☐	In process	☐	Other, describe:
Health	☐	Completed	☐	In process	☐	Other, describe:
Other/Motor/Sensory	☐	Completed	☐	In process	☐	Other, describe:
Social/Emotional	☐	Completed	☐	In process	☐	Other, describe:
Outside assessment	☐	Completed	☐	In process	☐	N/A

Does the student have **other health concerns/conditions or diagnoses** including history of ear infections, autism/neurodiverse, neurological, trauma/TBI, serious illness, prematurity (please list):

Please list any special education, 504, RtI, or MTSS **services** the student currently receives including **primary and any secondary disabilities**. *Please share a current copy of the student's plan or indicate whether it is available online.*

ANYTHING ELSE WE SHOULD KNOW?

Instructions on who and how to submit this form:

AUDITORY PROCESSING CASE HISTORY FORM

Child's Name:	Date of Birth:
Person completing this form:	Today's date:
Relationship to child:	
Parent/Guardian Name(s):	
Preferred method of contact (email/text/phone):	
Current School/Grade:	Teacher's Name:
Other schools attended:	
Primarily language spoken at home:	Other languages child knows:
What percentage of time is English spoken at home?	

PREGNANCY/BIRTH HISTORY

Was child born prematurely? ☐ Yes ☐ No How many weeks?

Child's birth weight? lbs oz

Did the mother experience any unusual illnesses, accidents or drug exposure during this pregnancy (e.g., Measles, Rh Incompatibility, toxemia, alcohol, prescription drugs, illegal drugs, etc.)? If yes, explain: ☐ Yes ☐ No

Unusual conditions or concerns at birth or first 6 months?

DEVELOPMENTAL HISTORY

Any developmental difficulties or delays?

Indicate the approximate age at which your child reached the following milestones:

_____ Babble	_____ Say first words	_____ Sit
_____ Imitate Sounds (or attempt to)	_____ Name objects correctly (foods, toys, pets)	_____ Crawl
_____ Use gestures to communicate	_____ Put two and three words together (e.g., "me go")	_____ Walk
_____ Vocalize to make needs/wants known	_____ Use complete sentences	

Did your child's babbling or speech development ever appear to stop? If yes, describe: ☐ Yes ☐ No

Is child talkative now? Describe:

MEDICAL HISTORY

Present state of health (describe any problems, concerns):

Current Medications:

Check all that apply:

- ☐ Head Trauma
- ☐ Encephalitis
- ☐ Meningitis
- ☐ Noise Sensitivity
- ☐ Ototoxic medication exposure (includes chemotherapy or diuretics)
- ☐ Perinatal Cytomegalovirus (CMV)
- ☐ Repeated Sinus Infections
- ☐ Repeated Ear Infections
- ☐ Family history of hearing loss (including extended family)
- ☐ Allergies
- ☐ Drug use
- ☐ Other medical/genetic diagnosis

Provide more details for any checked above:

For repeat ear infection, please answer the following:

Age at first ear infection? When was the most recent ear infection?

Tubes? Dates? How many times?

Other ear surgeries? Describe type and date:

Describe your child's balance and level of coordination? Does your child fall or lose balance easily?

List any other illnesses, hospitalizations, injuries, or specific medical problems with dates:

EVALUATION HISTORY

Has your child had any prior testing or testing outside the school evaluations? Please include all assessments (speech/language, reading, occupational or physical therapy, hearing, vision, psychological evaluation, neurological evaluation? Please attach or submit copies if possible.

Testing	*Date*	*Completed by*	*Results*

THERAPY/INTERVENTION HISTORY

Is your child currently receiving therapy/intervention/tutoring services? ☐ Yes ☐ No

Has your child received any therapy/intervention/tutoring previously? ☐ Yes ☐ No

If yes, please list dates, provider, and pertinent details:

COMMUNICATION SKILLS
(speech, language, hearing and listening skills)

Estimate the percentage of time you understand your child's speech: <40% 40% 60% 80% 100%

Describe concerns as specifically as possible, i.e. when was the problem first noticed and by whom?

What approaches have been tried to address your child's difficulties?

Does your child?

Associate meaning with what s/he hears?	☐ Yes	☐ No
Understand, remember, and follow verbal/auditory directions, questions? If not, how does child respond?	☐ Yes	☐ No
Exhibit frustration or anxiety concerning his/her communication skills?	☐ Yes	☐ No
Have trouble "finding the word" to express what s/he wants to say?	☐ Yes	☐ No
Enjoy reading? Does s/he read for pleasure?	☐ Yes	☐ No
Comprehend what s/he reads?	☐ Yes	☐ No

If yes to any, please describe:

How much do you read to your child?

Describe your child's:

Memory (Is your child better at remembering things s/he sees or hears?):

Understanding versus ability to express him/herself.

Ability to express him/herself (include difficulty and/or ease).

EDUCATIONAL HISTORY

Does your child have an…? ☐ IEP ☐ 504 Plan

Did your child repeat a grade? ☐ Yes ☐ No Describe:

Please describe any concerns about school performance:

What academic subjects are easiest for your child?

What subjects are difficult for your child?

How are these difficulties handled by:

Your child?

You as a parent/guardian?

Teachers/school staff?

Do these difficulties create problems in other areas (social, behavioral, emotional, etc.)?

SOCIAL/HOME HISTORY

How does your child get along with siblings?

How does your child get along with peers?

Does your child have close friends?

Overall tempo of your home: Rushed? Set Routine? Quiet?

Child's reaction to change in routine?

Child's reaction to trouble?

Child's hobbies or interests?

Does your child listen to loud music? ☐ Yes ☐ No

Use earbuds or headphones? ☐ Yes ☐ No

ANYTHING ELSE WE SHOULD KNOW?

AUDITORY-FOCUSED QUESTIONNAIRES

Semi-formal assessment tools such as questionnaires and rating scales provide valuable data about student behaviors related to listening, communication, and academic achievement. These tools can assist in documenting functional auditory behaviors as a part of the screening or assessment process. They allow multiple voices to be heard, including that of the student, when appropriate, and can act as the bridge between formal and informal measures by offering both quantitative and qualitative perspectives on auditory processing concerns. The following are questionnaires that have been suggested for use in identifying individuals suspected of having auditory processing or listening difficulties. Where available, original publisher links have been provided.

