Neurobiology, Differential Diagnosis, & Treatment of Co-morbid CAPD & ADHD

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Outline

Neurobiology of CAPD & Attention  Frank Musiek

Diagnosis of CAPD & Differential  Teri James Bellis

Diagnosis of CAPD & ADHD  Gail Chermak

Intervention for Co-morbid CAPD & ADHD  Gail Chermak

Q & A Panel
ASHA 2011

Neurobiology of Audition
& Attention

Frank Musiek
Neuroaudiology Lab
University of Connecticut
Attention

The process of directing and focusing certain psychological resources to enhance perception, performance, and mental experience. (Bernstien et al.’97)
Attention

Bottom Up (extrinsic)

Top Down (intrinsic)
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 stimuli to another
  – voluntary & involuntary
“The Question” on Attention

Are the mechanisms that comprise the brain’s attentional system separate (or not) from sensory and memory systems?

-- unresolved!

Posner & DiGirolamo, 2000
Attention & Auditory Processing

“Following from the modern ‘spotlight’ metaphor of selective attention, it is perhaps more likely that any deficit in selective attention is secondary to the deprivation of attentional processes from their normal neural representations of the signal.”

(Phillips, 1990)
Common procedures in assessing attention

- Directed laterality
- Passive - active listening
Routes of the reticular activating system superimposed on the auditory pathway of the brainstem
Basal Forebrain

Cholinergically rich area
Relay system to trigger neurotransmitters to other areas of the brain?
(Klinkenberg, Sambeth, Blokland, 2002,; Nieoullon, 2002)

dAch= control of top down attentional orienting & stimulus discrimination

Dopamine= regulation of attention, regulation of anticipatory processes, sustained attention, Parkinson’s=
Effects of Selective Attention on Auditory Evoked Potentials

- ABR
- MLR
- N1, P2
- P300

Black: not attend
Red: attend
Evoked potential studies are showing fronto-central and parietal areas responsive to selective attention paradigms, while temporal regions (auditory) essentially are not.....

-Hillyard et al. 1973
-Tzourio et al, 1997
-Woods et al. 1993
-others.........
PET Results

No significant cortical activation in the Temporal Cortex (Heschl’s and Planum) with attention.

Significant activations for:

- Cingulate (anterior & posterior)
- Pre central (Frontal)
- Pre frontal (RT)

Tzourio et al. 1997
Areas of Enhanced Activity with Attention

1= precentral gyri
2= prefrontal area
3= inferior parietal

norepinephrine

(Posner, & others)
Dichotic listening & Attention

- non fusion dichotics
- fusion dichotics
CV-Syllables / Non-Forced Attention

Musical instruments / Non-Forced Attention

(Hugdahl)
Dichotic Procedures

While RE, LE scores change, total scores do not.

---

Free recall

---

RE focus

---

LE focus
Dichotic Rhyme

- **Free recall**
- **RE focus**
- **LE focus**
Anatomy: Structural Imaging

- Overall reduction in total brain size into adolescence (Castellanos et al. 2002)

- Cortical thickness-regional decrease in thickness associated with ADHD with DRD4 gene (Shaw et al. 2007).
Neglect

• Severe Inattention?
• Most commonly caused by lesions to the right hemisphere
  – Right Temporal-Parietal area
  – Cingulate Gyrus
• Thalamus (Reticular Formation)
• Auditory neglect - is not just an attention problem (Musiek, 2009).
Key Points

- Top down, bottom up, intrinsic, extrinsic are graded/shared actions
- Frontal lobe, cingulate may modulate auditory regions via norepinephrine, dopamine, Ach
- Inferior parietal, thalamus likely plays a role
- Auditory functions in non attention conditions are dominate & obligatory, attention may, in certain conditions modulate these functions. However key auditory areas are not necessarily influenced by attention physiologically
- ADHD has anatomical/pharmacological correlates
ASHA 2011

Neurobiology of Audition & Attention

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(See LaBerge, 2000 & others)
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..... a snapshot of ADHD
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Diagnosis, Differential Diagnosis, and Comorbidity

Teri James Bellis, Ph.D
University of South Dakota
Vermillion, SD
Diagnosing (C)APD
Principles of (C)APD Diagnosis

- Purpose of Diagnostic Testing: To identify presence and delineate characteristics/nature of central auditory deficit

- Requires audiologist-administered diagnostic tests of central auditory function
Provides information regarding integrity of left-hemisphere, right-hemisphere, interhemispheric, and brainstem auditory structures
May include psychophysical and/or neuro(electro)physiologic tests of central auditory integrity

Leads directly to development of deficit-specific treatment and management plans
Diagnostic Tests for (C)APD

- Must employ a test battery approach that assesses various levels/loci within the CNS, as well as different perceptual processes.

