

AUDITORY PROCESSING IN THE EDUCATIONAL SETTING

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Auditory Processing Where are We?

- ▣ What do you know about auditory processing?

- ▣ What do you want to know about auditory processing?

- ▣ What is auditory processing/auditory processing disorder?

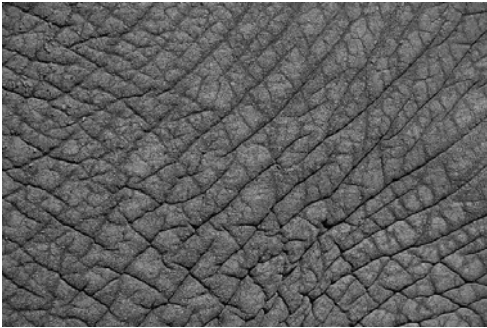
Auditory Processing

- ▣ What is auditory processing?
 - what is done with what is heard, what we do with what we hear, how the brain takes acoustic information and transforms it to meaningful information

- ▣ Auditory processing may be described as the “efficiency and effectiveness by which the central nervous system (CNS) utilizes auditory information” (ASHA, 2005).

- ▣ What is an auditory processing disorder?
 - Difficult to define:
 - ▣ Lack of consensus
 - ▣ Complexity of APD
 - ▣ Heterogeneity of APD
 - ▣ Some people would argue that APD does not exist

What are you looking at?



Joao Pereira

What are you looking at?



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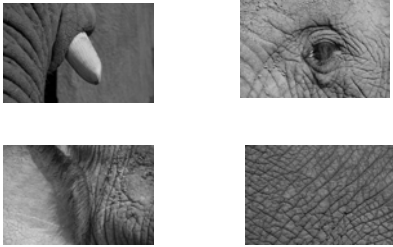
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Auditory Processing Disorder

- ❑ A deficit in the perceptual processing of auditory stimuli, and the neurobiological activity underlying that processing
- ❑ Cannot be attributed to higher-order language, cognitive, or related confounds
- ❑ May lead to or be associated with difficulties in higher-order language, learning and communication function
- ❑ May co-exist with, but is not the result of, dysfunction in other modalities (Bellis, 2004)

ASHA definition

- ❑ ASHA defines APD as “a deficit in neural processing of auditory stimuli that is not due to higher order language, cognitive, or related factors” (2005)
- ❑ Auditory mechanisms and processes responsible for the following behavioral phenomenon:
 - Sound localization and lateralization
 - Auditory discrimination
 - Auditory pattern recognition
 - Temporal Aspects of audition
 - Auditory performance decrements with competing acoustic signals
 - Auditory Performance decrements with degraded acoustic signals

(ASHA, 1996 & 2005)

Auditory Processing Mechanism

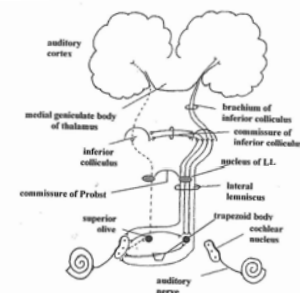
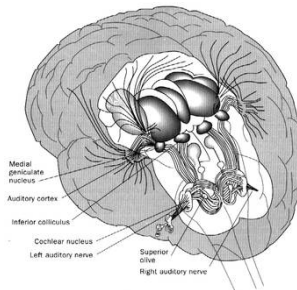


Figure 1-9. Simplified schematic of ascending brainstem auditory pathways.

Auditory Processing Mechanism



<http://www.audiospeech.ubc.ca/haplab/auditoryPath.jpg>

Prevalence of APD

- ▣ 2-5% of school age population
- ▣ 2:1 ratio of boys to girls
 - (Chermak & Musiek, 1997)

Auditory Processing

- ▣ What causes an auditory processing problem in the pediatric population?
 - Diseased or injured central auditory nervous system <5%
 - Maturation delay 25-30%
 - Disorganized auditory processing system 65-70%

Chermak, 2001

Common Indicators of APD

- ▣ Behaves as if hearing loss is present
- ▣ Significant scatter across subtests on speech language and psycho-educational tests weakness in auditory dependent areas
- ▣ Verbal IQ scores may be lower than performance scores
- ▣ Child requires highly organized classroom
- ▣ Difficulty following multi-step directions
- ▣ Poor reading or spelling skills
- ▣ Difficulty with classroom discussion or group work
- ▣ Withdrawn or sullen
- ▣ History of Otitis media
- ▣ Poor singing or music skills
- ▣ May have motor skill delays or concerns

Differential Diagnosis

- ☐ What do we need to differentiate between?
- ☐ What looks like APD?
 - Hearing Loss
 - ADHD
 - Auditory Neuropathy/Dysynchrony
 - Others?