AUDITORY PROCESSING DOMAINS QUESTIONNAIRE (APDQ)

O'Hara, B., & Mealings, K. (2018)

This is a 52-question checklist developed as a differential screening tool for auditory processing disorder. It is to be completed by parents and/or teachers to review and rate observations of students aged 7 to 17 years in everyday listening skills. Three scales are presented that rate competent performance in hearing-auditory processing (AP), attention control (ATT), and cognitive-language skills (LD-NOS). It takes approximately 15 to 20 minutes to complete.

CHILDREN'S AUDITORY PERFORMANCE SCALE (CHAPS)

Smoski, W. J., PhD, Brunt, M. A., PhD, & Tanahil, J. C., PhD (1998)

This checklist is used by educators and parents to assess auditory performance in children. Six listening conditions are assessed in this 36-item checklist, including noise, quiet, ideal, multiple inputs, auditory memory/sequencing, and auditory attention span. The observation assessment is done by comparing the student to a reference population of other children of similar age and background. Items are rated on a scale from +1 (less difficulty) to -5 (cannot function at all). This instrument can be used as a pre- and post-treatment evaluation.

EVALUATION OF CHILDREN'S LISTENING AND PROCESSING SKILLS (ECLIPS)

Barry J. G., & Moore D. R. (2014)

The ECLiPS is a 37-item questionnaire used to evaluate a wide range of listening difficulties in children. It was developed based on research regarding the nature of listening difficulties and the relationship to disorders of language, literacy, and social communication. The questionnaire looks at five factors: (1) Speech and Auditory Processing (SAP), (2) Environmental & Auditory Sensitivity (EAS), (3) Language/Literacy/Laterality (L/L/L), (4) Memory & Attention (M&A), and (5) Pragmatic & Social Skills (PSS).

FISHER'S AUDITORY PROBLEMS CHECKLIST

Fisher, L. I. (1985)

This checklist is used by educators and other school support personnel to assist in identifying behaviors that characterize children as at risk for APD. It includes many components of auditory processing, including attention, auditory-visual integration, comprehension, figure-ground, and memory. A score is derived by multiplying by four each item not identified on this 25-item checklist. Normative data are available for kindergarten through sixth grade.

LISTENING INVENTORY FOR EDUCATION (LIFE-R)

Anderson, K., Smaldino, J., Spangler, C. (Revision 2023)

These checklists were designed for use with elementary and secondary students to help identify challenges to school listening situations and the student's self-advocacy skills. Both student and teacher forms are available and multiple versions exist for different ages. The Teacher Appraisal Form can be used as part of evaluating the use of hearing assistive technology.

SCALE OF AUDITORY BEHAVIORS (SAB)

Schow, R.L., Seikel, J.A., Brockett, J.E., & Whitaker,M. (2018)

This is a 12-item questionnaire that is included in the MAPA-2 battery of APD assessments. It can be completed by parents, teachers, or other significant adults. Ratings of 1 (frequent) to 5 (never) are given for a variety of common challenges of individuals with APD. It is designed to provide a functional check on the assessment domains of the test battery.

SCREENING INSTRUMENT FOR TARGETING EDUCATIONAL RISK (SIFTER)

Anderson, K. (1989)

These checklists screen the functional performance of students in the educational setting who are suspected of having hearing difficulties. They were originally designed for screening students with hearing loss but can be useful to gather functional data for suspected listening or auditory processing difficulties as well. Three versions of the SIFTER are available:

- Preschool SIFTER: screens for pre-academics, attention, communication, class participation and school behavior
- SIFTER: the original elementary school-aged screening tool designed to help determine whether hearing problems are impacting a child's classroom performance. Covers six areas: academics, attention, hearing, communication, emotional well-being, social interactions and class participation
- Secondary SIFTER: questions specifically designed for secondary students

THE LISTENING INVENTORY

Geffner, D., & Ross- Swain, D. (2006). Academic Therapy Publications

This is an informal behavior observation completed by parents and teachers. It can be used as a starting point to determine the need for further testing and as a discussion tool. It consists of 103 statements (0 to 5-point scale) to assess specific behaviors that can be associated with auditory processing weaknesses. It is divided into six areas: Linguistic Organization, Decoding/Language Mechanics, Attention/Organization, Sensory/Motor, Social/Behavioral, and Auditory Processes. Index scores are used and compared to criterion-based cut-off scores.

UNIVERSITY OF CINCINNATI AUDITORY PROCESSING INVENTORY FOR ADOLESCENTS AND ADULTS (UCAPI)

Keith R.W., Tektas, M., Ramsay, K., Delaney, S. (2020)

This 34-item questionnaire investigates the listening abilities in six skill areas: listening and concentration, understanding speech, following spoken instructions, attention, educational assistance, and other. It is designed to be filled out by the individual with suspected or diagnosed APD to document perceived challenges and may also be used to monitor effectiveness of interventions. Scores are obtained for each subset and can be used in making recommendations and treatment decisions.

AUDITORY PROCESSING ASSESSMENT RESOURCES

AUDITEC, INC

Auditec has produced quality recordings for the audiology community since 1972. In addition to individual test recordings pioneered by Dr. Frank Musiek, such as the dichotic digits and pitch patterns tests, Auditec also offers the MAPA-2 and the SCAN-3. Descriptions of each of the tests can be found on their website. Auditec also has APD assessments in a variety of languages including quite an extensive Spanish APD category. They also carry the Auditory Continuous Performance Test (ACPT) recording (out of print by publisher) which is a screening for auditory attention deficits. Many Auditec APD assessments are also available for purchase on the Oaktree Products website.

AUDITORY SKILLS ASSESSMENT (ASA): PEARSON ASSESSMENTS

The ASA is a screening tool of linguistic and nonlinguistic auditory skills designed to help identify young children who may be at risk for auditory skill or early literacy skills deficits. Designed for ages 3.6 - 6.11, it has three categories of subtests: Speech Discrimination, Phonological Awareness and Nonspeech Processing. The ASA assesses the child's abilities to discriminate words in noise, repeat nonsense words accurately, perform early phonological awareness tasks such as blending syllables and phonemes and recognizing rhymes, and discrimination between the sequence of nonverbal (musical) sounds. It yields a single age-based cut-off score.

BKB-SIN SPEECH-IN-NOISE TEST: ETYMOTIC

The BKB-SIN, developed by Etymotic Research, is a speech-in-noise test that uses Bamford-Kowal-Bench sentences and 4-talker babble to quickly estimate a speech-in-noise "loss" for children and adults. It is quick and easy to administer and score and includes age-related norms. SNR Loss is considered to be the increased signal-to-noise ratio required by a listener to understand speech in noise, compared to typical performance. Norms are available for ages 5 and up. The BKB-SIN is also available at Oaktree Products and various other audiology suppliers.

