Auditory Processing Disorder

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Auditory processing is not only what we hear, it is how we process and use the information that we hear.

Central Auditory Processing includes the auditory mechanisms that underlie the following abilities:

- Sound localization and lateralization
- Auditory discrimination
- Auditory pattern recognition
- Temporal aspects of auditory – including temporal integration, temporal discrimination (ie: gap detection), temporal ordering and temporal masking
- Auditory performance with competing or degraded acoustic signals

Evidence of APD

- Audiological evidence from children and adults with known lesions of APD
- Studies of children and adults whose only complaint is the inability to hear well in difficult listening situations, yet they have no concomitant speech and language deficits
- Listening problems of the elderly that can be associated with age related changes in the central auditory system
Evidence of APD

- Listening problems of the elderly that can be associated with age-related changes in the central auditory system
- Auditory Brainstem Response

Charateristics of APD

- Difficulty understanding speech in background noise
- Misunderstanding messages
- Responding inconsistently or inappropriately
- Frequently asking that information be repeated
- Taking longer to respond in oral communication situations
- Difficulty following long conversations
- Difficulty with phone conversation
- Difficulty attending and avoiding distraction
- Difficulty following complex auditory directions

Evidence of APD

- Poor Readers
  - Poor timing – delayed latencies
  - Poor representation of pitch – reduced amplitude
  - More variation of response – less consistency

Characteristics of APD

- Reduced tolerance or sensitivity to loud noise
- Heightened sensitivity or better than normal thresholds to sound
- Weak auditory memory
- Difficulty with sound localization
- Reading, spelling and learning problems
- Reduced musical and singing skills

APD Diagnosis

- Referrals
- Case History / Previous Records
  - Birth History
  - Developmental Milestone History
  - Hearing History
  - Medical History
  - Educational History
  - Social and Behavioral functioning
  - Previous Evaluations
  - Previous Therapies

Medical History of APD

- Degenerative processes such as multiple sclerosis
- Seizure disorders
- Head trauma
- Cerebrovascular accidents
- Metabolic disorders
- Cerebromorphological abnormalities
- Neuro-maturational Delays, often secondary to auditory deprivation
- Age-related changes in CANS function
Hearing Evaluation

- Diagnostic Audiological Evaluation
  - Immittance
  - Air, Bone, Speech in quiet
  - Otoacoustic Emissions

APD Evaluation

- APD Screening Evaluation
  - Ages 3 years, 6 months through 5 years, 11 months
- APD Diagnostic Evaluation
  - Ages 6 years to 50 years

Test Battery

- APD Screening Evaluation
  - Auditory Skills Assessment
    - Speech Discrimination – speech in noise, mimicry
    - Phonological Awareness – blending, rhyming
    - Nonspeech Processing – patterning, ordering
  - SCAN 3 C – screening
    - Auditory Figure Ground (+ 8 dB SNR)
    - Competing Words – Free Recall
  - Phonemic Synthesis

- APD Diagnostic Evaluation
  - Staggered Spondaic Word (SSW) Test
  - Phonemic Synthesis Test
  - SCAN 3 (adult or child version)
    - Filtered Words
    - Competing Words (Directed Ear vs. Free Recall)
    - Competing Sentences
    - Auditory Figure Ground
    - Time Compressed Sentences
    - Random Gap Detection

Scoring Tests

- Raw Score
  - 2010 Academy of Audiology Recommendations: Two or more tests that are two or more standard deviations away from the mean
- Behavioral Score
- Ear Advantage findings
- Patterns of test findings

Differential Diagnosis

- APD can coexist or mimic other disorders
- Clinicians must consider the following:
  - Attention
  - Memory
  - Low cognitive skills
  - Mental disorders
  - Autism Spectrum Disorder
  - Language processing
  - Lack of motivation
- Hearing loss
Differential Diagnosis - Attention

- Types of attention
  - Vigilance: capacity to maintain attention to external stimuli
  - Concentration: capacity to attend to internal stimuli
  - Selective: capacity to shift attention from one stimulus to another

Differential Diagnosis - Attention

- True attention disorders manifest themselves across sensory modalities rather than in the auditory modality only
- ADHD is a rule governed disorder, or a disorder of executive control and behavioral self regulation that affects multiple modalities
  - Problems initiating, inhibiting, sustaining, or shifting response to tasks or stimuli
  - Strong family contribution
  - Transfer of Dopamine fails, leading to a delay of gratification and seeking stimulation elsewhere

Differential Diagnosis - Attention

- ADHD Diagnosis (DSM-V)
  - Inattentive Type
    - Inattentive to details or makes careless mistakes
    - Trouble keeping attention on tasks or play activities
    - Does not seem to listen when spoken to directly
    - Does not follow through and fails to finish schoolwork, chores or duties
    - Trouble organizing activities
    - Avoids, dislikes, or doesn’t want to do things that take a lot of mental effort for a long time period
    - Loses things needed for tasks and activities
    - Easily distracted by extraneous stimuli
    - Forgetful in daily activities

