Differential Diagnosis & Intervention of Central Auditory Processing Disorders

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November 21, 2014
Session 1405
Disclosure

Annette Hurley, PhD has no conflict of interest or financial interest to disclose.
Agenda:

- Brief Historical Perspective of CAPD
- CAPD Screening
- CAPD Test Battery
- Test Interpretation
- CAPD vs Look-A-Likes
  - Language Processing
  - ADHD
  - ANSD
  - Autism
- **Management**
  - Formal
  - Informal
  - CASES
In the News

- An auditory processing disorder constitutes an “other health impairment” under the Individuals with Disabilities Education Act, according to a recent court decision by the U.S. Ninth Circuit Court of Appeals.

The ASHA Leader, September 2014, Vol. 19, online only.
doi:10.1044/leader.NIB6.19092014.14
When did CAPD begin?

  - Reported the children could hear sound, but are unable to recognize the sounds they hear.
  - Difficulty understanding in noise.
Brief History...

- 1970s  Central Auditory Dysfunction Symposium …name eventually became Central Auditory Processing Dysfunction…CAPD.

- Work of Paula Tallal 1970’s children with “developmental dysphasia” also had underlying temporal processing disorders…could not distinguish between stop consonants.


- Bruton Conference (2000) AAA: did not want to put an anatomical description

- AAA Clinical Practice Guidelines: Diagnosis, Treatment and Management of Children & Adults with Central Auditory Processing Disorder

- Still no clear consensus on what is (C)APD…how is it defined…how is it diagnosed…and how it is treated.
Area of Renewed Interest

- Is it real?
- Modality Specific? Is the brain modality specific?
- Area of Interest or Renewed Interest
- Does it truly exist?
- Who can diagnosis CAPD?
- No gold standard for assessment
- No gold standard for interpretation
- What constitutes a deficit?
CAPD Definitions.....

“ASHA (2005) Broadly stated, (Central) Auditory Processing as referring to the efficiency and effectiveness by which the central nervous system (CNS) utilizes auditory information.

Narrowly defined, (C)AP refers to the perceptual processing of auditory information in the CNS and the neurobiologic activity that underlies that processing and gives ride to electrophysiologic potentials.”
What is (C)APD?

- (C)APD is a deficit in the neural processing of auditory stimuli that is not due to higher-order, cognitive, or related factors, yet (C)APD may be lead to or be associated with difficulties in higher order language learning, cognitive, and communication functions.” (ASHA, 2005)

- (C)APD can coexist with other disorders such as language impairment, ADHD, and learning disabilities.
Other Definitions of (C)APD

“(C)APD is a deficit in the auditory pathways of the brain that results in the inability to listen to or to comprehend auditory information accurately even though normal intelligence and hearing sensitivity are documented (1986).”

Bob Keith, Ph.D.

“What we do with what we hear.”

Jack Katz, Ph.D.
The Nature of CAPD

- Who diagnoses CAPD?
- Other professionals
  - Speech language pathologists
  - Psychologists
  - Educational Psychologists
  - Physicians?

CAPD is not a “catch-all” term! Has overlapping symptoms w/ language disorder, ADHD, and other cognitive impairments.
Pre-testing considerations....

- Peripheral Hearing!!
- Age of the child (Chronological and Mental)
- Cognitive capacity
- Linguistic Capacity (native language)
- Attention
- Memory (7 year old who can only repeat 3 numbers)
- Motivation
CAPD – Two Divergent Approaches

- Medical – Site of Lesion
- Educational – Auditory, Language, Reading and Learning Disorders
Whole Child

Development
Education
Difficulties
Coordination
Language
Temperament
Other...
Behavioral Characteristics noted:

- Difficulty hearing in noisy backgrounds
- Difficulty localizing the sound source
- Difficulty learning a foreign language
- Often asks for repetition
- Difficulty processing fast speech
- Inability to detect humor or sarcasm (prosody)
- Inappropriate responses
- Easily distracted by external stimuli
- Difficulty maintaining attention
- Difficulty following direction
- Poor musical ability
- Reading, spelling, and or learning problems.
A Boost to CAPD

- “Other health impairment”: A “chronic or acute health problem” that “results in limited alertness with respect to the educational environment” and that “adversely affects a child’s educational performance” [34 C.F.R. 300.7(c)(9), (2005)].

- The symptoms, characteristics, and diagnosis of CAPD meet these criteria: a chronic, medical condition; difficulty in processing sound; and limited attention to oral communication that can adversely affect a student’s ability to perform in a classroom.
  - The ASHA LEADER, September, 2014
A Boost...

- In further describing CAPD, court documents noted that it encompasses an individual’s
  - inability or difficulty to: identify the source of a sound;
  - discriminate between sounds;
  - determine similarities or differences in patterns of sound; sequence sounds into words;
  - understand speech when other sounds are present;
  - understand sounds when part of the signal is missing or degraded due to low frequency.
- In an educational or home setting, common symptoms of CAPD are a child’s difficulty following oral instructions or directions, difficulty hearing when there is background noise, poor listening skills, distractibility, and inattention
Differential Diagnosis

- Often there are co-morbid conditions
  - Difficulty with communication
  - Academic Difficulties
  - (ADHD/ADD)
  - Language Disorders
  - Learning Disorders
  - Reading Disorders (dyslexia)

- Other Related Difficulties
  - Acquired (CAPD)
  - TBI
We are testing the auditory system at the acoustic level.
The CAPD may not alone be the reason for the academic failure.
Often see very bright individuals with CAPD--may have learned to compensate for their difficulties.
Often we see CAPD in existence with language processing, phonological disorders, or dyslexia.
We know that training can improve deficits noted in the auditory system.
Screening for CAPD
Questionnaires

- Based upon the assumption that children and adults with CAPD have distinctive behavioral profiles than can provide useful screening information.
Screening: Behavioral Checklists

- Fisher’s Auditory Processing Checklist
  - Preponderance of items are related to a language-based deficit—comprehension; attention & memory
- Children’s Auditory Performance Scale
  - Rate behavior in conditions
  - Used by teachers and parents
- Evaluation of Classroom Listening Behavior
  - Completed by a teacher in order to identify listening and academic problems
- Children’s Home Inventory for Listening Difficulties (CHILD)
  - “Family-centered parent survey that allows parents to assess a child’s listening behavior within the home environment.
    - Ages 3-12
Behavioral Screening Instruments

- SCAN-3C
- SCAN-3A
- Has 3 screening subtests:
  - Gap Detection
  - Auditory Figure Ground
  - Competing Words (Free Recall)
Assessment for CAPD
Assessment Vs Diagnosis

- “Assessment may be defined as a data-gathering process that may include both formal and informal procedures to document areas of strength and weakness (ASHA, 2005).