CENTRAL TEST BATTERY (KATZ): PRECISION ACOUSTICS, INC.

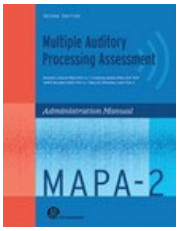
Also known as the Buffalo Battery, the subtests of the Central Test Battery include very well-known and widely used tests such as the Staggered Spondaic Words (SSW) and Speech-in-Noise with W-22 word lists. It also includes the Phonemic Synthesis (PS) test, referred to as a test of phonemic decoding, which assesses discrimination and blending of individual speech sounds. Developed by Dr. Jack Katz several decades ago, the SSW and other tests in this battery remains popular, especially with those who use the Buffalo Model of APD. Tests are designed for ages 5 through 59. The Central Test Battery is also available from Oaktree Products.

DIFFERENTIAL SCREENING TEST FOR PROCESSING (DSTP): PRO-ED

The DSTP is a screening instrument designed to differentiate among the various levels of auditory and language processing and identifies areas for referral or further evaluation. It can assist professionals in determining if additional diagnostic assessment is warranted and the specific areas of focus for further testing. The subtest areas of the DSTP represent a continuum of processing acoustic stimuli. Critical skills are evaluated in three major levels: acoustic, acoustic-linguistic, and linguistic. A major benefit of the DSTP is ease of administration and that it may be used for children as young as 6 years.

FEATHER SQUADRON: ACOUSTIC PIONEER

Feather Squadron is an iPad app designed to measure a range of auditory processing abilities. It was designed for children (from age 5 years) but is also normed and can be used for adults. An extended screening tool for a speech language pathologist (SLP) or psychologist to use is available. An audiologist is required to administer the full diagnostic evaluation which takes about 30 minutes. Results of the assessment are automatically sent to a profile on the website where a professional report including recommendations can be viewed and downloaded. The test is automated based on student age, adaptive based on student performance, and includes up to 10 subtests that assess lateralization, temporal processing, dichotic listening, speech-in-noise, and degraded speech (time compressed) as well as auditory memory.

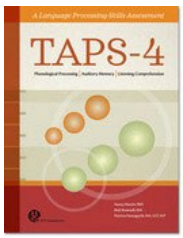


MULTIPLE AUDITORY PROCESSING ASSESSMENT (MAPA-2): ACADEMIC THERAPY PUBLICATIONS

The MAPA-2 is a comprehensive assessment of auditory processing and listening skills for ages 7 to 14 years. It may be used as a screener to be followed by other behavioral or physiological tests, or it may be used for a preliminary diagnosis in the auditory area. The test is administered via CD and can be used in a clinical setting or a sound booth. The MAPA-2 includes eight different subtests in three domains (monaural, temporal, and binaural) along with the Scale of Auditory Behaviors (SAB), a 12-item parent- or teacher-completed questionnaire of listening behaviors. The MAPA-2 is also available from Therapro and Auditec.

SCAN-3: C/A (CHILDREN/ADOLESCENTS AND ADULTS): PEARSON ASSESSMENTS

The SCAN-3 is a widely used battery of screening and diagnostic subtests offered in a version for children (5 to 12 years) and an adolescent/adult version (13+ years). The tests are offered on a CD and can be administered in a sound booth or with a portable audio device and headphones. Subtests include temporal (gap detection), binaural (dichotic), and speech (figure-ground, closure) processing tests, and the diagnostic tests offer standardized scores and percentile ranks. The SCAN-3 is also available from Auditec.



TAPS-4: A TEST OF LANGUAGE PROCESSING SKILLS: ACADEMIC THERAPY PUBLICATIONS

The TAPS-4 assesses skills through 11 subtests across three index areas: phonological processing, auditory memory, and listening comprehension and covers an age range from 5 to 21 years of age. TAPS-4 includes audio administration for improved standardization and accuracy, and it is also available via the ATPOnline assessment platform for automated administration and scoring. Subtests include: Word Discrimination, Phonological Blending, Phonological Deletion, Number Memory Forward,

Word Memory, Sentence Memory, Processing Oral Directions, and Auditory Comprehension, along with supplemental subtests for each index area. The TAPS-3 (Test of Auditory Processing Skills) is appropriate for ages 4 to 18 years and is available in a Spanish-Bilingual Edition (SBE). The TAPS-3, TAPS-3 (SBE), and TAPS-4 are available from multiple sources online.

SOUNDSCOUTS: APD SUITE

SoundScouts is the creator and distributor of the LiSN-S (Listening in Spatialized Noise - Sentences Test) as well as a handful of newly developed APD assessments. The LiSN-S is an adaptive, three-dimensional, speech test that measures speech perception ability in noisy environments. Importantly, it also measures the ability of individuals to use the spatial cues that normally help differentiate a target talker from distracting speech sounds. An inability to use spatial cues (spatial processing disorder) has been found to be a leading cause of difficulty understanding speech in noisy environments, such as the classroom. SoundScouts' APD assessment suite was developed by Drs. Sharon Cameron and Harvey Dillon and aims to use a differential testing method approach to differentiate the effects of language and cognition from auditory processing. Assessments are designed for those ages 6 to 60.

DISCLAIMER: The identification of any products of private vendors in these Guidelines is only for the purpose of providing examples and does not constitute the Department's endorsement of such products.

APD PROTOCOL

INFORMAL

SEMI-FORMAL

FORMAL APD TEST BY DOMAIN

BINAURAL

TEMPORAL

SPEECH

SUPPLEMENTAL

AUDITORY PROCESSING ASSESSMENT PROFILE

NAME: _____ **DOB:** _____ **AGE:** _____ **DATE:** _____

Auditory Acuity: ☐ Normal ☐ See audiogram **Acoustic Reflexes:** ☐ Normal ☐ Abnormal **OAEs:** ☐ Normal ☐ Abnormal

	Below Average					***Average***									***Above Average***				
Standard Deviation	–3			-2		-1			0			+1			+2				+3
Standard Score	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	55		70			85			100			115			130			145	
Percentile Rank	>2%		2%			16%		25%	50%		75%		84%		98%			<98%	
ACOUSTIC:																			
LINGUISTIC:																			
COGNITIVE:																			
SOCIAL/EMOTIONAL:																			
EDUCATIONAL:																			

OBSERVATIONS/COMMENTS:

