Agenda - 60 minutes

APD Diagnosis
- Discuss rationale for APD as a diagnosis

Evaluation as an APD team
- Who does what?
- Using screening tools to identify and refer appropriately for diagnostic testing

Treatment Strategies
- Using the diagnosis to identify appropriate treatment for individual patients
APD Diagnosis: Does APD Exist?
What is APD?

APD is a deficit in one or more of the auditory mechanisms which underlie tasks such as:

- localization and lateralization,
- discrimination,
- temporal processing
- performance under conditions of degraded and/or competing acoustic signals.

APD may occur alone or may coexist with higher-level, global disorders which impact general processing abilities, including attention- and language-related disorders (ASHA, 1996).
ASHA uses the term Central Auditory Processing Disorder (CAPD) to refer to deficits in the neural processing of auditory information in the CANS not due to higher order language or cognition, as demonstrated by poor performance in one or more of the skills listed above (ASHA, 2005).

AAA: (C)APD refers to difficulties in the perceptual processing of auditory information in the central nervous system and the neurobiologic activity that underlies that processing and gives rise to the electrophysiologic auditory potentials. (AAA, 2010)
Does APD Exist?

- Individuals with APD have difficulty hearing that is not explained by a peripheral hearing loss.
- These individuals exhibit specific patterns of dysfunction on tests of central auditory function that mirror those of known pathologies involving the CANS and nothing else.
- Growing body of evidence obtained from new technological measures of auditory processing is demonstrating that representation of sound in the higher brainstem or brain pathways of many of these individuals is different from that of other, non-disordered individuals.

CAPD is listed in the ICD-10 under ear diseases (code H93.25) for both acquired and congenital CAPD, which confirms the physiological nature of this disorder and supports the medical necessity for care.

US Ninth District Circuit Court precedent-setting ruling13 that children with CAPD are entitled to receive services in schools under the category of “other health impaired” (OHI). Also reiterated that audiologists are the professionals qualified to diagnose CAPD, the legitimacy of CAPD diagnosis for children is extremely well-supported and established for a population who has long been underserved in our schools, as well as for adults seeking help for CAPD.

How Many People Have APD?

- Incidence (children): 3 to 5% - more common than hearing loss (Chermak and Musiek, 1997)

- Types
  - Developmental (age, immaturity)
  - Compensatory (after lesion)

Evaluation of APD as a Team

- Audiologist
- Speech Language Pathologist
- Psychologist
- Educators
- Physician
- Occupational Therapist
- Neurologist
- Tutors
- Parents
ONLY the audiologist diagnoses an APD.

CAPD is an auditory deficit; therefore, the audiologist is the professional who makes the diagnosis (ASHA, 2005)

The diagnosis should be made by audiologists who have been properly educated and trained in the area of (C)APD, including the administration and interpretation of these tests and procedures. Acoustic control of both the test stimuli and the testing environment is essential, and at times special equipment is necessary to diagnose (C)APD. (AAA, 2010)
Diagnoses written, reading, and verbal language processing and can SCREEN for APD referral to audiology.

SLPs diagnose cognitive-communication and language-related disorders (including language processing disorders) that may co-occur with CAPD.

Differentiating between language and phonological processing disorders and CAPD requires collaboration between audiologists and SLPs.
Subsequent to a central auditory evaluation, a speech-language pathologist can explore the possible impact of auditory processing-related deficits on specific aspects of language processing. An initial speech-language evaluation may suggest underlying central auditory processing deficits, with subsequent referral for a central auditory processing evaluation.

Speech-language pathologists also are best prepared to provide a number of the interventions elaborated in the preceding section of these guidelines (e.g., central resources training). AAA, 2010
Educational/cognitive psychologist: These assessments include tests of memory, executive functioning, and attention. An educational psychologist or cognitive psychologist may perform these assessments. ASHA 2005

School psychologists evaluate the child’s cognitive abilities in a number of domains including verbal and non-verbal abilities, cognitive capacity, and attentional issues AAA 2010
Supporting role in assessment and intervention for (C)APD. In instances where a sensory integration disorder (also known as regulatory-sensory processing disorder) or a motor-sequencing deficit has been identified, the audiologist may confer with the occupational therapist to determine potential interactions between these purportedly pansensory deficits and a (C)APD. AAA 2010
Purpose of Screening for APD

- To determine the need for further testing
- To reduce over-referrals
Screening Tools

Acoustic Pioneer

- Feather Squadron iPad app
- Game based interface
- Self-scoring

The scores indicate significant auditory weaknesses in 4 key areas and mild auditory weaknesses in 3 key areas of the assessment when compared to same-aged peers. These areas are thought to be important for higher level abilities and educational abilities. Further investigation is suggested should there be noted functional language or reading difficulties or impaired general learning abilities.