- Diagnosis, on the other hand, refers to the actual identification and classification of a specific impairment. (ASHA, 2005)
Behavioral Test Battery

I. Monaural Low Redundancy
   - Degraded Acoustic Signals
     - Background noise
     - Filtered Speech
     - Time Compressed Speech

II. Temporal Pattern Tests / Temporal Processing Tests
   - Discrimination and Patterning
     - Frequency Pattern / Ordering Tests
     - Duration Pattern / Ordering Tests
     - Gap Detection
III. Dichotic Listening

- Binaural Separation refers to the ability to process one message while ignoring another at the same time.

- Binaural Integration refers to the ability to process information presented to both ears at the same time when the information presented in each ear is different. An important skill to classroom success and everyday functioning - the ability to tune-in to the important auditory signals. Difficulty may be indicated if the individual is having difficulty attending/hearing in noisy environments.

  - Competing Words
  - Competing Sentences
  - Dichotic Digits
  - SSW
  - SSI
Behavioral Tests

IV. Localization/Lateralization Tests/Binaural Interaction

- Masking Level Difference
- Rapidly Alternating Speech Perception
V. Electrophysiological Tests

- Electrophysiologic data validates the results of behavioral data when abnormalities are shown in both behavioral and electrophysiological tests
- Auditory Brainstem Response (ABR)
- Auditory Middle Latency Response
- Auditory Late Response (P300 & MMN)

- BioMARK: an ABR to Speech
  - Approximately 30% of children with a language based learning disability have an abnormal BioMARK recording.
  - Normed for ages 3-4; 5-12; 18-28
Test Battery Approach

No Single test can diagnose CAPD.

- Monaural Low Redundancy Tests
- Binaural Interaction
- Tests of Temporal Processing
- Dichotic Tests
- Electrophysiological Tests
SCAN 3C (ages 5-12)  
SCAN 3A (ages 13-50)

- Screening sub-tests-approximately 10-25 minutes.
- Administration for the diagnostic and supplementary tests is 20-30 minutes.

- Addition of:
  - Gap Detection Test
  - Filtered Words 750 Hz low pass
  - Competing Words –Free Recall
  - Auditory Figure Ground at 2 additional levels
    - (all have option of 0, 8, & 12 dB SNR)
  - Time Compressed Speech (60%)
- Competing Sentences are graded as number of words correct.
Popular Tests

- Auditory Figure Ground (Speech in Noise)
- Filtered Words
- Time Compressed Speech
- Dichotic Digits
- Duration Pattern
- Frequency Pattern
- Masking Level Difference
- Gap Detection
- SSW
- Phonemic Synthesis
Diagnosis

- Diagnosis of (C)APD generally requires performance deficits on the order of at least two standard deviations below the mean on two or more tests or three standard deviations on one test. (ASHA, 2005).

- Deficits on all tests on the behavioral test battery may indicate a higher order deficit.

- Models: May be confusing because of over-lapping terminology
  - Bellis/Ferre & Buffalo Model
Process Based Interpretation

- Targets the underlying strengths and weakness of the underlying auditory process

- What auditory area(s)/process(s) are deficient?

- What should we do to remediate?
Differential Diagnosis

Central Auditory Processing Disorders from Other Co-morbid Conditions
Differential Diagnosis

- Most often consider young children
  - Academic Difficulties (ADHD/ADD)
  - Language Disorders
  - Reading Disorders (dyslexia)
  - ANSD
  - Other?
    - ASD
APD vs ADHD

- Can you test a child diagnosed with ADHD?
What is ADHD?

- Initially identified in Heinrich Hoffman’s 19th century descriptions of “Fidgety Phil”
- DSM-IV describes 3 classifications:
  - ADHD-HI: predominantly hyperactivity-impulsivity
  - ADHD-IA: predominantly inattention
  - ADHD-C: combined subtype
- Diagnosis is based on an accumulation of at least 6 symptoms, some of which were present before the age of 7.
Other signs

- Academic difficulty, especially in reading and math
- No significant memory deficits
- Difficulties in social functioning
- IQ 10-20 points below average
- Learning disability
- Language disorder
Diagnostic Difficulty

• Subjectivity
  • Questionnaire filled out by parent or teacher
  • Hyper dreamy shy energetic withdrawn daydreamer tomboy …

• High comorbidity with other conditions
  • Learning disabilities (15-25%)
  • mood disorders (15-20%)
  • Language disorders (30-35%)
  • anxiety disorders (20-25%)
  • Conduct disorder (15-20%)
  • tic disorders (10-15%)
  • Oppositional defiant disorder (40%)
Etiology - Biological

- Overall brain size 5% smaller
- Smaller amounts of brain tissue
- Smaller anterior cortices, corpus callosum
- Metabolic dysfunction in sub-cortical regions projecting to frontal lobes of brain
  - Lower cerebral metabolic rates for glucose reported in girls with ADHD, using PET scan
Rank Order of Behavioral Measures

ADHD
- Inattentive
- Distracted
- Hyperactive
- Fidgety or restless
- Hasty or impulsive
- Interrupts or intrudes

CAPD
- Difficulty hearing in background noise
- Difficulty following oral instructions
- Poor listening skills
- Academic difficulties
- Poor auditory association skills
- Distracted
- Inattentive

From Chermak et al, 1998
Conclusion

• ADHD-HI – easy to tell because they exhibit hyperactive symptoms

• ADHD-IA – hard to tell without testing
  • Typical audiological results:
    • Inconsistent PT
    • NL SRT
    • Poor to fair WRS in quiet and in noise
      • If noise much poorer than quiet, suspect CAP!
    • NL tymps
    • And … just don’t seem to be paying attention
ANSD: CAPD?

