

Auditory Processing

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Who are we?

Christa B. Reeves, AuD

Education

B.S.Ed. – Communication Sciences & Disorders, University of Georgia, 1992
M.A. – Audiology, University of Florida, 1994
Au.D. – Doctor of Audiology, University of Florida, 2004

Work Experience

CFY – Memphis Hearing Aid & Audiological Services, '94-'95
Audiologist – Costco Hearing Aid Center, '99-'00
Audiologist – Northside Hospital, Atlanta GA, '00-'09
Audiologist & OP Rehab Sup – DeKalb Medical Center, Atlanta GA, '09-'13
Audiologist & Owner – Little Listeners, Alpharetta GA, '13-present
Co-Founder and Conference Co-Organizer – International Guild of Auditory Processing Specialists (IGAPS), Kansas City MO, '12-present
Speaker – Georgia Educators Training Agency (GETA), '18-

Who are we?

Kavita Kaul, M.S., AuD, CCC-SLP/A

Education and Work Experience

I completed my graduate and undergraduate studies in India in All India Institute of Speech and Hearing. I am certified both in Audiology and Speech Language Pathology. I also got my Au.D degree from the Arizona School of Health Sciences for ATSU Arizona. I have worked in a variety of settings including Long Term Care; Inpatient and Outpatient Hospitals; and Public Schools. Currently I have a private clinic where I use my dual certification in Speech-Language- and Hearing to my advantage to evaluate and treat school aged children with Auditory Processing Disorders. I have been practicing since 1989.

What will you learn today?

- **8-10am – Auditory Processing: The Basics**
 - Auditory development from conception/birth
 - Hearing vs. Listening
 - Anatomy of APD and History of Neuroplasticity
 - Hierarchy of processing & other influential systems
- **10:30am-12:30pm – Auditory Processing: Evaluation, Interpretation, and Treatment**
 - Common causes of APD and co-existing disorders
 - Screening tools for appropriate referrals
 - Test Battery and testing considerations
 - Interpretation of APD test results & qualitative errors
 - APD Profile categories (combination of Katz & Bellis)
- **1:30-3:30pm – Auditory Processing: Differences Between Auditory and Language Processing**
 - Implications of APD on life and education
 - Recommendations and therapy options for various APD results
 - Therapy Tools – commercial and home-made
 - Accommodations and modifications
 - Other educational recommendations for communication, reading and Executive Function

Auditory Processing: The Basics

8am to 10am

What is Auditory Processing?

- Understand auditory development from conception/birth
- Understand the impact auditory processing has on early language development
- Recognize the difference between hearing and listening
- Understand the basic anatomy of APD and the history of neuroplasticity
- Know the hierarchy of processing & other influential systems

Embryonic Development of the Auditory Structures

- **Inner ear development** occurs in the first trimester of fetal development. The cochlea is completed by the 20th week and the *fetus is able to hear in the womb*. Inner ear development continues through the 8th month.
 - **Middle ear development** occurs mostly in the first trimester of fetal development around week 3 but continues until week 30-32.
 - **Outer ear development** begins in week 3, the pinna develops an adult shape by week 20, and the external auditory canal continues to develop until age 7-9 years.
- Critical auditory skills develop early in utero and auditory experiences begin for an infant approximately ½ way through their fetal life.*

Embryonic Development of the Auditory Nervous System

- The human nervous system starts out as a simple, tubular, ectodermal structure
 - During the 3rd week of embryonic development, ectoderm thickens to form the neural plate.
 - The neural plate then forms the neural groove which deepens and fuses midway at a level corresponding to the future cervical spinal cord.
 - By the end of the 4th week, the neural tube separates and closes, leaving behind neural crest cells that develop into the sensory neurons of the ganglia of spinal nerves and some cranial nerves, postganglionic neurons of the ANS and the Schwann cells of the PNS
- The neural tube develops into the entire central nervous system and it's cavity becomes the ventricular system of the brain.*

Embryonic Development of the Auditory Nervous System

- During the 5th week of embryonic development, primary vesicles of the neural tube subdivide:
 - Prosencephalon (forebrain) gives rise to:
 - Telencephalon (cerebral hemispheres)
 - Diencephalon (thalamus, hypothalamus, retina, other structures)
 - Mesencephalon (midbrain) remains undivided
 - Rhombencephalon (hindbrain) gives rise to:
 - Metencephalon (pons, cerebellum)
 - Myelencephalon (medulla)
- A critical part of cerebral cortex growth occurs with massive proliferation and migration of neurons and glial cells in this stage that continue through the 3rd through 5th months of embryonic development. Neuronal connections continue into post-natal development.*

The Rapid Post-Natal Development of the Human Brain

- Brain weight at birth is approximately 400 grams.
 - This weight triples during the first 3 years of life due to the addition of myelin and growth of neuronal processes from life experiences through the 5 senses.
- Rate of growth slows after the first 3 years with maximum average weight of approximately 1400 grams achieved by 11 years of age
- Brain weight holds steady until approximately 50 years of age when it starts to decline.
- Brain weight can vary from 1100-1700 grams with only a modest, known correlation between brain weight and mental ability.
- Humans have larger brains, relative to their body size, than most other animals.

Auditory Developmental Milestones

Basic auditory developmental milestones:

- Birth- 3 months: instinctual response to sound (startle, coo/smile when hears mother's voice, etc...)
- 3-6 months: looks for familiar sounds and vocalizing voluntarily.
- 6-12 months: recognizes own name, understands common words ("no," "bye-bye") and begins to imitate speech. This is when a child starts to apply meaning to sounds (barks when he/she sees a dog, looks towards the door when the doorbell rings, etc...).

There is a rapid development of these auditory skills as the child's brain starts to organize and make sense of the auditory experiences that he/she hears.

Speech/Language Developmental Milestones

- Word segmentation – develops rapidly between 7.5 -10.5 months
 - THIS IS WHY EARLY INTERVENTION IS KEY!!
- Long-term storage of new words begins – develops by 8 months of age

The difference between hearing and listening

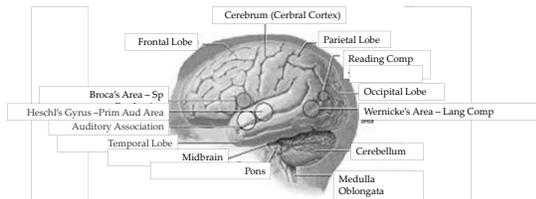
There is more to hearing than just the physical ability of the ears to transmit sounds to the brain. Important functions must occur for the brain to clearly process what it has heard.