AUDITORY PROCESSING ASSESSMENT PROFILE

NAME: Dezi Bell **DOB:** 01-01-2016 **AGE:** 9 **DATE:** Today

Auditory Acuity: ☑ Normal ☐ See audiogram **Acoustic Reflexes:** ☑ Normal ☐ Abnormal **OAEs:** ☑ Normal ☐ Abnormal

	Below Average					Average									Above Average				
Standard Deviation	-3			-2			-1			0			+1			+2			+3
Standard Score	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	55		70			85				100			115		130			145	
Percentile Rank	>2%		2%			16%		25%		50%		75%		84%	98%			<98%	
ACOUSTIC:																			
BIN-MAPA Dichotic Digits										✓									
BIN-FS Dichotic Sounds										✓									
BIN-FS Dichotic Words								✓											
T-MAPA Tap Test						✓													
T-MAPA Pitch Pattern					✓														
T-MAPA Gap Detection	✓																		
T-FS Tonal Pattern Temp Proc	✓																		
SP-FS Rapid Speech												✓							
SP-FS Speech in Noise										✓									
SP MAPA MSAAT										✓									
FS Word Memory										✓									
LINGUISTIC:																			
CTOPP Phonological Awareness					✓														
CTOPP Phonological Memory								✓											
CTOPP Rapid Symbolic Naming				✓															
CELF Expressive											✓								
CELF Receptive								✓											
COGNITIVE:																			
Conners 4 ADHD Index	✓																		
WISC Verbal Comprehension											✓								
WISC Processing Speed												✓							
SOCIAL/EMOTIONAL:																			
No concerns/data																			
EDUCATIONAL:																			
Word Identification/Spelling (WIST)			✓																
Gray Oral Reading (GORT-5)					✓														
KeyMath Diagnostic Assmt											✓								

OBSERVATIONS/COMMENTS:

Student has diagnosis of ADHD and Dyslexia

APD DEFICIT SPECIFIC INTERVENTIONS

COMPUTER BASED AUDITORY SKILLS

- ☐ Acoustic Pioneer: Zoo Caper Sky Scraper
- ☐ Acoustic Pioneer: Insane Airplane
- ☐ Acoustic Pioneer: Elephant Memory Training
- ☐ Brain Train
- ☐ CAPDOTS
- ☐ Fast ForWord
- ☐ HearBuilders
- ☐ Sound Storm
- ☐ LACE
- ☐ BrainHQ

COMPENSATORY SKILLS

- ☐ Active listening
- ☐ Self-advocacy
- ☐ Organization
- ☐ Visualization
- ☐ Repair of communication breakdown
- ☐ Subvocalization
- ☐ Chunking
- ☐ Use of note-taker (peer or automated)

INSTRUCTIONAL ACCOMODATIONS

- ☐ Cue student to look and listen
- ☐ Check for understanding
- ☐ Use visuals to support auditory information
- ☐ Multisensory instruction
- ☐ Decrease distance from student
- ☐ Obtain student attention prior to engaging
- ☐ Monitor listening fatigue & provide listening breaks
- ☐ Assign peer partners
- ☐ Mark transitions between activities
- ☐ Repeat information
- ☐ Rephrase information
- ☐ Reduce multisensory interaction
- ☐ Allow wait time
- ☐ Identify key words and summarize key points frequently
- ☐ Avoid divided attention
- ☐ Give adequate response time
- ☐ Encourage self-advocacy

SPEECH-LANGUAGE & LITERACY SKILLS

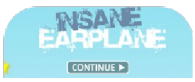
- ☐ Phonemic & phonological awareness training
- ☐ Vocabulary building
- ☐ Listening comprehension
- ☐ Active listening
- ☐ Auditory closure
- ☐ Auditory discrimination
- ☐ Speech reading
- ☐ Following directions
- ☐ Key word identification
- ☐ Answering questions
- ☐ Asking questions
- ☐ Auditory memory
- ☐ Sequencing activities
- ☐ Story recall
- ☐ Identifying semantic absurdities
- ☐ Inferencing from stories
- ☐ Recalling details
- ☐ Multiple meaning words
- ☐ Identifying heteronyms
- ☐ Role playing/charades
- ☐ Phoneme sequencing and sound blending
- ☐ Pattern identification
- ☐ Speech in noise training
- ☐ Speech in noise training - directed ear
- ☐ Sound localization training
- ☐ Dichotic listening training
- ☐ Music training
- ☐ Noise desensitization training

ENVIRONMENTAL & HAT ACCOMODATIONS

- ☐ Strategic, flexible seating
- ☐ Quiet study area
- ☐ Use of earmuffs
- ☐ Assign peer note-taker or provide teacher notes
- ☐ Remote microphone hearing assistive technology
- ☐ Improve room acoustics
- ☐ Reduce background noise
- ☐ Record lessons
- ☐ Use captioning
- ☐ Low gain personal hearing aids

COMPUTER-BASED AUDITORY TRAINING PROGRAMS

Computer and app-based auditory training programs offer many advantages and are growing in number and popularity. They are convenient, motivating to children and youth, offer adaptive play based on real-time performance, and feature control of the auditory stimulus in a way that regular therapy cannot. A variety of listening games exist that target varied and specific auditory deficit(s). Most require a tablet or computer, and headphones, and use a login account to track student progress. Efficacy studies have shown that children participating in auditory therapies made gains in both language and reading. Below is a list of available programs. School providers are encouraged to review the research associated with each and to talk with their school colleagues to choose the best currently available application that meets their students' needs and school district standards.

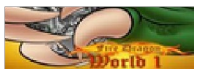


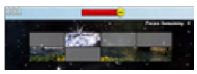
ACOUSTIC PIONEER

In addition to their diagnostic auditory processing assessment platform, Feather Squadron, Acoustic Pioneer has three downloadable apps designed to incrementally improve dichotic listening skills (competing information in both ears) as well as a variety of tonal listening, memory and processing skills. The auditory training games use specific training protocols that are outlined on their website.

BRAINHQ

Brain HQ is a comprehensive on-line brain training program from Posit Science. Exercises cover six areas that include attention, brain speed, auditory and visual processing, and memory. Participants can choose a focus area, such as auditory skills. Training is geared for older adolescents and adults. Michael Merzenich, also known for FastForWord (FFW), led the scientific team that developed this program. (For younger users, see FFW).





BRAINTRAIN CAPTAIN'S LOG MINDPOWER BUILDER - SCHOOL EDITION

BrainTrain Captain's Log MindPower Builder is an online program designed to address a wide range of cognitive skills, including auditory working memory, attention, executive function skills including response inhibition, and visuospatial skills, among others. It is based on the principles of neurofeedback.