- Definition: A form of hearing impairment in which the outer hair cell function works properly, but neural transmission in the auditory pathway is disordered.
- Approximately 7% of permanent childhood hearing loss have ANSD.
(C)APD vs ANSD

- Management Differences:
  - Current Research determining site of dysfunction pre vs post synaptic
  - Hearing aids may not be of benefit. Increasing amplitude without overcoming pathologic condition.
  - Cochlear implants- may be beneficial for some patients

**Most patients with ANSD have difficulty listening in background noise.**
<table>
<thead>
<tr>
<th>HEARING LOSS</th>
<th>AN/AD</th>
<th>(C)APD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family History</td>
<td>Family History</td>
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<tr>
<td>Infections:</td>
<td>Infections:</td>
<td>Infections:</td>
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<tr>
<td>[Toxoplasmosis, Rubella, Cytomegalovirus (CMV), Herpes Virus, Syphilis]</td>
<td>[Toxoplasmosis, Rubella, Cytomegalovirus (CMV), Herpes Virus, Syphilis]</td>
<td>[Toxoplasmosis, Rubella, Cytomegalovirus (CMV), Herpes Virus, Syphilis]</td>
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<td>Hyperbilirubinemia</td>
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<tr>
<td>Craniofacial Anomalies</td>
<td>Immune Disorders</td>
<td>RH Incompatibility</td>
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<tr>
<td>Low Birth Weight</td>
<td>(Type 1 Diabetes)</td>
<td>Difficulty During Birth</td>
</tr>
<tr>
<td>Other Syndromes</td>
<td>Uremia</td>
<td>Toxic Exposures</td>
</tr>
<tr>
<td>Ototoxic Medications</td>
<td>Genetic/Syndrome</td>
<td>Ototoxic Medications</td>
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<tr>
<td>Prematurity</td>
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<td>Prematurity</td>
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<tr>
<td>Anoxia</td>
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<td>Anoxia</td>
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<tr>
<td>Infections after Birth</td>
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<td>Infections after Birth</td>
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<tr>
<td>Mechanical Ventilation</td>
<td></td>
<td>Head Trauma</td>
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<tr>
<td>Bacterial Meningitis</td>
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<td>Cerebrovascular Disorders</td>
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<td>Metabolic Disorders</td>
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<td>Epilepsy</td>
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<td>Recurrent Otitis Media</td>
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<td></td>
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<td>Meningitis/Encephalitis</td>
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<td></td>
<td>Developmental Disorders (e.g. Dyslexia, Learning Disability, Language Impairment, Attention Deficit Hyperactivity Disorder)</td>
</tr>
<tr>
<td>Audiometric Test/Procedure</td>
<td>Auditory Neuropathy</td>
<td>(C)APD</td>
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<tr>
<td>---------------------------------------------------</td>
<td>---------------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Pure Tone Thresholds</td>
<td>Various degrees of hearing loss and configurations</td>
<td>Usually within normal limits</td>
</tr>
<tr>
<td>Tympanometry</td>
<td>Elevated or Absent</td>
<td>Usually within normal limits</td>
</tr>
<tr>
<td>Acoustic Reflexes</td>
<td>Poor</td>
<td>Depending upon site(s) of central auditory nervous system (CANS) dysfunction</td>
</tr>
<tr>
<td>Speech Recognition in Quiet</td>
<td>Poor</td>
<td>Variable, depending upon site(s) of CANS dysfunction</td>
</tr>
<tr>
<td>Speech Recognition in Noise</td>
<td>Poor</td>
<td></td>
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<tr>
<td>Otoacoustic Emissions</td>
<td>Present</td>
<td>Present</td>
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<tr>
<td>Gap Detection</td>
<td>Abnormal</td>
<td>Often abnormal, depending upon site(s) of central auditory nervous system (CANS) dysfunction</td>
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<tr>
<td>ABR</td>
<td>Absent</td>
<td>Usually normal</td>
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<tr>
<td>MLR</td>
<td>Questionable</td>
<td>Depending upon site(s) of central auditory nervous system (CANS) dysfunction</td>
</tr>
<tr>
<td>ALLR/P300</td>
<td>Questionable</td>
<td>Variable, depending upon site(s) of CANS dysfunction</td>
</tr>
</tbody>
</table>
Other Auditory Problems

- Temporal Processing Difficulties
  - Gap Detection
  - Localization
  - Frequency discrimination abilities

FM system or other assistive listening device to increase Signal/Noise Ratio.
‘Most’ individuals with ANSD will have auditory processing disorder.
CAPD vs Language Processing

Auditory Processing → Language Processing

Acoustic Signal → Meaning
What if a child did not reply

- Signal was blocked
- Chose not to answer
- Could not remember the question
- Was not sure what the question meant.
- Signal was not received (HOH)
- Not capable of replying
  - Apraxia, neuro-motor
- Unfamiliar language
- Thinking about something else
- Signal was not compromised and not clear.

From C. Richard in Geffner & Ross-Swain Central Auditory Processing Disorders.
## Language Processing vs CAPD

Upon hearing a phrase, ask the following questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did you hear it?</td>
<td>Can you explain what it means?</td>
</tr>
<tr>
<td>Can you repeat it?</td>
<td>Will saying it slower help?</td>
</tr>
<tr>
<td>Can you identify the first sound?</td>
<td>Will repeating it multiple times help?</td>
</tr>
<tr>
<td>Can you identify another sound you heard?</td>
<td>Will making it louder help?</td>
</tr>
<tr>
<td>If the answer to these questions is “yes,”</td>
<td>If the answer to these questions is “no,”</td>
</tr>
</tbody>
</table>

Then the problem is language processing, not auditory processing

From Richard
Processing disorder...