- The tests chosen should meet accepted psychophysical and scientific standards, should control for higher-order confounds, and should be appropriate to the individual being tested!
Most importantly:

The tests used should have been demonstrated to be sensitive, reliable, and efficient for identification of CANS dysfunction
Because of the interactive nature of auditory processing, to document a (central) auditory deficit, you must use:

- Test tools that have documented sensitivity and specificity to known dysfunction of the CANS
- Tools developed/validated for other purposes (i.e., learning disability, language impairment) CANNOT be used for this purpose!
Behavioral Tests (Categories)

- Dichotic Speech Tests
- Temporal Patterning Tests
- Tests of Other Temporal Processes
- Monaural Low-Redundancy Speech Tests
- Auditory Discrimination Tests
- Tests of Localization/Lateralization
Electrophysiologic Test Tools (Categories)

- Standard ABR, MLR, Corticals, P300
- Multi-channel MLR and Corticals to speech and nonspeech signals (electrode and ear effects and hemispheric asymmetries)
- Other (e.g., MMN, etc.)
- Complex ABR (e.g., speech-evoked ABR)
Electrophysiologic and related measures may play an important role in the objective demonstration of neural deficits in the auditory system in many cases, as well as in the documentation of treatment efficacy. They may also indicate which patients might benefit from training (e.g., speech-evoked ABR).
Test Battery Interpretation

- Norm-referenced criteria

- Using the patient as his/her own control (pattern analysis using neurophysiologic tenets):
◆ Intra-test analysis (including ear differences)

◆ Inter-test analysis

◆ Cross-discipline analysis
A diagnosis of (C)APD is enabled only when performance on \( > 2 \) tests is abnormal AND the pattern of findings is consistent with underlying neuroscience tenets (ASHA, 2005; AAA, 2010)

Lack of a pattern (e.g., poor performance on all measures) argues for more global or motivational deficit, not (C)APD
Differential Diagnosis
Brain organization underlies comorbidity of disorders.

Differential diagnosis requires administration of sensitized tests of central auditory function and multidisciplinary input to evaluate functioning across domains.

Analysis of inter- and intra-test patterns of performance is critical for differential diagnosis of (C)APD and ADHD.
Differential Diagnosis

- AD/HD:
  - No clear auditory pattern (all normal or uniformly depressed; inconsistency in test performance)
  - Different functional sequelae per DSM
  - Poor performance on vigilance tasks
  - Often ameliorated by medication
Comparison of Performance of Typically Developing Children, Children with (C)APD, and Children with ADHD on Behavioral Diagnostic Tests of Central Auditory Function
Bellis et al. (2011)
Bellis et al. (2011)
Bellis et al. (2011)
Bellis et al. (2011)
Bellis et al. (2011)
Bellis et al. (2011)
References

Intervention

for

Co-morbid CAPD & ADHD

Gail D. Chermak
Deficient auditory processing (or degraded access to sound due to hearing loss) may affect neural organization & plasticity of multiple brain systems responsible for efficient auditory & auditory-language processing, including---

Executive Control
Attention
Learning
Working Memory

Ciccia et al., 2009
Brain Is a Functionally Integrated System; Therefore

Working memory, attention, executive function impairments can impact central auditory processing.
<table>
<thead>
<tr>
<th>CAPD</th>
<th>ADHD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primarily Auditory Deficits</strong> due to CANS Involvement</td>
<td><strong>Supramodal Deficits</strong> due to Frontal-Striatal Involvement</td>
</tr>
<tr>
<td>“Distracted” by Auditory Competition</td>
<td>Distracted by Multisensory Stimuli</td>
</tr>
<tr>
<td><strong>Deficit in Binaural Integration &amp; Separation</strong></td>
<td><strong>Deficit in Sustained Attention</strong></td>
</tr>
<tr>
<td>(Dependent to some degree on divided/selective attention)</td>
<td></td>
</tr>
<tr>
<td><strong>May Present Verbal Working Memory Deficits</strong></td>
<td><strong>Working Memory Deficit May Be Core Deficit in Certain ADHD Subtypes</strong></td>
</tr>
<tr>
<td><strong>Academic problems (including poor reading) revolve around phonological decoding &amp; listening comprehension deficits</strong></td>
<td><strong>Executive Function Deficits</strong> (response inhibition, initiating, sustaining, &amp; shifting attention, hyperactive, etc.)</td>
</tr>
<tr>
<td><strong>Omissions (misses) on CPT</strong></td>
<td><strong>Commissions (false alarms) on CPT</strong></td>
</tr>
</tbody>
</table>
### Rank Order of Behavioral Means Greater Than 1 Standard Deviation Above the Respective Grand Mean