CAPDOTS

CAPDOTS by The Listening Academy, Inc. is an online auditory training program that focuses on dichotic training. CAPDOTS Integrated emphasizes exercises to improve binaural integration deficits. For these tasks, varied information presented to each ear must be interpreted and repeated. CAPDOTS Selected incorporates exercises to improve binaural separation skills that require interpreting information presented to one ear while disregarding auditory input into the opposite ear. Training can be started in children as young as 5 years of age.

FAST FORWORD

Fast ForWord (FFW) is one of several online training tools by Carnegie Learning. It is a well-established software program based on the underlying temporal processing research of Tallal et al. (1996) and Merzenich et al. (1996). The FFW program is designed to develop temporal and acoustic skills to detect rapid transitions of speech and support literacy development. The initial two levels specifically address auditory processing skills. Later levels integrate the auditory processing skills from early levels into reading and literacy/language skills. Its games are designed to build processing, cognitive, memory, and sequencing in 40 to 60 hours of use, however individual growth may vary. Training can be started at approximately age 5 years.

HEARBUILDER

HearBuilder incorporates multilevel activities centered on specific auditory language objectives for following directions, phonological awareness, auditory memory, and sequencing. Tasks increase in complexity from visual and auditory to auditory alone. The program is appropriate for pre-K through fifth grade and is designed to address foundational literacy skills.

LISTENING AND COMMUNICATION ENHANCEMENT

Listening and Communication Enhancement, known widely as LACE, is an auditory training program produced by Neurotone, and was designed for older teens and adults (8th Grade and up). It is not appropriate for younger children. The program has four modules: Speech-In-Noise, Rapid Speech, Competing Voice and Auditory Working Memory.

SOUND STORM

Sound Storm, formerly LiSN & Learn Auditory Training, was developed by National Acoustic Labs in Australia and is currently owned and operated by Sound Storm CAPD Pty Limited. It is an app-based program specifically designed to remediate spatial sound disorders in children ages 6-12. An interactive, three-dimensional auditory environment is produced under headphones where speech is spatially separated in noise. The tasks are presented in a game-like format where the child identifies a target word from a sentence.

DISCLAIMER: The identification of any products of private vendors in these Guidelines is only for the purpose of providing examples and does not constitute the Department's endorsement of such products.

GLOSSARY OF TERMS

AAA: American Academy of Audiology, www.audiology.org

ASHA: American Speech-Language-Hearing Association, www.asha.org

EAA: Educational Audiology Association, www.edaud.org

504 PLAN: Section 504 is a civil rights law and is designed to protect individuals with disabilities from discrimination; a 504 Plan ensures equal access to an education for children with disabilities

ACCOMODATIONS: changes made to the environment, instruction or materials to support access to the curriculum and which do not alter the learning content or outcome expectations of the curriculum

ACOUSTIC: relating to sound or the sense of hearing

APHASIA: an injury to the brain that causes an impairment of language; can affect the production or comprehension of speech or the ability to read and write

ASSESSMENT: the process of evaluating skills and abilities; generally, an in-depth process

AUDITORY DISCRIMINATION: the ability to hear and distinguish one sound from another; for example, hearing the difference between the sounds in the words such as:
'cap' vs. 'cat' vs. 'hat'

AUDITORY FIGURE-GROUND: the ability to pick out or hear specific sounds from a noisy background; for example, listening to the teacher in a noisy classroom or hallway is using auditory figure-ground skills

AUDITORY CLOSURE: the ability to complete or fill-in missing sounds from a word or phrase

BINAURAL: pertaining to both ears

BINAURAL INTEGRATION: the ability to process and combine different auditory information presented that is presented simultaneously in both ears, essentially combining and processing simultaneous information from both ears even though the input to each ear is different

BINAURAL INTERACTION: when both ears work together or combine to make hearing more effective

BINAURAL SEPARATION: the ability to process auditory input in one ear while ignoring auditory information presented to the other ear; an easy example of this is listening to the teacher in a noisy classroom - the individual can listen to the teacher and ignore the

general noise in the room; essentially, focusing on the input in one ear while ignoring the simultaneous input to the other ear

BODY OF EVIDENCE: a collection of information about a student's academic performance which, when complete, documents the student's current level of achievement

BOTTOM-UP PROCESSING: is a sensory process of using real-time data to perceive and/or interpret information

CENTRAL AUDITORY PROCESSING: also seen in the literature as (central) auditory processing or auditory processing; the perceptual processing of auditory information in the central auditory nervous system (CANS) and the neurobiological activity that underlies that processing and gives rise to electrophysiologic auditory potentials (ASHA, practice portal)

DEGRADED SPEECH: speech that is distorted or changed in any way that makes understanding the speech more difficult; can be caused by background or environmental noise, or electronic manipulation or transmission

DICHOTIC: as it pertains to listening, is presentation of sound to one ear and a different sound to the other ear simultaneously

DYSLEXIA: a specific learning disability that is neurobiological in origin; characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities; difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction; secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge (adopted definition from the International Dyslexia Association, 2002)

DYSCALCULIA: a learning disability that impacts the ability to learn mathematics/arithmetic, specifically numbers, mathematical concepts and basic math tasks

ECEA (EXCEPTIONAL CHILDREN'S EDUCATION ACT): overarching law for special education and gifted education in Colorado

EXECUTIVE SKILLS: a set of mental skills and processes that allow a person to manage everyday tasks and behaviors, set and achieve goals, and plan and organize
HYPERACUSIS: a heightened sensitivity to sounds which others perceive as normal; it may result in reactions can be different in each individual but may include annoyance, irritation, fear, or pain

IDEA (INDIVIDUALS WITH DISABILITIES EDUCATION ACT): a US federal law that requires public schools to provide a free and appropriate public education (FAPE) to eligible students ages 3-21

IEP (INDIVIDUALIZED EDUCATION PROGRAM): a written plan customized for a student with a disability; an IEP is a legal document, governed by federal law, and outlines a student's needs, supports, services and learning goals; the IEP is developed by a team that includes school staff, the child's parents, and sometimes the student themselves; it's designed to provide tailored support for students aged 3-21 who have been evaluated and found eligible for special education services under one of the 13 disability categories defined by law (from Understood.org); please refer to external sources for a complete definition of IEP due to complex nature of the plan and regulatory requirements

INTERDISCIPLINARY: multiple disciplines integrating expertise, methods, data and perspectives to gain a comprehensive understanding of a student, his/her needs, and in developing/targeting outcomes/goals