ADHD or (C)APD

ADHD	CAPD
1. Inattentive	1. Difficulty hearing in Background Noise
2. Distracted	2. Difficulty following oral instructions
3. Hyperactive	3. Poor listening skills
4. Fidgety or restless	4. Academic difficulties
5. Hasty or impulsive	5. Poor auditory association skills
6. Interrupts or intrudes	6. Distracted
	7. Inattentive

Chermak, 1999

Risk Factors

Hearing Loss	Auditory Neuropathy/Dysynchrony	(C)APD
Family History	Family History	Family History
Infections	Infections	Infections
Hyperbilirubinemia	Hyperbilirubinemia	Hyperbilirubinemia
Craniofacial Anomalies	Immune disorders	Rh incompatibility
Low Birth Weight	Uremia	Difficulty During Birth
Other Syndromes	Genetic Syndrome	Toxic Exposures
Ototoxic Medication		Ototoxic Medication
Prematurity		Prematurity
Anoxia		Anoxia
Infections after Birth		Infections After Birth
Mechanical Ventilation		Head Trauma
Bacterial Meningitis		Cerebrovascular disorders
		Metabolic disorders
		Epilepsy
		Recurrent otitis media
		Meningitis/Encephalitis
		Developmental Disorders

From: Hurley & Hurley (2007) Differential Diagnosis of (C)APD and Neuropathy, Chapter 14, in Handbook of Central Auditory Processing Disorder, Auditory Neuroscience and Diagnosis, Vol. 1, Musiek and Chermak, Eds.

Auditory Processing Assessment

- ☐ Teacher Checklists
 - FISHER'S
 - CHAPS
 - SAB
- ☐ Classroom Observation
 - Attention span (structured and unstructured)
 - Cooperative and willingness to try (easy/difficult)
 - Response to frustration
 - Need for praise and encouragement

Who Evaluates for Auditory Processing?

- ▣ Multidisciplinary Evaluation
 - Psychologist
 - Speech Language Pathologist
 - Occupational Therapist
 - Audiology
- ▣ Audiologist Diagnoses
 - Multi modality
 - Modality Specific
 - Performance based
 - Diagnosis based

Audiometric Evaluation

- ▣ Confirm or rule out peripheral hearing sensitivity problem.
- ▣ Hall (2004) reported 35% of patients referred for auditory processing evaluation had unidentified hearing loss.
 - Middle ear problems
 - Sensorineural problems

Auditory Processing Assessment

- ▣ Audiometric
 - Monotic speech tests – understand words or sentences with each ear separately
 - Low pass filtered speech
 - Auditory figure ground
 - Monotic tone tests – each ear separately with tones (pitch perception and temporal functioning)
 - Duration pattern test
 - Pitch Pattern test

Auditory Processing Assessment

- ▣ Audiometric (cont'd)
 - Dichotic speech tests – different stimulus is presented simultaneously to each ear.
 - Competing Sentence tests
 - Competing Words
 - Dichotic Digits
 - Binaural Integration/Interaction tests
 - Binaural fusion
 - Masking level differences
 - Speech in noise presented binaurally or in soundfield

Auditory Processing Assessment

- ▣ Non-audiometric Assessments
 - Attending
 - Discrimination
 - Memory
 - Language Comprehension

Auditory Processing Protocol

- ▣ Educational Relevance???

 - Is child having an educational problem? No, then why?
 - Will an auditory processing evaluation provide additional information to what is already known?
 - Will intervention be planned to accommodate or deal with any auditory processing concerns?