- Generic term used to describe a variety of communication disorders: language processing, language perception, sensory processing, central auditory processing.

- Audiologists, SLPs, and OTs?
Auditory Problems

- Frequently says “huh? or “what”
- Misunderstands or misinterprets what is being said
- Needs information to be repeated or rephrased
- Has difficulty following conversations or discussions
- Has difficulty following spoken directions
- Has difficulty listening in the presence of background noise
- Confuses words that sound alike “mishears”
- Has poor short-term memory
- Inability to retain information
- Has difficulty localizing sound sources
- Has difficulty discriminating among sounds
- Has trouble blending sounds to form words
  - Phonological Processing
Language Problem Behaviors

- Difficulty ‘getting to the point’ in conversation
- Difficulty organizing and expressing thoughts
- Difficulty ‘getting started’ with open-ended questions
- Uses vague language
- Difficulty knowing what to say
- Difficulty reading and responding to social cues
- Experiences word-finding problems
- Difficulty remembering lengthy directions
- Has pronounced differences between measures of verbal and performance abilities
LP vs AP continued

- Audiologists are responsible for evaluating and diagnosing problems in the reception and/or transference of an acoustic signal in the peripheral auditory system and central auditory nervous system.
- SLPS are responsible for evaluating and diagnosing problems in analyzing an acoustic signal in phonological awareness and/or linguistic interpretation.
- Treatment for processing disorders cannot be effective unless the specific skills in deficit are carefully differentiated.
Guide for Interpretation

- Identify the presence or absence of auditory processing skill weaknesses
- Identify specific auditory processing skill weaknesses (auditory discrimination, or auditory memory)
- Determining the effects of the weakness...spelling, following directions, etc
- Determining which treatment/interventions will be beneficial
What to do after diagnosis?

Treatment & Intervention
Important to Remember

• Patients/Clients come to our clinic because of listening difficulties/academic concerns

• Normal hearing thresholds
• Academic Difficulties
• Co-existing Reading or Language Problems
• Risk Factors
  • History of OME
  • Jaundice
Diagnosis:

Now you have to look at all of the results, look for patterns, point of breakdown, differences between ears, strengths, compensatory strategies.

Remember, if there is a deficit, you haven’t helped anyone if you don’t have information for treatment!!!!
Successful remediation of APD/CAPD has three crucial components:

1. Environmental Modifications
2. Developing Compensatory Strategies
3. Specific Remediation
1. Environmental Modifications

- Reduce distractions
- Be aware of your delivery style
- Plan carefully for transitions
- Check frequently for auditory exhaustion
- Be supportive
- Consider acoustic modifications and other classroom/academic modifications
- FM system?
II. Compensatory Strategies

- Rehearsal (silent, physical, etc.)
- Pre-tutoring academic tasks, directions, projects, etc.
- Networking of ideas, webbing, mind mapping
- Imagery
- Cognitive monitoring
- Chunking
- Mnemonics
Some Specific Skills to Teach

- Analysis of key ideas
- Task analysis
- Analysis of errors
- Systematic retrieval of information
- Organization skills (environment, notebooks, thoughts, how to take notes, etc…)
- Vocabulary Building
More Specific Skills to Teach

- How to calendar
- HOW to DO a project
- Study skills
- Direction following strategies
- Memory boosters (Computer Programs? Cog Med)
Plasticity

• Changes (reorganization) in the CANS due to experience or stimulation which leads to reorganization of the cortex.

• Can be positive or negative

  • Improved synaptic efficiency, increased neural density and behavioral changes.
  • Long-lasting
    (From: Musiek, Chermak & Weihiing, 2007)
Three Types of Plasticity

- Developmental: results from the maturation of the nervous system...more connections, myelination...Stimulation

- Compensatory: occurs after damage as other parts of the brain take over

- Learning-related: habilitation/rehabilitation efforts
Considerations

- **Age appropriate materials**
  - (cognitive, language, & communication skills)

- **Maintaining motivation**
  - Vary the tasks

- **Progression of AT**
  - Difficult/Challenging; Accuracy between 30-70% correct before increasing difficulty (Musiek & Schochat, 1998)
III. Direct Auditory Remediation

- Targeting the area of auditory weakness
Utilizing Residual Hearing

Dates back to the 6th century- doctors used large bells to stimulate a hearing response in people who were deaf (Musiek, Chermak, Weihsing, 2007)

Auditory training to help with hearing aids-1950s -
  - Listening and Communication Enhancement (LACE™)

Cognitive Training during Aural Rehabilitation
Auditory Training

- Informal: Speech-language pathologists, educational audiologists, reading tutors, other school professional, parents

- Listening Activities, Target Words, Localization activities, Following Directions, Rhymes, Musical chairs, etc.
Auditory Training

Improve speech encoding

- Populations for children with
  - language disorders (Kraus, et al 2005, 2006)
  - brain injury, (Musiek et al, 2004)
  - stroke (Willis & Hurley, 2014; Weinbing et al, 2006; Hurley & Billiet, 2008)
Auditory Training

- Passive: acoustic stimulation
  - Music Programs
    - Controversial
      - Very little published research with control group or blinded
  
- Active: *Probably* more effective
  - Patient is involved
  - Reinforcement
  - Challenging, but not frustrating!
Auditory Training

- **Formal:** Controlled acoustic environment
  - Dichotic Interaural Intensity Training (Musiek & Schochat, 1998)
  - Constraint Induced Auditory Therapy (Hurley & Davis, 2011)
  - Interaural Asymmetry Dichotic Listening (Moncrief & Wertz, 2008)
  - Backward Masking
  - Frequency Discrimination
- **Informal:** SLPs, educational audiologists, reading tutors, other school professional, parents, etc.
  - Listening Activities/Games etc.
How much Time?

- Intensive therapy time (daily vs weekly)
- Intrinsic Factors: attention, fatigue, performance
- Extrinsic Factors: cost, caseload, schedule
- Termination of therapy
- Motivation/Determination of the patient
Is this working?