Differential Diagnosis - Attention

- ADHD Diagnosis (DSM-V)
  - Hyperactivity
    - Fidgets with hands or feet or squirms in seat
    - Leaves seat when remaining seated is expected
    - Runs or climbs excessively when not appropriate
    - Trouble playing or doing leisure activities quietly
    - Often ‘on the go’ or acts as if ‘driven by a motor’
    - Talks excessively
    - Impulsivity
    - Blurs out answers before questions have been finished
    - Trouble waiting one’s turn
    - Interrupts or intrudes on others

Differential Diagnosis - Attention

- Types of ADHD
  - Combined Type:
    - Both criteria of inattentiveness and hyperactivity are met for the past 6 months
  - Predominantly Inattentive Type:
    - Criteria of inattentiveness is met for the past 6 months
  - Predominantly Hyperactive-Impulsive Type:
    - Criteria of hyperactivity / impulsivity are met for the past 6 months

Differential Diagnosis – ADHD vs.. APD

- ADHD:
  - Represents a higher-order, more global cognitive attention or motivational deficit that is not sensory-modality specific
  - Cognitive disorder of pervasive inattentiveness (daydreaming and disorganization) and academic difficulties
  - Characterized by inappropriate motor activity, restlessness, and socially inappropriate interaction patterns
- APD:
  - Sensory-perceptual deficit in the processing of information that it specific to the auditory modality
  - Results in listening problems and difficulty maintaining auditory attention in quiet and competition
  - Characterized by a selective attention deficit and associated language processing and academic difficulties
Differential Diagnosis – ADHD vs. APD

ADHD – Inattentive
- Inattentive
- Distracted
- Hyperactive
- Fidgety / restless
- Hasty / impulsive
- Interruptive / intrusive
- Output disorder
- Blurs out answers
- Management with medications

ADHD – Hyperactive
- Difficulty hearing in noise
- Asks for things to be repeated
- Mishears things
- Difficulty following directions
- Poor listening skills
- Poor auditory association
- Poor memory
- Input disorder

ADHD Diagnosis
- Questionnaires
  - Connors 3
  - Vanderbilt Assessment Scale
  - Behavior Assessment System or Children (BASC)
  - Child Behavior Checklist / Teacher Report form
- Personal Observation
- TOVA
- IVA+
  - Computerized test
  - Measures visual and auditory attention

The Utility of Visual Analogs of Central Auditory Tests in the Differential Diagnosis of (Central) Auditory Processing Disorder and Attention Deficit Hyperactivity Disorder
Teri James Bellis, Cassie Billiet, Jody Ross

- 3 purposes of study
  - Differences in performance of children with APD as compared to those with ADHD and those with no disorder on central tests and their corresponding visual analogs
  - Degree of auditory modality specificity of deficits observed for the children with APD
  - Contribution of the visual analogs to the differentiation of the children with APD from those with ADHD and from typically developing children

Attention Case #1 – DN
- Case History
- Audiological Evaluation
- APD Evaluation
- Impressions
- Recommendations

Attention Case #2 - AB
- Case History
- Audiological Evaluation
- APD Evaluation
- Impressions
- Recommendations

Attention Case #3 – LW
- Case History
- Audiological Evaluation
- APD Evaluation
- Impressions
- Recommendations
Attention: Things to look for....

- Consider case history
- Consider checklist of behaviors
- Auditory electrophysiological tests
- Patterns of test findings
- May be co-existing conditions

Differential Diagnosis – Cognition and Memory

- Cognitive Disorders:
  - Higher order, supramodal disorders that affect function across sensory modalities
  - i.e.: mental dysfunction
  - APD does not typically underlie these more pervasive disorders but should be considered a symptom of the cognitive deficit
- Memory:
  - Higher order, supramodal cognitive skill that interacts with incoming sensory input to affect retention of information
  - Seen in APD secondary to decoding deficits

Cognition Case #1 - AR

- Case History
- Audiological Evaluation
- APD Evaluation
- Impressions
- Recommendations

Cognition Case #2 - CW

- Case History
- Audiological Evaluation
- APD Evaluation
- Impressions
- Recommendations

Cognition: Things to look for....

- Consider case history
- Verbal IQ score versus Non-verbal IQ
- Consider checklist of behaviors
- Auditory electrophysiological tests
- Patterns of test findings – ear advantages
- Remember: APD is symptom of global dysfunction
- Consider comparing score to chronological age and mental age

Autism

- Developmental disability that can cause significant social, communication and behavioral challenges
- New diagnostic criteria – DSM V
  - Social (Pragmatic) Communication Disorder
  - Autism
Characteristics of Autism

- Not point at objects to show interest (for example, not point at an airplane flying over)
- Not look at objects when another person points at them
- Have trouble relating to others or not have an interest in other people at all
- Avoid eye contact and want to be alone
- Have trouble understanding other people's feelings or talking about their own feelings
- Prefer not to be held or cuddled, or might cuddle only when they want to
- Appear to be unaware when people talk to them, but respond to other sounds
- Be very interested in people, but not know how to talk, play, or relate to them
- Repeat or echo words or phrases said to them, or repeat words or phrases in place of normal language
- Have trouble expressing their needs using typical words or motions
- Not play "pretend" games (for example, not pretend to "feed" a doll)
- Repeat actions over and over again
- Have trouble adapting when a routine changes
- Have unusual reactions to the way things smell, taste, look, feel, or sound
- Lose skills they once had (for example, stop saying words they were using)