<table>
<thead>
<tr>
<th>Non-linguistic area</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearing Screening and Lateralization</td>
<td>normal result</td>
</tr>
<tr>
<td>Tonal- Pattern Temporal Processing</td>
<td>normal result</td>
</tr>
<tr>
<td>Tonal- Pattern Memory</td>
<td>mild weakness</td>
</tr>
<tr>
<td>Rapid Tones</td>
<td>normal result</td>
</tr>
<tr>
<td>Dichotic double-sounds</td>
<td>significant weakness</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Linguistic area</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Word Memory</td>
<td>mild weakness</td>
</tr>
<tr>
<td>Rapid Speech</td>
<td>significant weakness</td>
</tr>
<tr>
<td>Dichotic double-numbers</td>
<td>significant weakness</td>
</tr>
<tr>
<td>Speech-in-Noise (without localization cues)</td>
<td>significant weakness</td>
</tr>
<tr>
<td>Speech-in-Noise (with localization cues)</td>
<td>mild weakness</td>
</tr>
</tbody>
</table>
Questionnaires - Fisher’s Auditory Problems Checklist

- Attention
- Auditory-visual integration
- Closure
- Comprehension
- Discrimination
- Figure-ground
- Localization
- Long-term memory
- Motivation
- Sequential memory
- Short-term memory
- Speech-language problems
Screening by Test

- Binaural integration/separation
- Speech in noise task
- Temporal Processing

- Commercially available: SCAN-C, CELF-4

- If you are not isolating the auditory system you are not testing APD; you are only testing language skills in a sound field environment, without isolating temporal conditions, background noise, or individual ear performance.
LI and APD often co-exist

- CELF -4: Children with APD had the most difficulty with
  - following directions
  - recalling sentences
  - formulation of sentence
  - forward number repetition (representing a memory task)

Sharma, et. al., (2009). JSLHR, 52, 706-722
Referral is made, APD is diagnosed....
What type of APD is diagnosed?

- A diagnosis of CAPD is enabled only when performance on > 2 tests is abnormal AND the pattern of findings is consistent with underlying neuroscience tenets (ASHA, 2005)

- Lack of a pattern (e.g., poor performance on all measures) argues for more global or motivational deficit, not CAPD
Areas of Auditory Processing

- Binaural Separation
  - Picking out 1 message
- Binaural Integration
  - Putting information together from multiple messages
- Monaural Separation/Closure
  - Filling in the missing pieces of the message
- Temporal Resolution
  - Acoustic contours of speech, sequencing, discrimination, gestalt pattern perception, trace memory
Basic Principles of Treatment Strategies

Intervention should arise logically from specific auditory deficits and functional/behavioral sequelae.

Results of diagnostic testing, along with other information, provide the framework.

The key to effective treatment is accurate diagnosis.
Intervention should:

1. Be a multidisciplinary endeavor, and should address both bottom-up and top-down skills.

2. Be individualized and deficit-specific (the diagnosis drives the treatment).

3. Focus on improving access to auditory information, strengthening central resources, and remediating the auditory deficit.
Step 1

- Identify the auditory deficits using results of behavioral central auditory testing and other data to determine specific areas of auditory dysfunction that need to be targeted.
Step 2

- Relate auditory deficits to language, learning, communication, and related sequelae for development of ecologically valid treatment plan

- Functional Deficit Profiling (Ex: Bellis-Ferre model)
### Types of APD - Main (Bellis-Ferre)