Hearing = the actual physiological and anatomical function of the ear and auditory system itself.

Listening = what the brain does with the information that is heard; also known as Auditory Processing.

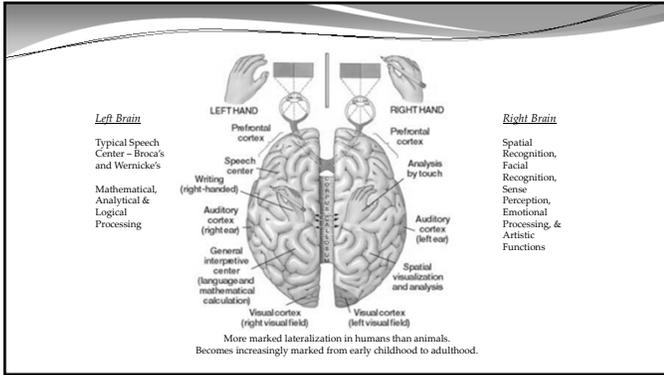
*"Auditory Processing is what the brain does with what the ear hears."
- Jack Katz, Ph.D.*

Basic Anatomy of the Central Auditory System



Simple anatomy overview

- The primary non-linguistic auditory cortex typically resides in the right hemisphere. (melody of music)
 - The primary linguistic auditory cortex typically resides in the left hemisphere. (lyrics of music)
 - We say "typically" because a reverse brain dominance can be observed in a small number of children. This can be common in children who are left-handed:
 - 27% of left handed children are right brain dominant for language (4% right, 15% Ambidextrous) (*"Handedness & Hemispheric Language Dominance in Healthy Humans," Knecht, Deppe, Lohmann, Floel, Ringelstein, Henningsen, Brain, Volume 123, Issue 12, December 2000*)
 - The corpus callosum runs down the center of the brain, separates the 2 hemispheres, and facilitates cross lobe interaction:
 - Boys typically have a thinner corpus callosum than girls which is why they tend to not multi-task as well as girls.
- Specific patterns on the APD testing can reveal the areas of the brain most effected and can help determine the appropriate treatment and need for further testing.*



The Great Brain Lateralization Debate

“Everyone should understand the personality types associated with the terminology ‘left-brained’ and ‘right-brained’ and how they relate to him or her personally; however, we just don’t see patterns where the whole left-brain network is more connected or the whole right-brain network is more connected in some people. It may be that personality types have nothing to do with one hemisphere being more active, stronger, or more connected,” – Jared Nielsen

“Researchers Debunk Myth of “Right-brain” and “Left-brain” Personality Traits” – U Health, University of Utah, August 2013

The Great Brain Lateralization Debate

“It’s absolutely true that some brain functions occur in one or the other side of the brain. Language tends to be on the left, attention more on the right. But people don’t tend to have a stronger left- or right-sided brain network. It seems to be determined more connection by connection,”

- Jeff Anderson, M.D., Ph.D., lead author of the study, which is formally titled “An Evaluation of the Left-Brain vs. Right-Brain Hypothesis with Resting State Functional Connectivity Magnetic Resonance Imaging.”

Neuroplasticity

Brain plasticity (or neural plasticity) is the basis behind therapy and why it is successful, even in the adult brain.

Neuroplasticity can be observed on multiple scales ranging from individual neurons to complete cortical remapping.

Activity dependent plasticity is promoted by multiple variables including behavior, environmental stimuli, thought, and emotions

History of Neuroplasticity

- 1500's – The localization theory was strongly supported by neurologists that presumed brain damage was untreatable.
- 1793 – Italian anatomist Michele Vincenzo Malacarne conducted one of the first studies on the effects of "training" on the cerebellums of animals. It was largely forgotten until the 1890's
- 1890's – William James proposed the idea that the brain and it's function are not fixed throughout adulthood, but again it was largely forgotten until the 1960's

History of Neuroplasticity

- 1923 – Karl Lashley experiment on Rhesus monkeys demonstrated changes in neuronal pathways – still not widely accepted.
- 1945 – Justo Gonzalo discovered that cortical function had the capacity to increase neural excitability and re-organize activity through plasticity.
- 1964 – Marian Diamond produced first scientific evidence of anatomical brain plasticity.

History of Neuroplasticity

- 1960's – Paul Bach-y-Rita, Michael Merzenich and Jon Kaas performed studies to prove that healthy brain tissue could take over functions of brain tissue that had been destroyed.

Other notable scientists that have contributed to proving neuroplasticity include Shepherd Ivory Franz, Eleanor Maguire, David Hubel, and Torsten Wiesel.

"The Brain That Changes Itself" by Norman Doidge, reviews Bach-y-Rita and Merzenich's studies.

History of Neuroplasticity

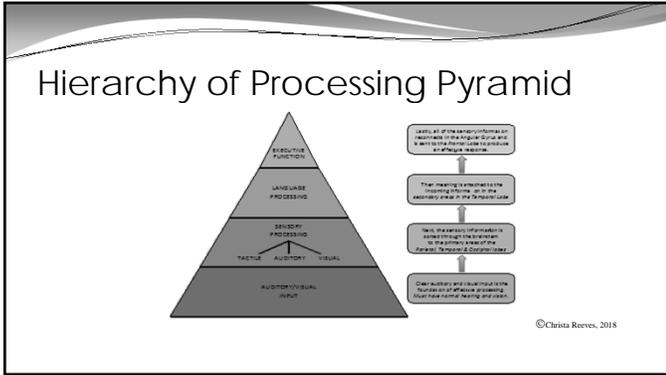
Decades of research have proven that changes in the lowest neocortical processing areas can affect neuronal activation in response to experience, changing both brain structure and functional organization.

Since 2014, neuroscientists have been involved in proving that the brain can, and does alter function in response to external stimuli.

This is important research that has been needed to support that auditory training is an effective approach to remediating Auditory Processing Disorder.