LATERALIZATION: the ability to know where a sound has occurred in space; a perception that sound originated from one side of the head or the other

LOCALIZATION: the ability to identify the source of a sound

MISOPHONIA: a condition where common sounds result in an atypical response; triggering sounds may include typical sounds in the environment such as a person chewing, clock ticking, or the buzz of a fluorescent light; responses may include negative emotions such as fear or anger, physiological responses such as increased heart rate, or behavioral reactions

METACOGNITIVE: being aware of one's own thought processes; often described as 'thinking about thinking'

METALINGUISTIC: the conscious awareness and understanding of language; being able to use and manipulate language such as language content, grammatical elements, and language rules and functions

MODIFICATIONS: adjustments in the learning material or pace of instruction which alter the foundational curriculum; may include different content, grading criteria, or different learning materials

MULTIDISCIPLINARY: multiple, distinct disciplines working together to bring their respective, different areas of expertise together in a connected view/approach to a student, his/her needs and in setting goals/outcomes

MULTI-TIERED SYSTEM OF SYPPORTS (MTSS): in education, an integrated system of supports providing targeted supports to students based on their unique, individual needs

MYELINATION: the process in the brain of coating the nerve fibers with myelin; this helps the nerve fibers move signals faster and more efficiently

NEUROCOGNITIVE: the cognitive processes that allow people to interact with the world – to learn, reason and participate in the world; includes: attention, memory, language, processing, problem-solving, and perception

NEUROSCIENCE: the scientific study of the nervous system, includes the brain, spinal cord and peripheral nervous system; is an integrated approach from multiple disciplines such as biology, chemistry, physiology, and multiple others

OTITIS MEDIA: an inflammation or infection of the middle ear; commonly referred to as an "ear infection"

PERIPHERAL HEARING: the outer, middle, and inner ear; the parts of the ear that collect sound and translate sound into electrical signals to be processed by the brain

PHONOLOGY: the sound system of language, how sounds work in a language to create meaning

PHONEMIC: as it relates to phonemes (individual sounds); hearing, recognizing, and the ability to manipulate individual sounds

PROSODIC: the features which include intonation, rhythm, and stress in sound; does not include the phonemic aspect

PRAGMATIC: as related to language, reflects how content is related to meaning; how human language is utilized in social interactions

RECEPTIVE LANGUAGE: the ability to 'input' language; taking in and comprehending language

RESPONSE TO INTERVENTION (RtI): RtI is a tiered approach to early identification and support process for students with academic and/or behavior needs within the general education classroom; RtI is not considered to be special education services

REVERBERANT: in acoustics, the persistence of sound after it is produced; sound created by reflections from environment such as surfaces, people

SCREENING: the process of evaluating for the possible presence of something, such as possible hearing loss; this limited evaluation is generally scored on a pass/fail basis

SEMANTIC: in language, the study of linguistic meaning

SPATIAL PROCESSING DISORDER: difficulty hearing well in background noise due to the inability to process sounds coming from different directions

SPECIALLY DESIGNED INSTRUCTION: instruction designed especially to meet the needs of a student; this can be adaptations in what is being taught, how it is being taught or the delivery method for the student

TEMPORAL: the way our hearing system processes sounds across time, includes rhythm, timing and processing of sounds across time; temporal processing is important and is used in listening to speech, music and everyday sounds

TEMPORAL RESOLUTION: the hearing system's ability to be aware of, and process, rapid sounds across time; it is much like a camera, the better the resolution, the better temporal processing of sounds; temporal resolution helps in understanding speech in the presence of background noise

TINNITUS: Perceived sounds heard in the ears in the absence of external sounds; often described as ringing, buzzing, roaring, or whooshing sounds in the ears

TRANSDISCIPLINARY: a collective approach that draws connections and integrates information from multiple professionals (disciplines) to achieve a more complex, holistic understanding of the student and their strengths and needs

UNIVERSAL STRATEGIES: instructional methods and strategies designed to support all learners in the classroom and educational setting

VISUAL-SPATIAL: the ability to perceive, analyze, and manipulate visual information in relation to experience and the environment

REFERENCES

Ahmmed, A. U., & Ahmmed, A. A. (2016). Setting appropriate pass or fail cut-off criteria for tests to reflect real life listening difficulties in children with suspected auditory processing disorder. *International journal of pediatric otorhinolaryngology*, 84, 166–173. https://doi.org/10.1016/j.ijporl.2016.03.014.

American Academy of Audiology. (2010). *Guidelines for the diagnosis, treatment, and management of children and adults with central auditory processing disorder.* https://audiologyweb.s3.amazonaws.com/migrated/CAPD%20Guidelines%2082010.pdf_539952af956c79.73897613.pdf.

American Speech-Language-Hearing Association. (n.d.). *Central auditory processing disorder [Practice portal]*. https://www.asha.org/Practice-Portal/Clinical-Topics/Central-AuditoryProcessing-Disorder/.

American Speech-Language-Hearing Association (ASHA). (2005a). *(Central) auditory processing disorders.* Available at www.asha.org.

American Speech-Language-Hearing Association (ASHA). (2005b). *(Central) auditory processing disorders–the role of the audiologist* [Position statement]. Available at www.asha.org.

Bellis, T. J. (2003). Assessment and management of central auditory processing disorders in the educational setting: From science to practice (2nd ed.). Clifton Park, NY: Delmar Learning.

Bellis, T. J., & Anzalone, A. M. (2008). Intervention approaches for individuals with (central) auditory processing disorder. *Contemporary Issues in Communication Science and Disorders*, 35(Fall), 143–153.

Bergemalm, P. O., & Lyxell, B. (2005). Appearances are deceptive? long-term cognitive and central auditory sequelae from closed head injury. *International Journal of Audiology*, 44(1), 39–49. https://doi.org/10.1080/14992020400022546.

Borges, L. R., Paschoal, J. R., & Colella-Santos, M. F. (2013). (Central) auditory processing: the impact of otitis media. *Clinics (Sao Paulo, Brazil)*, *68*(7), 954–959. https://doi.org/10.6061/clinics/2013(07)11.

British Society of Audiology. (2018) *Position Statement and Practice Guidance: Auditory Processing Disorder.* https://www.thebsa.org.uk/wp-content/uploads/2023/10/Position-Statement-andPractice-Guidance-APD-2018.pdf.

Burns, M. S. (2021). Cognitive and communication interventions: Neuroscience applications for speech-language pathologists. Plural Publishing Inc.