<table>
<thead>
<tr>
<th>ADHD</th>
<th>CAPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inattentive</td>
<td>1. Difficulty hearing in background noise</td>
</tr>
<tr>
<td>2. Distracted</td>
<td>2. Difficulty following oral instructions</td>
</tr>
<tr>
<td>3. Hyperactive</td>
<td>3. Poor listening skills</td>
</tr>
<tr>
<td>4. Fidgety or restless</td>
<td>4. Academic difficulties</td>
</tr>
<tr>
<td>5. Hasty or impulsive</td>
<td>5. Poor auditory association skills</td>
</tr>
<tr>
<td>6. Interrupts or intrudes</td>
<td>6. Distracted</td>
</tr>
<tr>
<td>7. Inattentive*</td>
<td></td>
</tr>
</tbody>
</table>

| Grand Mean                     | 3.25                                          |
| Standard Deviation             | 0.55                                          |
| 2.90                           |
| 0.66                           |

Note that inattentive was included based on “events-down/odds up” rounding rule; the standard deviation was .01 points below the criteria of +1 SD of the grand mean. Chermak, Somers and Seikel 1998
### Rank Order of Behavioral Means Greater Than One or Two (*) Standard Deviations Above the Respective Grand Mean

<table>
<thead>
<tr>
<th></th>
<th>ADHD-PI</th>
<th>CAPD</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADHD-PI</strong></td>
<td>AVG</td>
<td><strong>Inattentive</strong></td>
<td>AVG</td>
</tr>
<tr>
<td><strong>Academic Difficulties</strong></td>
<td>4.45*</td>
<td><strong>Asks for things to be repeated</strong></td>
<td>4.39*</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Poor listening skills</strong></td>
<td>4.39*</td>
</tr>
<tr>
<td>Daydreams</td>
<td>4.05</td>
<td>Difficulty following instructions given orally</td>
<td>4.33</td>
</tr>
<tr>
<td>Distracted</td>
<td>4.04</td>
<td><strong>Difficulty hearing background/ambient noise</strong></td>
<td>4.28</td>
</tr>
<tr>
<td>Poor listening skills</td>
<td>3.86</td>
<td><strong>Academic Difficulties</strong></td>
<td>4.22</td>
</tr>
<tr>
<td>Disorganized</td>
<td>3.82</td>
<td><strong>Distracted</strong></td>
<td>3.78</td>
</tr>
<tr>
<td>Asks for things to be repeated</td>
<td>3.70</td>
<td>Reduced rate of information processing</td>
<td>3.78</td>
</tr>
<tr>
<td>Auditory dividend attention deficit</td>
<td>3.67</td>
<td>Auditory dividend attention deficit (Bin Integration)</td>
<td>3.76</td>
</tr>
<tr>
<td>Difficulty hearing in background/ambient noise</td>
<td>3.62</td>
<td>Auditory selective attention deficit (Bin Separation)</td>
<td>3.76</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Auditory sustained attention deficit</td>
<td>3.71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poor Memory</td>
<td>3.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Difficulty discriminating speech</td>
<td>3.65</td>
</tr>
<tr>
<td>Grand Mean</td>
<td>3.11</td>
<td><strong>Grand Mean</strong></td>
<td>2.93</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.50</td>
<td><strong>Standard Deviation</strong></td>
<td>0.72</td>
</tr>
</tbody>
</table>

Chermak, Tucker & Seikel (2001)
Comprehensive, Multidisciplinary Approach

- **Bottom-Up Treatment**
  - Auditory Training
  - Environmental Modifications

- **Top-Down Management**
  - Central Resources/Compensatory Training
  - Educational Accommodations
  - Workplace, Recreational & Home Accommodations

- Builds listening skills & strategies
- Promotes efficient allocation of perceptual & higher-order (central) resources (e.g., language, memory, attention)
- Provides compensatory methods to minimize functional listening deficits

Chermak & Musiek, 2007
Bottom-Up Treatment

- **Environmental Modifications: Control Noise & Enhance Acoustics**
  (i.e. Increase Clarity of Signal & Listening Environment, Assistive Listening Systems, Clear Speech, Improved Room Acoustics, etc.)