Auditory Processing Protocol

- ▣ Multidisciplinary Evaluation (esp. SLP/Academic/Psychological)
- ▣ Checklists
 - Fishers
 - CHAPS
 - SAB
- ▣ Observation (if done by SW or principal)
- ▣ Case History

Auditory Processing Protocol

- ▣ Audiologic Battery
 - SCAN-C (Filtered Words, Auditory Figure Ground, Competing Words, Competing Sentences)
 - MAPA (SAAT, Dichotic Digits, Pitch Patterns, Tap Test, Competing Sentences)
 - BKB SIN (Speech in Noise)
 - BIO MAP (Speech stimulus ABR – electrophysiological evaluation)

MAPA Multiple Auditory Processing Assessment

- Schow, Seikel, Brockett and Whitaker, 2007
- 10 years of development
- Compilation of tests that evaluate ASHA recommended areas, documented through factor analysis studies
- Available through Auditec of St. Louis
 - www.auditec.com

Test Domains

- Auditory Patterning and Temporal Ordering, APTO
- Monaural Separation Closure, MSC
- Binaural Integration Binaural Separation, BIBS

Table 6-8. Auditory Domain, ASHA-Defined Area, and Potential Specific Test Instrument

Auditory Domain	ASHA (1996, 2005) Defined Area	Specific Test Instrument
Temporal Auditory Pattern/Temporal Ordering (APTO)	Auditory Temporal Processing and Patterning	"MAPA P100 Pattern Test" "MAPA P100 Test" "MAPA P100 Pattern Test" "Auditory Pattern Test Revised" "Clock Sequence Pattern"
Monaural Separation Closure (MSC)	Monaural Listening Comprehension Speech Tests	"MAPA M100" "MAPA M100 Speech in Noise for Children & Adults" "SCAN Auditory Figure Ground" "SCAN Figure Ground" "SCAN Figure Ground and Auditory Figure Ground" "Quick & Dirty" Time-extended/compressed speech Performance-Integrity Functions (PI-F) Speech in Noise (SIN) Speech in Noise (SIN) Speech in Noise Identification (SIN-IDS)
Binaural Integration Binaural Separation (BIBS)	Dichotic Speech Tests	"MAPA B100" "MAPA B100 Speech in Noise" "SCAN Competing Words" "Competing Speech Words" "SIN" "Clock Dichotic Digit"
Auditory Discrimination Tests	Difference Limens for Intensity	Intensity Level Difference Intensity Level Difference (SIL) (Intensity Intensity) Sound Localization and Localization
Electroacoustic Measures	Otoacoustic Emissions (OAE) and Acoustic Reflex Threshold	Otoacoustic Emissions (OAE) and Acoustic Reflex Threshold
Physiological Measures	Acoustic Reflex Decay (ARD) and Auditory Brainstem Response (ABR) Latency Response	Acoustic Reflex Decay (ARD) and Auditory Brainstem Response (ABR) Latency Response

From: Schow and Seikel (2007), Screening for (Central) Auditory Processing Disorder, in Chapter 6, *Handbook of Central Auditory Processing Disorder, Auditory Neuroscience and Diagnosis*, Vol. 1, Musiek and Cherniak, Eds.

Auditory Processing & Peripheral Losses

- Dichotic Digits
- Competing Sentences
- Electrophysiological
 - MLR
 - P300

Interpreting Results

- Subprofiles-Useful as Guidelines
 - Bellis/Ferre Model
 - Buffalo Model
- Functional Performance vs Disorder
- Differential Diagnosis must be Multidisciplinary

Bellis/Ferre Model

- ☐ Auditory decoding deficit
 - difficulty with speech in noise, speech discrimination, sound blending, retention of phonemes, reading, speech to print may be poor.
- ☐ Integration deficit
 - difficulty with multimodality tasks that require inter-hemispheric transfer of information.

Bellis, 2003

Bellis/Ferre Model

- ☐ Prosodic deficit
 - Difficulty with humor, multiple meanings and utilizing information in suprasegmentals of speech.
- ☐ Associative deficit
 - May demonstrate receptive language difficulties, can not apply rules of language to incoming auditory information
- ☐ Output-Organization
 - Difficulty in sequencing, planning and organizing responses.