- Evidence Based….progress?
  - Psychophysical
  - Electrophysiologic
  - Questionnaires and scales

- Reinforcement/Feedback-
  - Adaptive procedures- may change the difficulty level with patient response
What’s available?

- Computer Mediated Programs
  - Fast ForWord
  - Earobics
  - Brain Train
  - Brain Fitness (Adults)
  - Play Attention

- Traditional Therapy
  - Phonemic Training
Computer-Mediated Auditory Training Programs

- Convenient
- Hold interest for young children
- Standardization of stimuli/ Precise Control
- Must consider what deficit/skill are we training
- Some programs may actually be auditory language programs
- Length of training
Fast ForWord

- Poor temporal processing may underlie reading and language difficulties.
- Program designed to improve:
  - Underlying temporal processing skills
  - Memory
  - Attention
  - Phonologic awareness/language structures
  - Reading Comprehension
Fast ForWord…(cont.)

- Intensive
- 60-100 hours
- Reinforcement and novelty
- Based upon principles of neuroscience

Positive Outcomes

- Other studies have shown no differences between FF and other auditory training programs
Earobics
Auditory Language Program

- Phonemic awareness
- Sound discrimination
- Sequencing
- Sound/symbol association
- Decoding
- Complex directions with and without background noise
- Auditory memory
- Auditory Comprehension
Earobics...

- May be purchased by parents for home
- Reasonable price
- Great computer graphics
- Directions may be set in 10 native languages
- Positive outcomes in peer review studies
- Increased amplitude of auditory evoked responses
  - Hayes et al, 200; Warrier et al, 2004; Russo et al, 2005
Phonemic Awareness Training
Dr. Jack Katz

- Phonemic Training Program - for Decoding problems
- Phonemic Synthesis Program - for Decoding that supports PTP
- Short-Term Auditory Memory Training - for digit, word and working memory problems.
Reading Programs

- Lindamood-Bell
  - Reading
  - Spelling
  - Language Comprehension
  - Math Reasoning
- Orton-Gillingham
- Other programs:
  - Wilson Reading Program
  - Davis Reading Program
APPs

- Phonetic Birds ($1.99) an auditory training app that uses game play to help children learn to listen for changes in sound patterns
- Sound Match: Auditory memory trains the ear- not the eyes
- Hear Coach is a suite of listening games developed by Starkey Laboratories; it features games that challenge both your cognitive and auditory sharpness.
- Auditory Processing Studio by Virtual Speech Center Inc. (2,400 audio exercises $29.99)
Lindamood-Bell Programs

- Reading
- Spelling
- Language Comprehension
- Math Reasoning
Auditory Closure Ideas

Adapted from Bellis

- Missing word exercises
- Missing syllable
- Missing phoneme exercises
- After these are completed in quiet, try completing them in the presence of background noise
Prosody Training Ideas

from Bellis & Sloan

- Syllabic stress in words, sentences, stories, etc.
- Normal tone, rising intonation, falling intonation
- Identifying the key words in sentences
- Reading aloud with exaggerated prosodic features (expression)
- hot dog vs. hotdog green house vs. greenhouse
Temporal Patterning Training

- Clapping to patterns
- Tapping to patterns
- Loudness and rhythm patterns
- Boost vs Boost

The goal is to start simple and progress to more complex patterns.
Interhemispheric Exercises

- Singing
- Humming
- Verbal to motor
- Motor to verbal
- Twister, Name That Tune,
  Feely Bag, etc.

The idea is to support the areas of deficit and to improve the interhemispheric transfer of information. It’s one of the most fun to do!!
Dichotic Training

- Dichotic Interaural Intensity Difference Training. (Musiek)

- Dichotic Interaural Asymmetry Listening (Moncrief & Wertz, 2008)

- Constraint Induced Auditory Training (CIAT) (Hurley & Davis, 2011)
INTEGRATION/ INTERHEMISPHERIC (C)APD

- The two cerebral hemispheres are not working together.
- Difficulty transferring information from one part of the brain to another.
- Lag in maturation of the central nervous system auditory pathway (corpus callosum).
- Often left-ear deficits are found in dyslexia patients.
- Adults with lesions due to stroke or head injury.
Therapy for Integration/Inter-hemispheric (C)APD

Formal Auditory Training:
- Must be done in a clinic or laboratory
- Clinician routes 2 different signals (Dichotic) to each ear through an audiometer. Ear that is not performing well gets a stronger intensity, increases the opposite ear over time.
Formal Digits Auditory Training

Channel 1: 60 dB HL
Channel 2: 30 dB HL
Frequency: 1000 Hz

4, 8 → 6, 1
Informal Training

- Two different sound sources are used:
- One generates a story / One generates noise.
- Example: Harry Potter book going to the deficit ear - talk radio in the opposite ear.
- Over time, increase the noise in the opposite ear.
Informal Training

Right: Story

Left: Competing Noise

No standardization of volume controls for either ear.
What is CIAT?

- Auditory Training Program
- Specifically Addresses Deficit Ear
- Dichotic Auditory Training Exercises
  - Sentences (3, 4, 5, 6 & 7 syllables)
  - Semantically Related Words (yes/no; sun/set; read/book)
  - Digits (1-9 with the exception of 7)
  - Consonant-Vowel Syllables (pa, ba, ga, da, ka, ta)
  - Stories (Public domain literature)
Key Point to Remember

• “…Select an intervention that appears well designed to treat the child’s auditory deficit” (Fey et al., 2011)
Informal Listening Activities

Listening is an important skill. Listening Activities are used to help improve auditory memory and help individuals with attention or central processing disorders.

Informal Activities

- Smart Mom Toy Box: Brain Buzz:  www.learningrx.com
Wii-habilitation to enhance Listening Skills

- Nintendo Wii reports over 84 million units have been sold worldwide, with over 41 million in the United States alone. In March, 2011, over 454,000 Wii units were sold\(^2\). This system remains popular.