Neuroplasticity Review

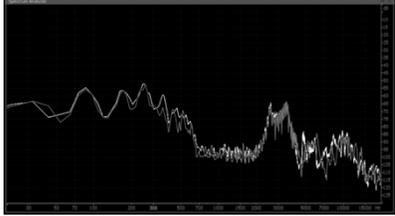
- Neural plasticity goes both ways: stimulated or not stimulated
- Hebbian Theory proposes that nerves adapt during the learning process – Donald Hebb 1949
 - *"Neurons that fire together wire together"*
- However, the inverse happens as well if the pathways are not utilized so that the space will be used by other pathways that need room to grow.
 - *"Neurons that fire apart wire apart"*



- ### Hierarchy of Processing
1. The ears hear the message
 2. The brainstem sorts the sensory input and sends the auditory/language information to the Temporal Lobe.
 3. The temporal lobe engages the primary skills and sets the secondary skills into motion to "clean up" the message.
 4. The message then arrives at Receptive Language where meaning is applied.
 5. That meaning is then sent to Expressive Language to produce an appropriate verbal or non-verbal response.
 6. Executive Function skills are engaged to plan, sequence, stay on task, etc.....

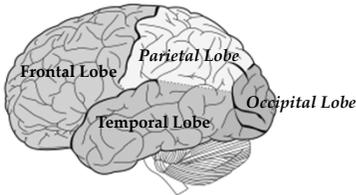
- ### The Role of Auditory Processing
- 4 Primary Auditory Processing skills essential for effective communication:
1. Listening to speech in noise
 2. Understanding distorted/rapid speech or speech with missing parts
 3. Listening effectively with both ears
 4. Understanding tonal and timing differences in speech

Example of Temporal Processing Deficit "Date" versus "Gate"



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The Other Sensory Systems



Parietal Lobe –
Sensory Processing

Occipital Lobe –
Visual Processing

The Other Sensory Systems

- *Parietal Lobe* integrates incoming sensory information including mechanoreception (touch) and proprioception (spacial sense and navigation).
- *Occipital Lobe* integrates incoming visual information including orientation, spatial-frequency, color, and "what" and "where/how" details from visual memory.

Pre-Frontal Cortex

- Pre-Frontal Cortex is involved with:
- Planning complex cognitive behavior
- Personality expression
- Decision making
- Moderating social behavior
- Orchestrating thoughts and actions in accordance with internal goals

Questions??

Auditory Processing: Evaluation, Interpretation, and Treatment

10:30am - 12:30 pm

How To Identify APD?

- Look for common causes in the case history
- Understand common co-existing disorders
- Utilize appropriate APD screening tools
- Understand what tests need to be performed for diagnosis
- Know how to interpret the test results and read reports
- Recognize the qualitative signs of APD
- Be familiar with common APD Profile Categories (Katz & Bellis)

Causes of APD

- Developmental causes from auditory deprivation (approximately 70-75% of APD):
- Ear infections, frequent illness, allergies, sinusitis, oxygen deprivation, delayed growth
 - Permanent or fluctuating hearing loss – Any type or degree
- Neuromorphological causes (20-25% of APD):
- Family history of APD
 - Learning disability
- Neurological causes (5-10% of APD):
- Brain damage/neurological insult/head injury
 - Seizures
 - Hyperbilirubinemia
 - Prematurity
 - Oxygen deprivation

Common Co-Existing Disorders

- Sensory Integration- for those with auditory integration difficulties
- Executive Dysfunction
- ADHD
- Mitochondrial/ Metabolic disorders
- Developmental disorders such as Intellectual disability and Autism/Aspergers/PDD-NOS
- Dyslexia
- Behavior Disorder
- Depression/Anxiety
- Language Disorder
- Reading Disorder
- Also do not ignore possible APD issues with Stuttering

Understanding a child's true processing abilities could involve any of the 5 processing systems and they all can interact (positively AND negatively) with each other.

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Screening tools for APD

Live voice screeners:

- TAPS (Test of Auditory Processing Skills – new edition available 2018)
 - Phonological Awareness, Auditory Memory, Auditory Cohesion
 - Ages 4-0 to 18-11
- APAT (Auditory Processing Abilities Test, Ross-Swain & Long)
 - Linguistic Awareness, Auditory Memory
 - Ages 5-0 to 12-11
- The Listening Comprehension Test (Bowers, Huisingsh, LoGuidice)
 - Listening Comprehension, Language
 - Ages 6-0 to 11-11

Screening tools for APD

Live voice screeners:

- CELF-5 Screening Test (Clinical Evaluation of Language Fundamentals, Wigg, Secord & Semel) (Following directions; Recalling sentences; Sentence/paragraph Comprehension)
 - Language
 - Ages 5-0 to 21-11
- DSTP (Differential Screening Test for Processing, Richard & Ferre)
 - Acoustic, Acoustic/Linguistic, Linguistic
 - Ages 6-0 to 12-11
- Acoustic Pioneer
 - Temporal Patterning, Lateralization, Dichotic Listening, Auditory Memory, Speech-in-Noise
 - Ages 5-0 to 65-11 (depending on the tests used)

Screening tools for APD

Live voice screeners:

- DTAP (Developmental Test of Auditory Perception, Reynolds, Voress, Pearson)
 - Language, Speech-in-Noise, Auditory Perception
 - Ages 6-0 to 18-11
- CTOPP-2 (Comprehensive Test of Phonological Processing – 2nd Edition, Wagner, Torgesen, Rashotte, Pearson)
 - Phonological Awareness, Auditory Memory
 - Ages 5-0 to 24-11
- ASA (Auditory Skills Assessment, Geffner & Goldman)
 - Speech Discrimination, Phonological Awareness, Nonspeech Processing
 - Ages 3-6 to 6-11

Screening tools for APD

Pre-recorded screeners:

- SCAN-3 (Test for Auditory Processing Disorders, Keith)
 - Temporal Processing, Listening-in-Noise, Dichotic Listening, Listening to Degraded Speech
 - Children's version, Ages 5-0 to 12-11
 - Adult version, Ages 13-0 to 50-11

Screening tools for APD

Questionnaires:

- Buffalo Model Questionnaire
- Fisher's Auditory Checklist
- SIFTER (Screening Inventory for Targeting Educational Risk)
- Auditory section of the Sensory Profile
- CHAPS (Children's Auditory Performance Scale)
- The Listening Inventory

What is Auditory Processing?