Autism Case #1 - SK

- Case History
- Audiological Evaluation
- APD Evaluation
- Impressions
- Recommendations

Autism Case #2 - TG

- Case History
- Audiological Evaluation
- APD Evaluation
- Impressions
- Recommendations

Differential Diagnosis – Communication Disorders

- Expressive language disorder
- Receptive language disorder
- Articulation / Phonological disorder

Differential Diagnosis – Communication Disorders

- APD
  - Difficulty hearing in noise
  - Difficulty following directions
  - Poor listening skills
  - Poor auditory association
  - Mishears words
  - Input disorder

- Language Processing
  - Difficulty getting to the point
  - Difficulty organizing and expressing thoughts
  - Difficulty getting started with open ended questions
  - Uses vague language
  - Word finding difficulties
  - Pronounced differences between performance and verbal abilities

Differential Diagnosis – Communication Disorders

- Did you hear it?
  - L - Yes; APD - ?
- Can you repeat it?
  - L - Yes; APD - No
- Can you identify the first sound? Another sound?
  - L - Yes; APD - No
- Will saying it slower help?
  - L - No; APD - Yes
- Will repeating it multiple times help?
  - L - ?; APD - Yes
- Will making it louder help?
  - L - No; APD - Yes
Communication Disorders: Case #1 - LE

- Case History
- Audiology Evaluation
- APD Evaluation
- Impressions
- Recommendations

Communication Disorders: Things to look for....

- Consider case history
- Consider checklist of behaviors
- Auditory electrophysiological tests
- Test condition versus normal, non-manipulated condition
- Patterns – ear effects

Differential Diagnosis – Hearing Loss

- Things to consider
  - Peripheral hearing dysfunction changes input that is provided to the CANS for processing
  - Structural and functional reorganization of central auditory pathways occurs at the sub cortical and cortical levels secondary to hearing impairment
  - Many measures of central auditory function are affected by hearing loss
- Testing
  - SSW – Corrected SSW analysis
  - Dichotic Digits
  - Competing Sentences
  - Frequency Patterns / Durations Patterns
  - What did we learn from article?

Hearing Loss Case #1 - AC

- Case History
- Audiology Evaluation
- APD Evaluation
- Impressions
- Recommendations

Hearing Loss Case #2 - ER

- Case History
- Audiology Evaluation
- APD Evaluation
- Impressions
- Recommendations

Hearing Loss Case #3 - BR

- Case History
- Audiology Evaluation
- APD Evaluation
- Impressions
- Recommendations
Hearing Loss: Things to look for....

• Consider case history
• Consider checklist of behaviors
• Auditory electrophysiological tests
• Ear advantage findings with symmetrical hearing loss
• Unilateral hearing loss – poor performance in normal hearing ear

Differential Diagnosis – Cognitive Aging

• Biology of aging
  – Neural timing
  – Decreased inhibition
  – Broader neural tuning
  – Temporal jitter
  – Longer neural recovery
  – Increased neural noise
  – Decreased brain connectivity

Differential Diagnosis – Cognitive Aging

• Communication Challenges
• Aging
  – Gains:
    • Knowledge is preserved
    • Vocabulary
    • Expertise
    • Context
  – Losses:
    • Working memory
    • Processing speed
    • Divided attention
    • Possible hearing loss

Differential Diagnosis – Mental Disorders

• Mental disorders:
  – i.e.: personality disorders, bipolar, schizophrenia
  – Effects of medications

Differential Diagnosis – Mental Disorders

• Case History
• Audiological Evaluation
• APD Evaluation
• Impressions
• Recommendations

Mental Disorders Case #1 - ER

• Effects of short term training study
  – 75 adults (age 55 to 79)
  – Procedure
    • Initial Testing
    • 8 weeks of brain fitness or educational videos
  – Results
    • Faster neural timing for the auditory training group, especially for consonants
    • Significant increases in working memory
    • 1 dB increase on hearing in noise test
Traumatic Brain Injury

• Caused by a bump, blow or jolt to the head or a penetrating head injury that disrupts the normal function of the brain
• Severity – mild to severe
• Functional deficits
  – Thinking – memory and reasoning
  – Sensation – touch, taste and smell
  – Language – communication, expression and understanding
  – Emotion – depression, anxiety, personality changes, aggression, acting out, social inappropriateness

Traumatic Brain Injury

• APD Evaluation
  – Chief Complaint: auditory memory
  – Temporal processing
  – Hearing in noise
• APD Treatment
  – Accommodations
  – Compensation strategies

Midwest Ear Institute Therapy

• 14 therapy sessions followed by a re-evaluation
• Therapy carried out by audiologists and speech pathologists
• Home therapy can also be recommended via computer training or use of Ipad/Tablet apps
• Collaboration with schools and IEP teams

Future Directions

• Objective measures study at Midwest Ear Institute using late auditory evoked potentials pre and post therapy
• More training for professionals in Kansas City
• More outreach services for school districts

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