- **Auditory Training**
  [i.e., Direct (Auditory) Skills Remediation to Reorganize the CANS]
Top-Down Management

- Central Resources/Compensatory Training (i.e., Language Strategies, Cognitive Strategies, & Metacognitive Strategies)

- Educational Accommodations (i.e., Instructional Modifications & Learning Strategies)

- Workplace, Recreational & Home Accommodations (e.g., written directives such as memos, e-mails; post chores on white board)
CAPD & ADHD

- Poses Some Degree of Differential Diagnostic Challenge

- Co-morbid Diagnoses Involve Both Auditory Modality/Perceptual & Supramodal Issues Which Require Adjustments to Intervention
Why Adjustments Needed?

- Attention Deficits
- Behavioral Disinhibition
- Self-Regulation Deficits
  - Motivation & Passivity Issues
  - On-Task Persistence Issues
- Working Memory Deficits
Intervention Strategy

Some combination of approaches used in treatment/management of CAPD and those used in treatment/management of ADHD are required to effectively intervene with individuals presenting co-morbid CAPD & ADHD.

Chermak, Hall, & Musiek, 1999
Chermak, Bellis, & Musiek, 2007
Not Going to Discuss

Specific Behavioral Techniques and Drug Treatment Approaches for ADHD
Intervention for CAPD Should Have A Strong Metacognitive Component. Metacognitive Engagement:

- Promotes efficient allocation of perceptual & higher-order (central) resources (e.g., language, memory, attention)

- Focuses attention on critical elements, encourages abstraction of procedures, & self-evaluation of understanding all of which encourage generalization.

- Reduces feelings of helplessness, facilitates development of self-esteem through self-empowerment, & likely to enhance success of interventions. *(AND MAY REDUCE PASSIVITY OFTEN SEEN IN INDIVIDUALS WITH ADHD.)*
Metacognition & Executive Control

- Challenge for individuals with co-morbid ADHD & CAPD since executive function, a component of metacognition, typically compromised in ADHD.

  - Sustained attention deficit secondary to behavioral disinhibition and self-regulation deficits

- Strengthening self-monitoring is one key to managing ADHD.
Adverse Effects of Noise & Reverberation

- Children Require Better Listening Environments to Achieve Comparable Performance Than Adults.

- Children with Hearing Loss, Learning in Second Language, or with Auditory or Attention Problems Require Even More Favorable Acoustics.

ASA 2002; Breier et al., 2002; Crandell, 1993; Nelson, Kohnert, Shaw, & Sabur, 2005

Background noise or other competition challenges individual with either CAPD (e.g., binaural separation) or ADHD (e.g., distraction) and co-morbidity exacerbates situation.
Bottom-Up Treatment

- **Environmental Modifications: Control Noise & Enhance Acoustics**
  (i.e. Increase Clarity of Signal & Listening Environment, Assistive Listening Systems, Clear Speech, Improved Room Acoustics, etc.)

- **Auditory Training**
  (i.e., Direct [Auditory] Skills Remediation to Reorganize the CANS)
Environmental Modifications Benefits All
Bottom-Up Acoustic Access Approaches

- Enhance Signal & Listening Environment
- Noise & Reverberation Reduction
- Preferential Seating
- Visual Aids
- Assistive Listening Systems (ALDs or HATs)
- Clear Speech
- National Standards (e.g., ANSI 12.60-2002--Acoustical Performance Criteria, Design Requirements, & Guidelines for Schools)
Bottom-Up Treatment

Auditory Training
Auditory Training (AT) Defined

- Direct auditory skills remediation to maximize processing (use) of acoustic signals

- Set of acoustic conditions and/or tasks designed to activate auditory & related systems and change their neural base & associated auditory behaviors in a positive way.

- Use of repetitive listening exercises to improve ability to perceive auditory events.