"Auditory Processing is what the brain does with what the ear hears."

- Jack Katz, PhD

Primary (Basic) Auditory Processing Skills:

- Listening in Noise (Auditory Figure Ground)
- Listening to Distorted Speech (Auditory Closure)
- Listening with Both Ears (Dichotic Listening)
- Understanding Tonal and Timing Differences in Speech (Temporal Processing)



Listening-In-Noise

- Also known as Auditory Figure Ground
- Applies to how we determine relevancy and irrelevancy of auditory information:
 - Relevant – extracting and storing the important auditory information
 - Irrelevant – blocking out/pruning off unnecessary auditory information
- Most common symptoms of AFG weakness mirror ADHD:
 - Acting out – “hyperactive”
 - Withdrawal – “inattentive”



Listening to Distorted Speech

- Also known as Auditory Closure
- Applies to cleaning up low redundancy (unclear) speech including:
 - Accented Speech
 - Distorted Speech
 - Speech with Missing Parts
 - Rapid Speech
- Most common symptoms of Auditory Closure deficits:
 - Difficulty learning a foreign language
 - Auditory overload like with AFG deficits
 - Huh/What? Kids
 - “Deer in the headlights” stares in conversations or with directions

Listening with Both Ears

- Also known as Dichotic Listening
- Applies to how we use the information coming in from both ears
 - Integration – effectively combining the information coming in from both sides
 - Separation – effectively blocking out information in one ear and focusing on the information only on one side.
- Common symptoms of Dichotic Listening include:
 - Similar listening characteristics to Auditory Closure
 - Sensory Integration deficits
 - Motor deficits for crossing midline
 - Auditory/visual deficits including difficulty with reading comp
 - Poor Visualizing to Verbalizing skills



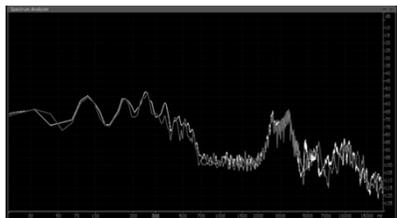
Understanding Tonal & Timing Differences

- Also known as Temporal Processing
- Applies to how we use subtle frequency and timing mechanisms in speech to understand subtle differences in phonemes and words.
- Most common symptoms of Temporal Processing Deficits include:
 - Discrimination errors in similar sounding words
 - Frequent misinterpretation of messages
 - Difficulty with rapid speech
 - Easily overwhelmed with wordy phrases/questions
 - Poor rhythm skills
 - Poor motor coordination



Example of Temporal Processing Deficit

“Date” versus “Gate”



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Secondary (Complex) Skills That Influence Auditory Processing

- Phonological Awareness
 - Auditory/Linguistic – must have some knowledge of the language being learned, requiring higher order language skills to be engaged.
- Auditory Memory
 - Engages language and frontal lobe cognitive skills.
- Auditory Attention
 - Engages frontal lobe attention skills.
- Auditory Association
 - Engages language experience to understand the nuances of how auditory input fits together with meaning and frontal lobe skills to maintain order and sequencing.

Auditory Processing Tests for the Basic Auditory Skills

- **Listening in/filtering out background noise**
 - Speech-in-Noise Test
 - Auditory Figure Ground sub-tests of the SCAN-3C/A
 - Auditory Figure Ground sub-tests of the TAPS-3
 - SSI-ICM (Synthetic Sentence Identification with Ipsilateral Competing Message)
- **Listening with both ears - Integration:**
 - SSW (Staggered Spondaic Word Test)
 - Dichotic Digits Test
 - SCAN-3C Competing Words subtest
 - Competing Environmental Sounds Test
 - DSI (Dichotic Sentence Identification) Test

Auditory Processing Tests for the Basic Auditory Skills

- **Listening with both ears - Separation:**
 - Competing Sentences sub-test of the SCAN-3C/A
 - Competing Sentences Test
 - SSI-CCM (Synthetic Sentence Identification with Contralateral Competing Message)
- **Listening to degraded speech - Distorted:**
 - Filtered Words from the SCAN-3C/A
 - NU-6 Low Pass Filtered Word Test
- **Listening to degraded speech - Rapid:**
 - Time Compressed Sentences from the SCAN-3C/A

Auditory Processing Tests for the Basic Auditory Skills

- **Temporal Processing – Discrimination/Recognition:**
 - Word Discrimination in quiet
 - Word Discrimination from the TAPS-(4 available recently)
 - Phoneme Recognition Test
 - CTOPP
- **Temporal Processing – Tonal Discrimination:**
 - Pitch Pattern Sequence Test
- **Temporal Processing – Timing Discrimination:**
 - Duration Pattern Sequence Test
 - Random Gap Detection Test/GDT Screening on SCAN-3C/A
 - Gaps in Noise
 - Interactive Metronome - LFA

Auditory Processing Tests for the Complex Auditory Skills

- **Auditory/Linguistic:**
 - Phonological Blending from the TAPS- (4 available recently)
 - Phonemic Synthesis Test
 - Phonological Segmentation from the TAPS- (4 available recently)
 - LAC-3 (Lindamood Auditory Conceptualization Test)
 - CTOPP
- **Auditory Attention:**
 - ACPT (Auditory Continuous Performance Test)
 - Selective Auditory Attention Test

Auditory Processing Tests for the Complex Auditory Skills

- **Auditory Memory/Sequencing:**
 - TAPS- (4 available recently) (Test of Auditory Processing Skills) Memory tasks (Auditory Number Mem Forward and Reversed, Word Memory and Sentence Memory)
 - APAT (Auditory Processing Abilities Test) Memory tasks
- **Auditory Association:**
 - Auditory Comprehension from the TAPS-3
 - Auditory Reasoning sub-test from the TAPS-3