- It is important to note that games should not replace formal rehabilitation techniques but may be used as a supplement to therapy.

List of video games in What’s in Your ToyBox? Hearing Journal.
Self-auditorization

- Having the person repeat/read aloud
- Automatic feedback look…. 
Self-Auditorization

- Having the person repeat/read aloud
- Humans instinctively endeavor to hear their own speech more clearly by resorting to subvocalization or “self-talk” to enhance the auditory feedback loop.
- Subvocalization activates both the auditory loop and tactile proprioceptive loop.
- Behaviors cannot be changed unless the individual is made aware of the behavior
- The mind learns what the body does, whether it is accurate or inaccurate
- Training the client to simultaneously hear, feel, see, and say phonemes accurately provides a multisensory, self-monitoring scaffold for accurate discrimination, analysis and automaticity of phonological processing
Formal Music Training

  - Better discrimination
  - Facilitates learning
  - Attention
  - Ability to hear in noise
  - Brains are different!

- Kraus, et al, Experience-induced Malleability in Neural encoding of Pitch, Timbre, and Timing: Implications for Language and Music
CASES

DX and Intervention
Jack: 5 year old Screening

- Born 5 weeks early.
- Mechanical ventilation was required at birth.
- Developmental milestones were achieved at appropriate ages.
- Positive history of middle ear infections and three sets of PE tubes
- Passed language screening

- Jack is in the first grade. School performance is described as “poor.”
- He is demonstrating poor phonemic skills, difficulty learning to read, difficulty hearing in group situations, and mispronounces many words.
- There is a family history of dyslexia.
<table>
<thead>
<tr>
<th>Age 5.5</th>
<th>Raw Score</th>
<th>Outcome</th>
<th>Raw Score</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18</td>
<td>Fail</td>
<td>36</td>
<td>Pass</td>
</tr>
<tr>
<td>Age 6</td>
<td>35</td>
<td>Pass</td>
<td>40</td>
<td>Pass</td>
</tr>
</tbody>
</table>
• **Recommendations:** Jack was referred for a speech-language evaluation. Results of this assessment indicated a phonological disorder. Jack began weekly speech therapy sessions. A computer mediated software program, Earobics, was started at home. A list of informal listening activities was also provided.

• **Intervention:** Jack returned to the clinic after one year at age 6. Follow-up screening results are shown in Table 21-11 and are within normal limits. The cABR improved, but remained abnormal.
  
  Jack’s mother reports significant improvement in his performance at school. This improvement is also reported by Jack’s teachers. Jack has been discharged from speech-language therapy as phonological skills are within normal limits. Jack’s progress will continue to be followed annually.

• cABR 1 year follow-up Normal.
Carrie: 15 year old Female

- Normal birth & developmental history
- Referred by psychologist
- Psycho-educational assessment revealed
  - average intelligence,
  - deficits in reading comprehension,
  - deficits in language processing,
  - deficits in auditory processing.
- Attention deficit disorder was ruled out.
- She reports difficulty with reading comprehension and has previously completed reading tutoring at a commercial learning center, with success.
- Carrie will be entering the 10th grade at a private school.
- Qualifies for Fast ForWord Summer Program
Test Results

Table 21-12. Pre and post behavioral (C)APD test results for Case 8 (Carrie).

<table>
<thead>
<tr>
<th>Filtered Words</th>
<th>Auditory Figure</th>
<th>Competing Words</th>
<th>Competing Sentences</th>
<th>Dichotic Digits Left Ear</th>
<th>Dichotic Digits Right Ear</th>
<th>Frequency Pattern Test Left Verbal</th>
<th>Gap Detection Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>9</td>
<td>12</td>
<td>10</td>
<td>12</td>
<td>4</td>
<td>10</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>
*WNL=Within normal limits

- Fast ForWord “helped her process information quicker.”
Pre and post ALER recordings for the right and left ears from Cz to the ipsilateral ear are shown in this figure. A summed response from two individual recordings is depicted.
Pre & Post ALER amplitude

<table>
<thead>
<tr>
<th>Ear</th>
<th>Pre N1 Latency (msec)</th>
<th>Post N1 Latency (msec)</th>
<th>Pre P2 Latency (msec)</th>
<th>Post P2 Latency (msec)</th>
<th>Pre N1-P2 Amplitude (μV)</th>
<th>Post N1-P2 Amplitude (μV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>104.34</td>
<td>112.67</td>
<td>160.56</td>
<td>175.13</td>
<td>4.98</td>
<td>6.77</td>
</tr>
<tr>
<td>Right</td>
<td>102.26</td>
<td>90.81</td>
<td>168.89</td>
<td>152.23</td>
<td>6.76</td>
<td>8.83</td>
</tr>
</tbody>
</table>
Edward: Ages 7-9

- Referred for a (C)APD assessment SLP.
  - Dx severe receptive and profound expressive language delay.
- Speech therapy since age 3. Currently 2x/week school and private therapy
- Normal birth history, with the exception of speech, gross motor skills were achieved at appropriate times.
- History of otitis media and pressure equalization tubes were previously placed.
- Normal peripheral hearing.
- Edward is currently in the 2nd grade with average to poor performance. He receives speech services twice weekly at school.
- A diagnosis of ADHD was made; however, pharmaceutical management has not begun.
- Completed Earobics Step 1 & 2 at age 7.
- This case demonstrates the results of a maturing central auditory nervous system and effective speech-language therapy and successful pharmaceutical management. Results of recent speech-language evaluation indicate normal speech-language abilities.