Bellis, 2003

Buffalo Model

- ☐ Decoding – difficulty analyzing auditory information, may be difficulty with temporal processing
- ☐ Tolerance-Fading Memory – may have impulsivity and forgetfulness in response to auditory information, sensitive to noise, difficulty completing multi-step directions
- ☐ Integration – difficulty putting auditory and non-auditory information together
- ☐ Organization – difficulty with auditory sequencing, may occur with decoding or tolerance fading memory

Masters, Stecker & Katz, 1998

Auditory Processing Management

- ☐ Environmental Modifications
- ☐ Direct Treatment
- ☐ Compensatory Strategies

Auditory Processing Management

- ▣ Environmental Modifications
 - Classroom Accommodations
 - "Preferential Seating"
 - Pre-teaching of new material
 - CLEAR Speech
 - Rephrase vs Repeat
 - Consideration of Learning Styles (visual, kinesthetic, vs auditory)
 - Amplification
 - Personal FM systems
 - Classroom soundfield

Auditory Processing Management

Direct Treatment

- Work on specific Skills
 - Phoneme discrimination
 - Speech in Noise Training
 - Phonological Awareness
 - Speech in Print (Word Attack) skills

Auditory Processing Management

- ▣ Compensatory Strategies
 - Use strengths
 - Work Around weaknesses
 - Teach Active Listening Techniques
 - Auditory Closure Skills
 - Vocabulary Building
 - Schema Induction

Case Study #1

- ▣ Male, Age 11
- ▣ History of middle ear infections, which have subsided following a tonsillectomy
- ▣ Academic difficulty with math, writing, and reading; additional support services are provided in the resource room at school
- ▣ The Scale of Auditory Behavior (SAB) was completed by father and the fifth grade teacher. Both reported concerns regarding ability to follow oral instructions, general listening skills, distraction and inattentiveness, and poor organization skills.

Case Study #1

- All audiological tests were normal. Hearing levels ranged from -5 dB HL to 5 dB HL. (Normal=20 dB HL or lower).

APD TEST PROTOCOL	Test Score Right	Test Score Left	Percentile
SCAN-C			
Filtered Words	16/20	15/20	31/40 = 16 th Percentile
Auditory Figure Ground	14/20	13/20	27/40 = 2 nd Percentile*
Competing Words	22/30	7/30	29/60 = 2 nd Percentile*
MAPA			
			Standard Deviation
Competing Sentences	10/10 = 100%	3/10 = 30%*	+1.5/-3
Dichotic Digits	34/40 = 85%	10/40 = 25%*	-1.5/+3
Pitch Patterns	21/30 = 70%*	25/30 = 83%*	>-3/+3
Speech In Noise			
Ranford-Kowal-Bench (BKB) Speech in Noise = 2dB (within normal limits)			

*outside normal limits

Case Study #1

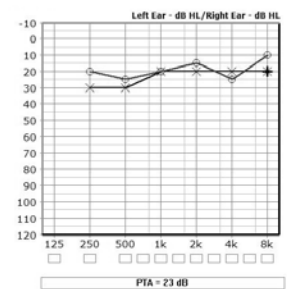
- Management and Recommendations
- See Handout

Case Study #2

- Male, 16 years old
- Screening done in SD suggested APD problems
- Hx: middle ear problems, brother dx with APD, sensitive to loud sounds, appears to be confused in noisy places, easily upset by new situations, difficulty following directions, short attn span, easily distracted, forgetful asks for repetition, shy, lacks self confidence, lacks motivation, does not complete assignments, easily fatigued, dislikes school.
- SAB=29 (<30 suggests need for eval)

Case Study #2

- Hearing evaluation
- Normal hearing for <18 years of age= 20 dB HL or less
- Hearing levels that are outside normal limits.
- Slight hearing loss.



Testing Results

- ☐ Quick SIN @ 70 dB HL=3.5 dB SNR
- ☐ Quick SIN @ 50 dB HL=10 dB SNR

Domain	Test	within 1 SD binomial	>+1 SD	>+2 SD
MSC—Monaural Separation Closure	MSAAT RE	X		
	MSAAT LE	X		
	SINCA RE			X
APTO—Auditory Pattern Temporal Ordering	SINCA LE			X
	Pitch Pattern			X
BIBS—Binaural Integration Binaural Separation	DP	X		
	DD	X		
	CS RE		X	
	CS LE			X
	SCAN CW**			X
	SCAN CS**			X

Case Study #2

- ☐ Management and Recommendations
- ☐ See Handout

Resources

- ☐ <http://www.cde.state.co.us/cdesped/download/pdf/CI-APD-Gu.pdf>
- ☐ <http://www.fl DOE.org/ese/pdf/y2001-9.pdf>

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