A Typical Diagnostic Battery

- Peripheral hearing evaluation:
 - Pure tone testing, SRT and word recognition in quiet
 - OAE (12 frequency DP's or TE's)
 - Immittance testing; Tymps, Reflexes (ipsi and contra) and Decay
- Central Auditory Processing Testing:
 - Minimal battery:
 - SPIN, SSW, Phonemic Synthesis Test, NU-6 Filtered Words, Pitch Patterns
 - Additional supportive tests:
 - SCAN-3 Competing Words DE, Competing Sentences, Time Compressed Sentences
 - TAPS- (4 available recently) Memory Battery
 - Interactive Metronome Long Form Assessment
 - TAPS- (4 available recently) Auditory Comprehension and Auditory Reasoning subtests (time permitting)
 - cABR – if available

General Observation During Test

- Replay: Item replayed because of extraneous or intraneous reasons
- Instruction: To follow the directions of the test accurately
- Cue: To repeat response because of unintelligible or partial responses
- Facial expressions
- Number of breaks
- Discomfort using headphones
- Redirections
- Sustained attention to task
- Fatigue

Pre-Testing Considerations

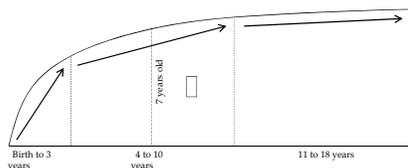
- Medications
- Diet – Limit sugar before testing and bring a snack
- Sleep – The child should treat the night before as a typical school night, even if they will not be attending school after testing.
- Sensory needs – Have various sensory tools available to ward off the “wiggles”
- AGE!!.....If they are very young, provide a lot of breaks to keep them on task.

The Great Age Debate

- Reliable assessment tools are available down to age 5!
 - SSW
 - SCAN-3
 - TAPS- (4 available recently)
 - (ACPT???, DSTP???, ASA???)
- There are even reliable tools for auditory development screening down to age 3.5 years.
- "Auditory Processing Abilities in Children: When to Test?" Audiology Today, Volume 27, No. 1. Jan/Feb 2015

All kids should have their development monitored from birth and on a regular basis!

Auditory Development Curve



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ASHA Stmt: APD Diagnosis in Schools

"A recent court decision by the United States Ninth Circuit Court of Appeals (2012) determined ... APD constitutes an "other health impairment" under the Individuals with Disabilities Education Improvement Act (IDEA, 2004).... This court case helped define CAPD under the IDEA for school administrators and educators, parents, the judiciary, and administrative bodies and legal representatives in the western states. Court filings related to the case described ... APD as a deficiency in neurological processing that adversely affects an individual's ability to identify and distinguish similar sounds and understand oral communication. In addition, evidence introduced in court established that CAPD requires a diagnosis by an audiologist.

This case could also improve access to services under IDEA in public school settings.... CAPD can satisfy the three elements of an "Other Health Impairment:" (1) a chronic medical condition (2) that impacts a child's alertness in a classroom and 3) adversely affects the child's ability to learn.

Some state education departments may review eligibility for CAPD under the IDEA disability categories of "Speech or Language Impairment" or "Specific Learning Disability." However, establishing CAPD in the category of "Other Health Impairment" provides a specific and recognized category with which to argue for service eligibility."

Result Patterns

- **Basic Skills Deficit Profiles (Katz and Bellis Theories)**
 - Decoding Deficit (including Phonological weaknesses)
 - Tolerance-Fading Memory (Speech in Noise and short term memory) Deficit
 - Integration Deficit
 - Prosodic Deficit

Result Patterns

- **Complex Skills Processing Weaknesses**
 - Auditory/Associative Deficit
 - Output/Organization Deficit
 - Memory Weaknesses
 - *(mention that it is highly unlikely to get only one pattern)*

Decoding Deficit

- A decoding deficit is the most common profile seen in individuals with an auditory processing disorder. It occurs in the primary (left) auditory cortex and manifests itself as difficulty quickly and accurately processing speech, generally at the phonemic level.
- Common school and communication problems:
 - spelling
 - reading accuracy
 - oral reading
 - phonics
 - articulation
 - receptive language
 - confusion with instructions

Decoding Deficit APD Test Results

- SSW Errors
 - High-low ear effect
 - Low-high order effect
 - Non-competing word errors
 - Right competing word errors
- Reduced phonological blending skills (a significant score on Phonemic Synthesis)
- Filtered Word errors
- Word Discrimination errors
- Poor Phonological Awareness skills

Tolerance Fading Memory (TFM) Deficit

A Tolerance Fading Memory Deficit implies an inability to retain auditory information, which in turn affects the amount of information a person can handle at one time. It occurs in various areas of the brain including the anterior temporal region and frontal lobes.

This is commonly associated with a Decoding Deficit where if the speech sounds are not strongly engraved in the auditory area of the brain then remembering these sound patterns will be that much more tedious.

Look for phonemic extraction deficits....also,
Seemingly strong TFM may be a sign of good memory compensatory strategies (self-learned or taught)
Often they influence each other in the end....

TFM Common Characteristics

- Common school and communication problems:
 - Inefficient listening in noise
 - Short-term memory weaknesses
 - Reading comprehension deficits
 - Expressive language disorder
 - Difficulty following directions
 - Distractible
 - Impulsive
 - Rapid speaker

TFM Deficit APD Test Results

- SSW Errors
 - Low-high ear effect
 - High-low order effect
 - Non-competing word errors in the right ear
 - Left competing word errors
- Poor auditory memory scores on the TAPS- or APAT
- Speech-in-Noise scores outside of normal limits
- Difficulty with SSI-ICM task

Integration Deficit

An Integration Deficit creates difficulties with tasks involving both visual and auditory input. It occurs within the posterior portion of the Corpus Callosum where information needs to transfer between the right and left hemispheres. Typically speech, language and an ability to understand speech in noise are normal.

- Common school and communication problems:
 - Delayed responses to auditory and visual stimuli
 - Difficulty with task transitions
 - Sensory processing weaknesses
 - Reading and spelling difficulties
 - Dyslexia
 - Poor handwriting skills

Integration Deficit APD Test Results

- SSW Errors
 - Type A pattern
 - Left competing word errors
- Specific qualifiers
 - Extreme Delays
- Poor PPST or DPST in the verbal condition only (able to report the pattern manually or humming)

Prosodic Deficit

- A Prosodic Deficit occurs in the non-primary, right auditory cortex and associated areas. It suggests an inability to properly utilize prosodic features, impacting one's ability to detect differences in pitch, intonation and stress/ syllabic emphasis that assist in applying meaning to speech.