<table>
<thead>
<tr>
<th>Decoding Deficit - Primary auditory cortex</th>
<th>Prosodic Deficit - Non-primary (right) auditory cortex</th>
<th>Integration Deficit - corpus callosum</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Spelling</td>
<td>• Judging communicative intent</td>
<td>• Linking prosody and linguistic content</td>
</tr>
<tr>
<td>• Mimics hearing loss</td>
<td>• Social-Emotional Concerns</td>
<td>• Interhemispheric integration tasks</td>
</tr>
<tr>
<td>• Hearing in noise</td>
<td>• Perception, Prosody</td>
<td>• Phonological deficits</td>
</tr>
<tr>
<td>• Sound blending</td>
<td>• Monotone speech</td>
<td>• Auditory lang and memory deficit</td>
</tr>
<tr>
<td></td>
<td>• Visuospatial difficulties</td>
<td>• Poor bimanual coordination</td>
</tr>
</tbody>
</table>
## Types of APD - subtypes (Bellis- Ferre)

<table>
<thead>
<tr>
<th>Auditory Associative deficit - left (associative) cortex</th>
<th>Output Organization deficit - temporal to frontal and/or efferent system</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Receptive language deficits</td>
<td>• Poor hearing in noise</td>
</tr>
<tr>
<td>• Difficulty comprehending information of increasing linguistic complexity</td>
<td>• Motor Planning Difficulties</td>
</tr>
<tr>
<td>• Poor reading comprehension</td>
<td>• Poor organizational skills, expressive language, and word retrieval</td>
</tr>
<tr>
<td>• Poor math application</td>
<td>• Poor sequencing and follow through</td>
</tr>
</tbody>
</table>
Step 3

- Select appropriate treatment and management strategies based on auditory deficits and related functional sequelae identified.

- Should be individualized and ecologically valid.
APD Treatment
Environmental Modifications (bottom up and top down)

To enhance access to and acoustic clarity of auditory information

To increase opportunity for effective listening/learning
Compensatory Strategies/Central Resources Training (top-down)

To strengthen higher-order top-down processing skills (metacognition, metamemory, metalinguistic)

To overcome secondary/associated motivational and related deficits
Direct Remediation Techniques (bottom-up)

To improve auditory performance by altering the way the brain processes sound

Involve targeted activities that maximize neuroplasticity
Auditory Training

- Takes advantage of neuroplasticity
- Auditory training can lead to functional AND structural alterations in neural and perceptual processing of auditory information
- Stimulation needs to be
  - Frequent
  - Intense
  - Challenging
  - Active participation
Auditory Training

- There is no substitute for one on one relationship with a qualified therapist
- There is no substitute for parent involvement
- Deficit specific intervention
- Need skills to generalize
- Need to monitor and quantify progress
Computer assisted therapy

- Allow for multisensory stimulation, sustained interest, reinforcement, and intense/frequent stimulation
- Must be individualized and deficit-specific
Types of Computerized Therapy

**Acoustic Pioneer**
- Dichotic Listening (Zoo Caper Skyscraper)
- Tonal activities - memory, pitched tones (Insane Airplane)

**Capdots**
- Binaural Integration Deficits (Integrated)
- Binaural Separation Deficits (Selected)
Types of Computerized Therapy

National Acoustics Lab
- Temporal Processing
- Localization (SoundStorm app)

CLEARworks4ears
- Phoneme discrimination
- Auditory Attention, Auditory Memory, Processing speed, etc.
Putting it into practice – Case Study

Age 8 years, 1 month

Normal peripheral hearing sensitivity

Primary complaint: Difficulty hearing in noisy environments;

Reading/spelling difficulties

ADHD ruled out
Case Study

Some bimanual/bipedal difficulties

No improvement with addition of multimodality cues

Parents and teachers reported “auditory comprehension difficulties” despite essentially normal language development
Impression

Primary Deficit: Binaural separation/integration

Secondary Deficits: Localization

Site-of-dysfunction: Interhemispheric pathways (corpus callosum)

Associated Difficulties: Speech in noise, linking prosodic and linguistic elements of speech, sound-symbol association, multimodal complaints

Met criteria for APD diagnosis - Integration Deficit
Environmental Modifications

- Acoustic Enhancements
- Preferential Seating
- Assistive Listening Devices
- Provide note-taker
- Avoid use of multimodality augmentation
Compensatory Strategies

- Attribution Training
- Problem-Solving Skills
- Active Listening Techniques
Direct Remediation Strategies

- Localization Training
- Dichotic Listening Training
- Multimodal Interhemispheric Exercises