<table>
<thead>
<tr>
<th>Test</th>
<th>Initial Age 7</th>
<th>Post 1 Age 8</th>
<th>Post 2 Age 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCAN: 3C Auditory Figure Ground</td>
<td>5</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Standard Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCAN: 3C Filtered Words Standard</td>
<td>5</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCAN: 3C Competing Words Standard</td>
<td>4</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCAN: 3C Competing Sentences</td>
<td>4</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Standard Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCAN: 3C Time Compressed Speech</td>
<td>2</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Standard Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dichotic Digits Right Ear</td>
<td>40</td>
<td>65%</td>
<td>92%</td>
</tr>
<tr>
<td>Percentage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dichotic Digits Left Ear</td>
<td>40</td>
<td>60%</td>
<td>90%</td>
</tr>
<tr>
<td>Frequency Pattern Test Left Verbal</td>
<td>60%</td>
<td>80%</td>
<td>100%</td>
</tr>
<tr>
<td>Gap Detection Threshold</td>
<td>Within Normal Limits</td>
<td>Did not Test</td>
<td>Did not Test</td>
</tr>
</tbody>
</table>

Normal ABR and cABR
Debbie: 30 year old SLP grad student

- Self referred for a (C)APD assessment after an audiological assessment established normal peripheral hearing.
- Experiencing difficulty transcribing and distinguishing/discriminating phonemes required as part of a phonetics course.
- She reports normal developmental history. She has never experienced academic difficulties before.
- Of interest, are Debbie’s history of protracted middle ear infections and the placement of pressure equalization tubes as a young child.
Results of this assessment indicate difficulty listening in degraded acoustic environments.

<table>
<thead>
<tr>
<th>Filtered Words</th>
<th>Auditory Figure Ground</th>
<th>Time Compressed Speech</th>
<th>Competing Sentences</th>
<th>Dichotic Digits</th>
<th>Frequency Pattern Test</th>
<th>Gap Detection Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Right</td>
<td>82%</td>
<td>98%</td>
<td>74%</td>
<td>100%</td>
<td>64%</td>
<td>92%</td>
</tr>
<tr>
<td>Left</td>
<td>76%</td>
<td>94%</td>
<td>62%</td>
<td>96%</td>
<td>56%</td>
<td>88%</td>
</tr>
</tbody>
</table>
Intervention...

- A list of environmental modifications and compensatory strategies were provided. The Listening and Communication Enhancement (LACE) program was recommended for Debbie for home use. Additionally, Debbie will begin Dichotic Listening Therapy three times per week for four weeks.

- **Intervention:** Debbie completed ten sessions of dichotic listening therapy. Additionally, Debbie completed the LACE program. Debbie reports positive changes from therapy and using environmental modifications to move to the front of the classroom and request that the classroom speakers be turned on. She also reports these exercises were important to personally complete to have first-hand knowledge of aural rehabilitation training programs.
James

- James is a 12-year-old male who was a participant in a study examining pre- and post-behavioral and electrophysiological measures after Fast ForWord® training, provided by a local school system.
- James was the product of a normal pregnancy and birth. All developmental milestones were developing appropriately until the age of three. At that time, it was noted by his parents that James' speech and language skills regressed. Initially, this decline was attributed to sibling jealousy as it coincided with the birth of a younger sibling and a family relocation.
- James also had a history of otitis media, the lack of progression in speech and language was next related to his history of ear infections. A pure tone hearing evaluation indicated normal hearing thresholds, bilaterally.
- Subsequently, autism and pervasive developmental disorder were also erroneously diagnosed. Seizure activity began at the age of three and a half years; the diagnosis of Landau Kleffner Syndrome (LKS) was made after a characteristic spiking EEG. Nocturnal seizure activity continued until James was eleven years old.
James attended speech/language therapy and occupational therapy through early intervention programs in order to address expressive and receptive language delay and verbal apraxia.

He sporadically uses sign language as needed when he experiences difficulty with word finding or speech production.

He has been in special education classes and is receiving speech/language therapy at school two times per week, thirty minutes per session.

A speech-language assessment indicated a moderate to severe receptive and expressive language disorder, characterized by moderately impaired receptive language skills, severely impaired expressive language skills, and severely impaired language memory skills.

Expressive language skills were significantly weaker than receptive language skills. Articulation skills were also impaired and consistent with a diagnosis of verbal dyspraxia.

Speech intelligibility was fair in known contexts and fair to poor in unknown contests. James is taking anti-convulsion medication for seizures and is medically managed for ADHD.
Because of James’ apraxia and speech difficulty, only the Dichotic Digits Test, a low-linguistically loaded behavioral test was administered. James could not repeat any numbers presented to the right ear (0%), but had a left ear score of 92%.

- Normal temporal resolution was found.
- James had a 2 msec gap detection threshold and scored 100% by verbal response on the Frequency Pattern and Duration Pattern Test.
- A Masking Level Difference of 10 dB was obtained. An electrophysiological study including the auditory brainstem response (ABR), complex ABR (cABR), Auditory Middle Latency Response (AMLR), and Auditory Late Evoked Response (ALER) and P300 were recorded.
• James completed an eight-week program of Fast ForWord, provided by James’ school district. He received dichotic listening therapy, once per week for two semesters for a total of twenty-two sessions. Additional therapy sessions could not be scheduled due to James’ geographical distance from the clinic. James continued to receive speech and language therapy two times per week for thirty minutes per session at his school.

• No change in the right dichotic scores was noted after Fast ForWord. Progress was made during dichotic listening therapy. Binaural separation scores for the right ear are shown. Listed also is the intensity level of the signal to the left ear.
<table>
<thead>
<tr>
<th>Test</th>
<th>Left Intensity</th>
<th>Right Intensity</th>
<th>Right Binaural Separation Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre Fast ForWord</td>
<td>55</td>
<td>55</td>
<td>0%</td>
</tr>
<tr>
<td>Post Fast ForWord</td>
<td>55</td>
<td>55</td>
<td>0%</td>
</tr>
<tr>
<td>Post Dichotic Listening Training</td>
<td>55</td>
<td>55</td>
<td>94%</td>
</tr>
</tbody>
</table>
ABR

- This figure shows a normal auditory brain stem response (ABR) recorded pre Fast ForWord and post Fast ForWord and Dichotic Listening training for the right and left ears.
Table 21-7 ABR latency and amplitude recorded pre and post therapy for Case 6 (James).