Prosodic Deficit APD Test Results

- Dichotic speech tasks
 - Left ear deficits
- Deficits on the PPST and/or DPST task for both the hummed and verbal conditions.

Auditory/Associative Deficit

- An Auditory Associative Deficit implies an inability to apply the rules of language to incoming auditory input. It occurs in the left cortex of the brain where acoustics and meaning come together and syntactic analysis occurs. An Auditory Associative Deficit is supported by bilateral deficits on the Competing Sentences Sub Test of the SCAN and the Staggered Spondaic Word Test.
 - Common school and communication problems:
 - Normal performance in school until 3rd or 4th grade when linguistic demands increase
 - Poor reading comprehension skills
 - Receptive language deficits in vocabulary
 - Difficulty with semantics- syntax (meaning and grammar of language)
 - Difficulty with pragmatics (knowledge of how to use language)

Auditory/Associative Deficit APD Test Results

- SSW Errors
 - Bilateral deficits
- Competing Sentences sub-test of the SCAN-3C/A
 - Bilateral deficits
 - Along with binaural separation deficit

TFM Deficit APD Test Results

- SSW Errors
 - Low-high ear effect
 - High-low order effect
- Non-competing word errors in the right ear
 - Left competing word errors
- Poor auditory memory scores on the TAPS- or APAT
- Speech-in-Noise scores outside of normal limits
- Difficulty with SSI-ICM task

Output/Organization Deficit

- An Output/Organization Deficit is an inability to plan, sequence or organize ones response to auditory stimulus or instructions. It occurs in transmission of auditory information from the temporal to the frontal lobes and/or along the descending auditory nerve pathways. The deficit is considered a complex skill deficit because receptive auditory skills are generally intact; it is the inability to act on the incoming information that is the problem.
- Common school and communication problems:
 - Better performance in school if information is provided in a written format
 - Struggle with any demonstration requiring the report of two or more critical elements; not because of an inability to hear or process the information, but because of an inability to sequence or formulate the correct response.
 - Narration of stories sequentially
 - Sound blending errors
 - Expressive speech errors
 - Difficulty with sequencing and follow-through
 - Impulsive
 - Disorganized
 - Inattentive

Output/Organization Deficit APD Test Results

- Significant scores on dichotic listening tasks
- SSW Errors
 - Reversals

Questions???

Auditory Processing vs. Language Processing

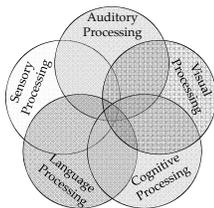
- 1:30-3:30pm

Are they different??

- What to look for during assessment and therapy

Therapy Approaches

- Therapy does not have to have a cookbook approach
- If you know the specific areas to remediate you can use many of the same tools in different ways to accomplish your goal



Understanding a child's true processing abilities could involve any of the 5 processing systems and they all can interact (positively AND negatively) with each other.

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Auditory Processing

- Lucker Multisystem Integrated Approach- LMSIA
- Auditory Sensitivity- Decreased sensitivity or awareness for auditory input
- Auditory Hypersensitivity- Increased sensitivity or emotional reactivity to auditory input
- Phonemic Extraction- Difficulty with recognizing and discrimination individual speech sounds
- Lexical Extraction- Difficulty with recognizing and meaningfully processing words
- Temporal Extraction- Difficulty with recognizing and understanding timing cues in conversation to differentiate and comprehend information based on context (“look out the door” vs. “Look out! the door”)
- General Attention- Difficulty staying on task or sustaining attention
- Auditory Distraction- Difficulty staying focused in the presence of extraneous auditory distractions

Auditory Processing

- Memory Input- Difficulty with efficient input of information in short-term memory required for working memory, ongoing conversational skills, and other mental manipulation tasks
- Memory Recall- Difficulty retrieving information stored in short-term memory for manipulation of information
- Memory Span- Difficulty holding longer units or lengths of information, with limited capacity.
- Phonemic Integration- Difficulty blending speech sounds into meaningful units or words
- Lexical Integration- Difficulty integrating a string of words to make meaningful units of information
- Sound Symbol Association- Difficulty with associating auditory information to visual-symbolic representations
- Organization-Sequencing- Difficulty keeping and manipulating information using organization and sequencing skills (completing tasks out of order)
- Output Encoding- Difficulty repeating and formulating responses efficiently due to speech motor processing delays or difficulties.

How APD impacts reading skills

- Reading is a visual symbol superimposed on previously acquired auditory language. That language develops through nearly exclusive dependence on the auditory channel. When weaknesses within the auditory channel are evident, reading development may be adversely affected. Reading behaviors that may be present in children with Auditory Processing Disorders (APD) include:
- Inability to hear the similarities in the initial and final sounds of words
- Cannot perceive the similarities in words (e.g., fat/that)
- Unable to hear the double consonant sounds in consonant blends
- Lack of discrimination of short vowels (e.g., ten, tin, ton)
- Cannot break words into syllables
- Do hear the sounds that are not emphasized (there vs there’s)

How APD impacts reading skills Cont...

- Cannot break words into individual sounds
- Inability to combine parts of words to form a whole word
- Cannot remember the sounds for the printed symbols or the names for the printed word
- Difficulty in distinguishing similarities and differences in sounds
- Lack of retention of sounds or syllables long enough to make matches or blends
- Inability to relate the visual components of words to their auditory counterparts
- Does not relate a part of a word to the whole word (syllabification)
- Inability to synthesize or analyze unfamiliar words

Quality of responses (Decoding)

- Delays: Responses not efficient, extra time taken, although responses are accurate
- Perseverations: Repeats word from recent item or repeats error that was given before
- Quiet Rehearsals: Saying the items under breath- lips moving; whispering
- Back to Back: Repeats a word of the item twice in a row (up up down town)
- Smush-2: Combines first 2 or last 2 (spondee) items (up stairs as upst)-Decoding
- Intrusive Words: Addition 5th word added in the list while responding despite instruction to refrain from doing so. (Attention Deficit)
- Available Word: Substitution of the missed word by using a another word heard in the 4 word sequence from the same test item (back door play ground repeated as back ground play ground)

Bottom-up Therapy Programs Decoding Deficits

- Little Listeners PASE Program
- Phonemic Synthesis Training (sound blending)*
 - Phonemic Training Program*
 - iLS (Integrated Listening Systems) Language Program
 - Interactive Metronome
 - Fast ForWord or Earobics
 - Lindamood-Bell Learning Programs- LiPS

* These activities are designed to help an individual improve their brain's concept of speech sounds.