Catts, H. W., Chermak, G. D., Craig, C. P., Johnston, J. R., Keith, R. W., Musiek, F. E., … & Watson, C. S. (1996). Central auditory processing. *American Journal of Audiology*, 5(2), 41-52. https://doi.org/10.1044/1059-0889.0502.41.

CISG. *Canadian Guidelines on Auditory Processing Disorder in Children and Adults: Assessment & Intervention.* (2012). Retrieved from http://www.ooaq.qc.ca/publications/docdocuments/Canadian_Guidelines_EN.pdf.

Chermak, G. D., & Musiek, F. E. (Eds.) (2007). Handbook of (central) auditory processing disorder: Comprehensive intervention – Volume II. San Diego, CA: Plural Publishing.

Colorado Brain Injury Steering Committee (2016). The Building Blocks of Brain Development ©, Colorado Department of Education https://www.cde.state.co.us/cokidswithbraininjury/building_blocks.

Colorado Department of Education (1997, Revision 2008). Central auditory processing disorders: A team approach to screening, assessment, and intervention practices. Denver: CO. Task Force on Auditory Processing.

Colorado Department of Education (n.d.) Exceptional Student Services Office of Special Education. https://www.cde.state.co.us/cdesped.

Crandell, C. C., & Smaldino, J. J. (2000). Classroom Acoustics for Children With Normal Hearing and With Hearing Impairment. *Language, speech, and hearing services in schools,* 31(4), 362–370. https://doi.org/10.1044/0161-1461.3104.362.

Diges, I., Simón, F., & Cobo, P. (2017). Assessing Auditory Processing Deficits in Tinnitus and Hearing Impaired Patients with the Auditory Behavior Questionnaire. *Frontiers in neuroscience*, 11, 187. https://doi.org/10.3389/fnins.2017.00187.

Dillon, H., & Cameron, S. (2021). Separating the Causes of Listening Difficulties in Children. *Ear and hearing*, 42(5), 1097–1108. https://doi.org/10.1097/AUD.0000000000001069.

E.M., a minor, by and through his parents, E.M. and E.M., v. Pajaro Valley Unified School District, 12-15743 (2012). https://www.justice.gov/sites/default/files/crt/legacy/2012/08/06/empajarobrief.pdf [PDF].

Flood, G. M., Dumas, H. M., & Haley, S. M. (2005). Central auditory processing and social functioning following brain injury in children. *Brain injury*, 19(12), 1019–1026. https://doi.org/10.1080/02699050500110223.

Geffner, D. S., & Ross-Swain, D. (Eds.) (2019). Auditory processing disorders: Assessment, management and treatment. Third Edition. San Diego, CA: Plural Publishing

Geffner, D. S., & Ross-Swain, D. (Eds.) (2012). Auditory processing disorders: Assessment, management and treatment. Second Edition. San Diego, CA: Plural Publishing

Gokula, R., Sharma, M., Cupples, L., & Valderrama, J. T. (2019). Comorbidity of Auditory Processing, Attention, and Memory in Children With Word Reading Difficulties. *Frontiers in psychology*, 10, 2383. https://doi.org/10.3389/fpsyg.2019.02383.

Loo, J. H., Bamiou, D. E., Campbell, N., & Luxon, L. M. (2010). Computer-based auditory training (CBAT): benefits for children with language- and reading-related learning difficulties. *Developmental medicine and child neurology*, 52(8), 708–717. https://doi.org/10.1111/j.14698749.2010.03654.x.

Jain, S., Kothari, S., V.S., Rohith, Kumar, H.S., & Jain, C. (2024) The relationship between auditory and cognitive processing abilities in children with specific learning disorders. *American Journal of Audiology*, [Preprint.] July 3, 2024 [accessed 2024 July 8]. Available from: https://pubs.asha.org/doi/abs/10.1044/2024_AJA-24-00001.

Jerger, J., & Musiek, F. (2000). Report of the Consensus Conference on the Diagnosis of Auditory Processing Disorders in School-Age Children. Consensus Development Conference Journal of the American Academy of Audiology, 11(9), 467-474.

Johnson, C. D., & Seaton, J. (2021). Educational audiology handbook (3rd ed.). San Diego: Plural Publishing, Inc.

Jolles, J., & Jolles, D. D. (2021). On Neuroeducation: Why and How to Improve Neuroscientific Literacy in Educational Professionals. *Frontiers in psychology*, *12*, 752151. https://doi.org/10.3389/fpsyg.2021.752151.

Katz, J. (2007, May 14). *APD Evaluation to Therapy: The Buffalo Model.* Audiology Online. https://www.audiologyonline.com/articles/apd-evaluation-to-therapy-buffalo-945.

Keith, W.J., & Purdy, S. (2014). Assistive and Therapeutic Effects of Amplification for Auditory Processing Disorder. *Seminars in Hearing.* 35. 27. 10.1055/s-0033-1363522.

Keith, W. J., Purdy, S. C., Baily, M. R., & Kay, F. M. (2019). *New Zealand Guidelines on Auditory Processing Disorder.* New Zealand Audiological Society. https://www.audiology.org.nz/.

Kraus, N. (2021). Descending Control in the Auditory System: A Perspective. *Frontiers in Neuroscience.* 15: 769192. https://doi.org/10.3389/fnins.2021.769192.

Kuk, F., Jackson, A., Keenan, D., & Lau, C. C. (2008). Personal amplification for school-age children with auditory processing disorders. *Journal of the American Academy of Audiology*, *19*(6), 465–480. https://doi.org/10.3766/jaaa.19.6.3.

Merzenich MM, Jenkins WM, Johnston P, Schreiner C, Miller SL, Tallal P. Temporal processing deficits of language-learning impaired children ameliorated by training. Science. 1996;271:77–81. doi: 10.1126/science.271.5245.77. [DOI] [PubMed] [Google Scholar]

Moore D. R. (2012). Listening difficulties in children: bottom-up and top-down contributions. *Journal of communication disorders*, *45*(6), 411–418. https://doi.org/10.1016/j.jcomdis.2012.06.006

Moore, D. R., Ferguson, M. A., Edmondson-Jones, A. M., Ratib, S., & Riley, A. (2010). Nature of auditory processing disorder in children. *Pediatrics*, *126*(2), e382–e390. https://doi.org/10.1542/peds.2009-2826

Moore, D. R., Rosen, S., Bamiou, D.-E., Campbell, N. G., & Sirimanna, T. (2013). Evolving concepts of developmental auditory processing disorder (APD): A British Society of Audiology APD Special Interest Group 'white paper.' *International Journal of Audiology, 52*(1), 3–13. https://doi.org/10.3109/14992027.2012.723143

Moore, D. R., Sieswerda, S. L., Grainger, M. M., Bowling, A., Smith, N., Perdew, A., Eichert, S., Alston, S., Hilbert, L. W., Summers, L., Lin, L., & Hunter, L. L. (2018). Referral and Diagnosis of Developmental Auditory Processing Disorder in a Large, United States Hospital-Based Audiology Service. *Journal of the American Academy of Audiology*, *29*(5), 364–377. https://doi.org/10.3766/jaaa.16130

Musiek, F. E., & Chermak, G. D. (Eds.) (2007). Handbook of (central) auditory processing disorder: Auditory neuroscience and diagnosis, Volume I. San Diego, CA: Plural Publishing.