<table>
<thead>
<tr>
<th>Ear</th>
<th>Wave</th>
<th>Pre-therapy</th>
<th>Post Fast ForWord</th>
<th>Post Dichotic Training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Latencies in msec</td>
<td>Amplitude in μV</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I</td>
<td>1.62</td>
<td>1.57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>3.95</td>
<td>3.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V</td>
<td>5.74</td>
<td>5.74</td>
</tr>
<tr>
<td>Left</td>
<td>I</td>
<td>1.66</td>
<td>1.62</td>
<td>1.57</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>3.91</td>
<td>3.99</td>
<td>3.99</td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>5.61</td>
<td>5.53</td>
<td>5.53</td>
</tr>
<tr>
<td>Right</td>
<td>I</td>
<td>.40</td>
<td>.41</td>
<td>.41</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>.17</td>
<td>.24</td>
<td>.26</td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>.27</td>
<td>.27</td>
<td>.45</td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>.30</td>
<td>.30</td>
<td>.31</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>.22</td>
<td>.22</td>
<td>.22</td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>.26</td>
<td>.26</td>
<td>.36</td>
</tr>
</tbody>
</table>
cABR

• Pre and Post cABR recordings are depicted for the left and right ears. Also depicted is a normative waveform.
### Table 21-8. Latency of Waves V and A for the cABR for Case 6 (James).

<table>
<thead>
<tr>
<th>Measure</th>
<th>EAR</th>
<th>Pre-therapy</th>
<th>Post Fast ForWord</th>
<th>Post Dichotic Listening Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>cABR (BioMARK) Algorithm Wave V latency (in msec)</td>
<td>Left</td>
<td>12</td>
<td>10</td>
<td>*3</td>
</tr>
<tr>
<td>cABR (BioMARK) Algorithm Wave A latency (in msec)</td>
<td>Left</td>
<td>6.78</td>
<td>6.62</td>
<td>6.53</td>
</tr>
<tr>
<td>cABR (BioMARK) Algorithm Wave V latency (in msec)</td>
<td>Right</td>
<td>15</td>
<td>11</td>
<td>*6</td>
</tr>
<tr>
<td>cABR (BioMARK) Algorithm Wave A latency (in msec)</td>
<td>Right</td>
<td>6.87</td>
<td>6.70</td>
<td>6.70</td>
</tr>
<tr>
<td>cABR (BioMARK) Algorithm Wave V latency (in msec)</td>
<td>Right</td>
<td>8.03</td>
<td>7.70</td>
<td>7.70</td>
</tr>
</tbody>
</table>

*denotes within normal limits
AMR

Figure 21-3. Pre auditory middle latency response (AMLR) recordings with right ear stimulation are shown for electrodes Cz, C3 and C4 in tracings 1, 2, and 3. Post Fast ForWord® recordings are shown in tracings 4, 5 and 6, and recordings after Dichotic listening training are shown in tracings 7, 8 and 9.

Figure 21-3
Table 21-9  Amplitude of the AMLR Na-Pa wave complex for Case 6 (James).

<table>
<thead>
<tr>
<th>Ear</th>
<th>Electrode</th>
<th>Pre-therapy Na-Pa amplitude (μV)</th>
<th>Post Fast ForWord Na-Pa amplitude (μV)</th>
<th>Post Dichotic Training Na-Pa amplitude (μV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>Cz</td>
<td>.82</td>
<td>.78</td>
<td>.93</td>
</tr>
<tr>
<td>Left</td>
<td>C3</td>
<td>.32</td>
<td>.11</td>
<td>.46</td>
</tr>
<tr>
<td>Right</td>
<td>Cz</td>
<td>.67</td>
<td>.86</td>
<td>.66</td>
</tr>
<tr>
<td>Right</td>
<td>C3</td>
<td>.54</td>
<td>.40</td>
<td>.44</td>
</tr>
<tr>
<td>Right</td>
<td>C4</td>
<td>.36</td>
<td>.64</td>
<td>.62</td>
</tr>
</tbody>
</table>
Pre and post Auditory Late Evoked Response (ALER) for the left and right ears are shown. Pre recordings are shown in tracings 4 and 1, post Fast ForWord® recordings are shown in tracings 5 and 2, and post Dichotic listening training therapy recordings are depicted in tracings 6 and 3.
<table>
<thead>
<tr>
<th>Ear</th>
<th>Measure</th>
<th>Pre-therapy</th>
<th>Post Fast ForWord</th>
<th>Post Dichotic Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>N1 Latency (in msec)</td>
<td>91.5</td>
<td>81</td>
<td>82.5</td>
</tr>
<tr>
<td></td>
<td>P2 Latency (in msec)</td>
<td>172.5</td>
<td>174</td>
<td>169.5</td>
</tr>
<tr>
<td></td>
<td>N1/P2 Amplitude (in μV)</td>
<td>8.61</td>
<td>8.64</td>
<td>8.14</td>
</tr>
<tr>
<td></td>
<td>N1 Latency (in msec)</td>
<td>85.5</td>
<td>85.5</td>
<td>79.5</td>
</tr>
<tr>
<td>Right</td>
<td>P2 Latency (in msec)</td>
<td>181.5</td>
<td>182.5</td>
<td>177</td>
</tr>
<tr>
<td></td>
<td>N1/P2 Amplitude (in μV)</td>
<td>9.55</td>
<td>10.57</td>
<td>11.35</td>
</tr>
</tbody>
</table>
Follow-up

- Although binaural separation scores were within normal limits, binaural integration was still difficult. Because of the geographical distance from James’ home and clinic, therapy was discontinued and dichotic exercises were provided for James to continue at home. In addition to objective evidence of improvement in the central auditory pathway, unsolicited parental reports were positive. They reported extended family members, as well as James’ teachers, commented that James’ speech was improving and that he was speaking in complete sentences and thoughts, rather than in a telegraphic-type speech. He was also initiating phone conversations, something he had never done in the past. They also reported that he rarely used signs anymore.

- James has not returned for formal follow-up evaluation. James completed NeuroFeedback training.

- He is no longer taking ADHD medication and is not any special education classes, nor does he qualify for any resource services through the school system at this time.
Questions

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Selected References