Phonemic Synthesis Therapy

Egg	Rug
Cat	Spill
Cats	Green
Sock	White
Spot	
Garage	
Blue	
Look	
Car	

Phonemic Synthesis (PS Training)

- This is an extended therapy version of the Phonemic Synthesis test that formally works an individual through phonological blending to increase their ability to adequately combine sounds to make words. It helps with baseline phonological skills and increases decoding skills at the neurological level through repetitive training. Phonemic Synthesis Training improves discrimination, memory, the ability to manipulate speech sounds and sequencing.
- PST can be administered formally through the recorded program (available at Precision Acoustics) or informally by determining the problem phonemes and developing lists of real words to synthesize.

PS Training – Informal Training

- Considerations for informal presentation:
 - Present sounds at 1 sound per second or slower
 - Start with easy and short sounds and words (VC, CV, CVC, followed by blends)
 - For most people, long vowels and B, Ch, G, J, K, P, S, Sh and Z are the easiest.
 - Don't exceed 4-5 sounds – longer words will not provide the necessary training for effective outcomes.
 - Always go back and review words that were mastered at previous sessions to ensure carry over.
 - Create lists of 20-50 words and repeat words within each list – repetition helps with retention.

The Phonemic Training Program

This is a procedure developed by Jack Katz that helps children learn the correct perception of the sounds of English. It is typically administered for 10-15 minutes at each therapy session with 10-15 minutes of PST, either at the beginning or the end with a completely different therapy program in the middle.

Steps for advancement in skills:

1. Start with Introduction of sounds without any bias.
2. Pay attention to the sounds and the sequence by which you present new sounds.
3. Test discrimination skills with new sounds
4. Omit sounds as the bank grows (20+) so you can concentrate on more difficult sounds.
5. Use "focusing" when similar sounds are indistinguishable
6. "Turnabout"

Other Phonemic Training Tools

The Phonemic Recognition Test on the CTB CD can also be used for training

The Speech Flip Book app by Tactus Therapy can be used

Fast ForWord or Earobics

These are computerized therapy programs.

Fast ForWord must be monitored by a trained therapist. Apply to be a provider at www.scilearn.com.

Earobics has home and clinic versions and the child can work on this therapy tool independent from clinical monitoring.

Lindamood-Bell Learning Programs

A specific learning program that focuses on intensive training of phonological skills. The child can attend a LMB school in addition to their certified school or as their certified school depending on the needs of the child. LMB performs their own assessment and provides the parents with a plan of care.

Localization Training

Using a clock like configuration of cards surrounding the patient, move to various locations with the patient blindfolded and test for appropriate localization of the tester's voice.

Refer to Katz "Therapy for APD: Simple and Effective Procedures" for specific procedures and scoring technique.

Top-Down Approaches OPEN FOR DISCUSSION

- Communication Strategies
- Classroom/Environmental Considerations
- Compensatory Strategies
- Miscellaneous Recommendations

Qualitative of responses Tolerance Fading Memory

- "Yes": Response to carrier phrase "Are you ready?" prior to starting each item despite instruction to refrain from doing so.
- Smush-1: Combines parts of two competing words- middle words- typically 2 errors-
- Tongue Twisters: Knows answer but does not say it right- Quick: Starts responding too soon before item is completely presented despite instruction provided to refrain from doing so
- Are You Ready- Repeating the carrier phrase despite instruction given to refrain from doing so.

Effective Bottom-up Therapy Programs for TFM

- Speech-in-noise training
- WINT-3 (Words-in-noise training)
 - Noise desensitization training
 - ILS Language Program
 - Little Listeners PASE Program Words-in-Noise recordings
- Memory training
- Rote memory exercises
 - Memory Span Training
 - Memory Duration Training
 - Memory Interference Training
 - Sequencing Training Deficits

Speech-in-noise (SPIN) Training

This kind of training can be accomplished through formal and informal tools.

Formally, you could use a tool like the WINT, mentioned earlier.

Informally, a noise desensitization program can be utilized at home and will help to reduce intolerance to background noise:

In casual non-learning environments (coloring for fun, putting together puzzles, or playing a board game) have soft, steady background music playing (i.e. - classical as opposed to pop music). Gradually increase the volume and the type of music to louder, more disruptive background noise over the course of days or weeks. Eventually work towards reading in background noise. In the meantime, avoid these frustrating learning environments when it is important to truly concentrate. Ultimately, one can not completely learn to cope with these environments without these experiences, but they need to be controlled and graduated to avoid "overload".

WINT-Noise Desensitization Program

- This is a speech-in-noise remediation tool that helps a child learn how to listen in and tolerate background noise. It is best to administer this test through an audiometer with calibrated headphones that can deliver the stimulus to each ear individually and at controlled levels, but the administration can be modified to be delivered through soundfield speakers.

Test materials and detailed instructions available through:
 Upstate Advanced Technologies
 12 Shadow Vale Drive
 Penfield, NY 14526 585-381-3459
gbsusat@frontiernet.net

Memory Span, Duration and Interference Training

- Utilize basic auditory memory tasks while gradually increasing the number of stimulus items, the duration of retention and interference.

Rote Memory Exercises

- Brain HQ by Posit Science (Fast Forward)
- Brain Builder –Advance Brain Technologies
- Superduperinc.com – Auditory memory games
- Lumosity.com

Sequencing Training

- After some successful memory training has been completed, expand the complexity by requiring the listener to remember the stimuli in a particular order.