Myklebust, H. R. (1954). Auditory disorders in children: a manual for differential diagnosis. Grune & Stratton.

Nagao, K., Riegner, T., Padilla, J., Greenwood, L. A., Loson, J., Zavala, S., & Morlet, T. (2016). Prevalence of auditory processing disorder in school-aged children in the Mid-Atlantic region. Journal of the American Academy of Audiology, 27(09), 691–700. https://doi.org/10.3766/jaaa.15020

Purdy, S. C., Sharma, M., & Morgan, A. (2018). Measuring Perceptions of Classroom Listening in Typically Developing Children and Children with Auditory Difficulties Using the LIFE-UK Questionnaire. *Journal of the American Academy of Audiology*, *29*(7), 656–667. https://doi.org/10.3766/jaaa.17053

Rawool, V. (2016). Auditory Processing Deficits: Assessment and Intervention. Thieme. https://shop.thieme.com/Auditory-Processing-Deficits/9781604068375

Rawool, V. W. (2018). Computerized auditory training for improving auditory processing skills. Part of ASHA Professional Development Series. Oct 10-12, 2018.

Reynolds, S., Miller Kuhaneck, H., & Pfeiffer, B. (2016). Systematic review of the effectiveness of frequency modulation devices in improving academic outcomes in children with auditory processing difficulties. *The American Journal of Occupational Therapy, 70*(1), 7001220030p1–7001220030p11. https://doi.org/10.5014/ajot.2016.016832

Richard, G. J. (2013). Language processing versus auditory processing. In D. Geffner & D. RossSwain (Eds.), *Auditory processing disorders: Assessment, management, and treatment* (2nd ed., pp. 283–299). Plural.

Richard, G. J. (2017). *The source: Processing disorders* (2nd ed.). Pro-Ed.

Sanjay, S., Vinod, S., Jain, C. (2023) Central auditory processing abilities in individuals with tinnitus and normal hearing sensitivity: a systematic review. *Egypt J Otolaryngol* 39, 126. https://doi.org/10.1186/s43163-023-00494-0

Schow, R. L., Whitaker, M. M., Seikel, J. A., Brockett, J. E., & Domitz Vieira, D. M. (2020). Validity of the Multiple Auditory Processing Assessment–2: A test of auditory processing disorder. *Language, Speech, and Hearing Services in Schools, 51*(4), 993–1006. https://doi.org/10.1044/2020_LSHSS-2000001

Sharma, M., Purdy, S. C., & Kelly, A. S. (2009). Comorbidity of auditory processing, language, and reading disorders. *Journal of Speech, Language, and Hearing Research, 52*(3), 706–722. https://doi.org/10.1044/1092-4388(2008/07-0226)

Smart, J. L., Purdy, S. C., & Kelly, A. S. (2018). Impact of personal frequency modulation systems on behavioral and cortical auditory evoked potential measures of auditory processing and classroom listening in school-aged children with auditory processing disorder. *Journal of the American Academy of Audiology, 29*(07), 568–586. https://doi.org/10.3766/jaaa.16074

Stavrinos, G., Iliadou, V. V., Pavlou, M., & Bamiou, D. E. (2020). Remote Microphone Hearing Aid Use Improves Classroom Listening, Without Adverse Effects on Spatial Listening and Attention Skills, in Children With Auditory Processing Disorder: A Randomised Controlled Trial. *Frontiers in neuroscience*, *14*, 904. https://doi.org/10.3389/fnins.2020.00904

Świerniak, W., Bendykowska, M., Brzozowska, N., Cyrzan, A., Gos, E., Raj-Koziak, D. ... Skarżyński, P. H. (2023). Symptoms of auditory processing disorders (APD) in children with tinnitus. Journal of Hearing Science, 13(3), 31-35. https://doi.org/10.17430/jhs/171436

Tallal P, Miller SL, Bedi G, Byma G, Wang X, Nagarajan SS, Schreiner C, Jenkins WM, Merzenich MM. Language comprehension in language-learning impaired children improved with acoustically modified speech. Science. 1996;271:81–84. doi: 10.1126/science.271.5245.81. [DOI] [PubMed] [Google Scholar]

Thompson, P., & Sousa, K. (2021, October 21). Best Practices for an Attention Deficit Hyperactivity Disorder (ADHD) Evaluation. Retrieved from Neuro-ED Assessment and Screeners: https://neuroedtest.com/attention-deficit-hyperactivity-disorder-adhd/

Tomlin, D., & Rance, G. (2014). Long-term hearing deficits after childhood middle ear disease. Ear and hearing, 35(6), e233–e242. https://doi.org/10.1097/AUD.0000000000000065

Weihing, J., Chermak, G. D., & Musiek, F. E. (2015). Auditory Training for Central Auditory Processing Disorder. Seminars in hearing, 36(4), 199–215. https://doi.org/10.1055/s-0035-1564458

Whitton, J. P., & Polley, D. B. (2011). Evaluating the perceptual and pathophysiological consequences of auditory deprivation in early postnatal life: a comparison of basic and clinical studies. *Journal of the Association for Research in Otolaryngology : JARO*, *12*(5), 535–547. https://doi.org/10.1007/s10162-011-0271-6

Wilson, W. J., & Arnott, W. (2013). Using different criteria to diagnose (central) auditory processing disorder: How big a difference does it make? *Journal of Speech, Language, and Hearing Research, 56*(1), 63–70. https://doi.org/10.1044/1092-4388(2012/11-0352)

Yathiraj, A., & Vanaja, C.S. (2018). Criteria to classify children as having auditory processing disorders. *American Journal of Audiology*. 27(2), 173–183. https://doi.org/10.1044/2018_AJA-170091