- Use of auditory stimuli to enhance auditory function

Musiek, Chermak, & Weihiing, 2007
<table>
<thead>
<tr>
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</tr>
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<tbody>
<tr>
<td><strong>Temporal Integration</strong></td>
</tr>
<tr>
<td><strong>Pitch, Loudness, Duration</strong></td>
</tr>
<tr>
<td><strong>Discrimination</strong></td>
</tr>
<tr>
<td><strong>Temporal Discrimination/Resolution</strong></td>
</tr>
<tr>
<td><strong>Temporal Masking</strong></td>
</tr>
<tr>
<td><strong>Temporal Ordering</strong></td>
</tr>
<tr>
<td><strong>Binaural Interaction (Interaural Intensity/Time Differences)</strong></td>
</tr>
<tr>
<td><strong>Binaural Integration (Divided Attention)</strong></td>
</tr>
<tr>
<td><strong>Binaural Separation (Selective Attention)</strong></td>
</tr>
<tr>
<td><strong>Interhemispheric Transfer</strong></td>
</tr>
<tr>
<td>(underlies binaural hearing &amp; binaural processing)</td>
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Interhemispheric Interaction

- Attentional capacity may be most efficiently exploited if items relevant to a demanding task are divided between the cerebral hemispheres. This advantage may derive from the connected hemispheres’ ability to process some information in parallel.

- Interhemispheric interaction expands attentional capacity; increases attentional resources available to auditory (and visual) tasks.

Banich, 2003; Scalf, Banich, & Erickson, 2009
Speech Recognition in Noise

Exercises Interhemispheric Transfer

- Interhemispheric transfer utilized to perform complex tasks involving both a sensory modality-specific channel & a higher order cognitive function transfer/allocation channel (Bamiou et al., 2007; Hugdahl, 2003)

- Left Hemisphere Compensating for Loss of Phonologic Information

- Right Hemisphere Compensating for Increased Attention Demands Resulting From Noise By Modulating Allocation of Resources Between the Hemispheres & Filtering Interhemispheric Signal Transmission.

Boatman et al., 2003; Banich, 1998
AT Tasks Exercise Multiple Processes/Goals

Dichotic Interaural Intensity Training (DIID) Trains:
- Binaural Integration & Separation
- Interhemispheric Transfer
- Working Memory** (via directed report)

* * Often deficient in ADHD

Speech Recognition in Noise Trains:
- Auditory Closure/Binaural Separation
- Interhemispheric Transfer
- Working Memory**
- Localization
LE = 32%

- 50 dB HL = 32%
- 50 dB HL = 40%
- 50 dB HL = 64%
- 50 dB HL = 80%

DIID

crossover

RE = 92%

- 50 dB HL = 92%
- 40 dB HL = 86%
- 30 dB HL = 60%
- 25 dB HL = 46%

[Musiek]
DiD

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<tr>
<th>LE = 32%</th>
<th>TRAINING</th>
<th>RE = 92%</th>
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<tbody>
<tr>
<td>50 dB HL = 88%</td>
<td>50 dB HL = 92%</td>
<td></td>
</tr>
<tr>
<td>50 dB HL = 86%</td>
<td>40 dB HL = 84%</td>
<td></td>
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<td>25 dB HL = 46%</td>
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[Musiek]
Informal Binaural Separation

Audiobooks** to one ear (weak ear)

Competing message to strong ear (evening news)

Adjust interaural intensity ratio (target book is challenging but not impossible to hear & understand)

As target becomes easier to understand (often within single session), decrease intensity of target & increase intensity of competition to maintain a consistent level of challenge

** LibriVox.com (Free audiobooks from the public domain)
Top-Down Management

Central Resources/Compensatory Training

- Metacognitive/Executive Control Skills/Strategies
- Linguistic & Metalinguistic Skills/Strategies
- Cognitive Skills/Strategies
Metacognitive Strategies

- Attribution Retraining
- **Self-Control**
- Self-Instruction
- Reciprocal Teaching
- Assertiveness Training

- Planning**
- Problem Solving
- Strategy Training
- Cognitive Style
- Metamemory Techniques

**Underlie Executive Control
Metacognitive Strategies

Planning & Self-Control Exercises Likely to Challenge Individuals with Co-morbid ADHD, But

Beneficial to Listening & Other Behaviors
## Planning Skills

- **Classic Example**—Take the Castle
- **Alternative**—Accommodating Multiple Birthday Parties or Environmental Projects…

## Self-Control

- “Freeze” to Stick Figure’s Pose When Music Stops*
- Role Playing (gain experience with emotional control/rules that guide interactions)

* **Also exercises working memory & auditory vigilance**
Linguistic & Metalinguistic Knowledge, Skills, & Strategies

- Schema Induction & Discourse Cohesion Devices#
- Auditory-Verbal Closure (Contextual Derivation)* ^
- Semantic Network Expansion^
- Phonological Awareness (e.g., Phonemic Analysis & Synthesis)*
- Prosody Training*
- Listening Strategies

^ Builds Vocabulary
^ Builds Auditory Closure
# Builds Auditory Closure

* Informal AT
Why Build Vocabulary In CAPD & ADHD?