Little Listeners PASE Program

PASE – Primary Auditory Skills Exercises:

- Includes direct listening activities for Distorted Words, Words-in-Noise and Competing Words as well as Interactive Metronome training for temporal processing remediation
- Clinical and Home-based versions available

Top-Down Approaches for TFM Deficits OPEN FOR DISCUSSION

- Communication Strategies
- Classroom/Environmental Considerations
- Compensatory Strategies
- Miscellaneous Recommendations

Qualitative or response Integration

- Extreme Delays: Extra time taken to respond accurately although evidently effortless

Effective Bottom-up Therapy Programs for Integration Deficits

- Little Listeners PASE Program
- Interhemispheric exercises to improve transfer of information (verbal-to-motor, motor-to-verbal) from one lobe to the other
- Dichotic listening training or Dichotic Offset training
- Sensory Integration training
- Speech-in-noise training
- Localization training
- Interactive Metronome

Dichotic Listening and Dichotic Offset Training

These tests focus on improving dichotic listening skills. Delivered via an audiometer, phonemes are used as the stimuli, instead of numbers to decrease the redundancy and increase the complexity of the task. The stimuli is presented to both ears at the same time with a slight "offset" of time in ms, starting with longer offsets and progressing to shorter offsets until the stimuli is almost simultaneous.

Interhemispheric Exercises

- Basic interhemispheric function exercises that force information to transfer from one lobe to the next and vice versa:
- Crossing midline exercises
- Piano
- "Feely bag" game
- Integration Toys
 - (Bop-It, Catch Phrase, Scrabble, Twister, UpWords, etc...)

Top-Down Approaches for Integration Deficits (OPEN FOR DISCUSSION)

- Communication Strategies
- Classroom/Environmental Considerations
- Compensatory Strategies
- Miscellaneous Recommendations

Effective Bottom-up Therapy Programs for Prosodic Deficits

- Interactive Metronome (Rhythm training for temporal processing remediation)
- Prosody training to focus on perception and production of suprasegmental aspects of speech, gestalt (part-to-whole) patterning skills, and oral reading with exaggerated prosodic features.
- Key word extraction
- Pitch, rhythm, and duration pattern training
- Reading Assistant Program - Fast Forward
- Auditory discrimination using non-speech stimuli (frequency, intensity, or duration difference limens; tonal glides)
- Speech-language intervention for pragmatics and prosody of speech.
- Acoustic Pioneer- Zoo Caper/ Insane Earplane

Top-Down Approaches for Prosodic Deficits (OPEN FOR DISCUSSION)

- Communication Strategies
- Classroom/Environmental Considerations
- Compensatory Strategies
- Miscellaneous Recommendations

Effective Bottom-up Therapy

- Programs for Auditory/Associative Deficits
- Appropriate remediation includes a comprehensive language assessment if one has not already been performed and speech-language intervention focusing on receptive language skills.
- Auditory and Language Skills overlap and bleed together
- Auditory Comprehension and Reasoning (Cohesion skills-TAPS)
- Therapy that targets ability to follow single and multistep directions
- Virtual Speech Center apps

Top-Down Approaches for Auditory/Associative Deficits

- OPEN FOR DISCUSSION
- Communication Strategies
- Classroom/Environmental Considerations
- Compensatory Strategies
- Miscellaneous Recommendations

Synchrony and Synergy

- The net affect of listening from both ears is much greater than the sum of the individual ear capacities
- A well-timed (synergy) and coordinated (synchrony) complex neurological foundation is necessary for filtering, processing and integration of incoming signals which fosters an effective and efficient system

Whole Brain

Whole Brain Function	Left Hemisphere	Right Hemisphere	Both Hemispheres
Listening	Phonemic Awareness Auditory Discrimination Auditory Attention Auditory Memory Auditory Integration	Phonemic Awareness Auditory Discrimination Auditory Attention Auditory Memory Auditory Integration	Listening
Remembering	Phonemic Awareness Short Term Memory Auditory Attention Auditory Memory Auditory Integration	Phonemic Awareness Short Term Memory Auditory Attention Auditory Memory Auditory Integration	Remembering Organization-Output
Reading	Phonemic Awareness Short Term Memory Auditory Attention Auditory Memory Auditory Integration	Phonemic Awareness Short Term Memory Auditory Attention Auditory Memory Auditory Integration	Remembering Organization-Output Integration Phonics
Organization	Phonemic Awareness Short Term Memory Auditory Attention Auditory Memory Auditory Integration	All of the above	All of the above

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Recommendations

- Bottom-Up
 - Phonemic Skills Training (recognition and blending)
 - Speech in Noise Training
 - Short Term Memory Training (input, span, and recall)
 - Dichotic Skills Training
 - Ear Separation/Lateralization/ Localization Training

Recommendations

- Top-Down
 - Speech and Language Therapy
 - Executive Function skills
 - (including self-monitoring; self-correction; and self-advocacy)
 - Critical Thinking Skills
 - Compensation strategies
 - Accommodations
 - Self-Advocacy
 - Hearing Aids and Assistive Technology

Considerations for All APD Deficits

- Psycho-educational evaluation to determine learning style and any co-existing learning disabilities/Executive skills weakness
- Speech Language Assessment for Communication skills
- Occupational therapy-evaluation if sensory concerns are evident during testing; Headphone intolerance/ Fidgety /Restless/cranky. Assess whether an associated sensory integration issue exists
- Vision therapy evaluation if math detail or reading fluency/accuracy problems are reported in the case history.
- Physician consult for medication or medication management if necessary

APD Assessment and Management in Schools

- Not ideal! Public schools do not have the resources to provide one-on-one therapy to all kids in need. Group therapy is contraindicated due to the intensity of the therapy needed and difficulty many kids have with group listening.
- The schools often have very rigid qualification protocols. If a child is in the "gray area" or works too hard to make good grades, they won't qualify for any services.
- Until recently, schools did not recognize APD as a stand-alone diagnosis. If other diagnoses didn't exist, the most a family could fight for was 504 accommodations which does nothing to improve the bottom up skills.
 - However... a recent statement from ASHA suggests change is coming:
<https://www.asha.org/EvidenceMapLanding.aspx?id=8589936309&recentarticles=false&year=undefined&tab=all>
<https://www.asha.org/EvidenceMapLanding.aspx?id=8589936309&recentarticles=false&year=undefined&tab=all>

Contact us if you want to be part of our group



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Discussions and Questions