- Current Models of Comprehension Emphasize Lexical Processing
- Words Are Building Blocks of Understanding: Strong Correlation Between Vocabulary and Comprehension
- Vocabulary is Strong Predictor of Self-Regulation Ability

Anderson & Freebody, 1981; Beck et al., 2002; Biemiller & Boote, 2006; Vallotton & Ayoub, 2010
Teaching How To Listen Actively

- Listen Intently & Take Responsibility For Listening Success
- Physical Adjustments: Show Interest With Eye Contact, Body Language & Posture; Cease Extraneous Movements
- Listen Empathetically (i.e., Place Yourself in Other’s Shoes)
- Use Closure, Inferencing, Deducing, & Predicting Skills
- Use Communication Repair Strategies (e.g., Request Repetition, Rephrasing, Confirmations, etc.)
- Ignore Background Noise
- Do Not Give Up Prematurely
Cognitive Skills
Working Memory

WM modulates attention

de Fockert et al., 2001

& promotes successful self-regulation

Hofmann et al., 2010
Working Memory Supports Auditory Processing, Listening, & Music Appreciation

- WM perceptually organize sounds (segregate & integrate spectral & temporal attributes) that occur simultaneously & sequentially
- WM predicts listening & reading comprehension (Daneman & Merikle, 1996)
- WM supports: Auditory localization (Martinkauppi et al., 2000)

**Auditory pattern processing** (Zatorre et al., 2002)

**Speech recognition in noise** (Salvi et al., 2002; Wong et al., 2009)
  (WM correlated with speech recognition in noise) (Akeroyd, 2008)

**Dichotic listening** (Jancke & Shah, 2002; Martin, Jerger, & Mehta, 2007)
  (Divided Attention/Dual Ear Report )

And most all behavioral measures of the CANS
Relevance of working memory in speech understanding increases as the signal is more degraded by background noise, perhaps as a compensatory mechanism.

Pichora-Fuller et al., 1995; Ronnberg, 2003
Co-morbid CAPD & ADHD

Intervention Foci

- Auditory Training (esp. Interhemispheric Transfer, Binaural Separation, & Binaural Integration)
- Control Noise/Reverberation & Enhance Acoustic Access
- Executive Control: Planning & Self-Regulation
- Build Vocabulary
- Listening Strategies
- Working Memory
Intervention Modifications for Comorbid ADHD & CAPD

- Therapy should be conducted with child in his/her typical state, which may be medicated, to enhance cooperation, motivation, understanding & attention to task.

- Schedule therapy in morning.

- Shorter sessions with breaks to minimize off-task behavior

- Minimize background noise or other competition, consider use of ALD to increase access to the acoustic signal, & environmental modifications

- Client repeat/paraphrase instructions

- Increase ISI due to slower cognitive tempo. (Sluggish, lethargic, slow reaction time, slow processing speed marks ADHD.)
Intervention Modifications for Comorbid ADHD & CAPD

- Allow more time to respond. (ADHD manifests with reduced speed of information processing.)
- Provide more immediate & frequent feedback/reinforcement to increase motivation.
- Implement effective behavior management (e.g., token economy, time out, response cost)
- Discourage hyperactive behavior: Provide verbal contract to discourage impulsive “How many more?”
- Repeat when client vocally disrupts
- Watch for impulsive (commission) responses when using computerized therapy.
Intervention Modifications for Comorbid ADHD & CAPD

- May not be able to engage in the intensity of training typically advocated nor sustain the attention to detail required in intensive (auditory) training.

- Goal should be to “over-learn” a skill or strategy. Clients with memory &/or attention problems require more practice or rehearsal to mastery.

- Strengthen internal compensatory strategies (e.g., self-monitoring, self-cueing); however, use external aids (e.g., planners, electronic calendars) as back-up for organization and time management.