

Auditory Processing Disorder Cases

Lisa L. Hunter PhD

lisa.hunter@cchmc.org



What (or who?) defines Auditory Processing Disorder?

AAA Guidelines, 2005: (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.

ASHA Technical report, 2005: A Central Auditory Processing Disorder (CAPD) is an observed deficiency in one or more of [auditory] behaviors. For some persons, CAPD is presumed to result from the dysfunction of processes and mechanisms dedicated to audition; for others, CAPD may stem from some more general dysfunction, such as an attention deficit or neural timing deficit, that affects performance across modalities. It is also possible for CAPD to reflect co-existing dysfunctions of both sorts.

Auditory Processing Disorder (APD) is not defined in the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-V), while Attention Deficit Disorder (AD/HD) and Specific Learning Disorder are.

Guidelines and recent developments

International Journal of Audiology 'White Paper' 2012

- Brought together leading scientists and clinicians to present treatment disorder practice.
- Statement of Audiology with com chosen to



Categories of APD- BSA Guidelines

Guidelines and recent developments

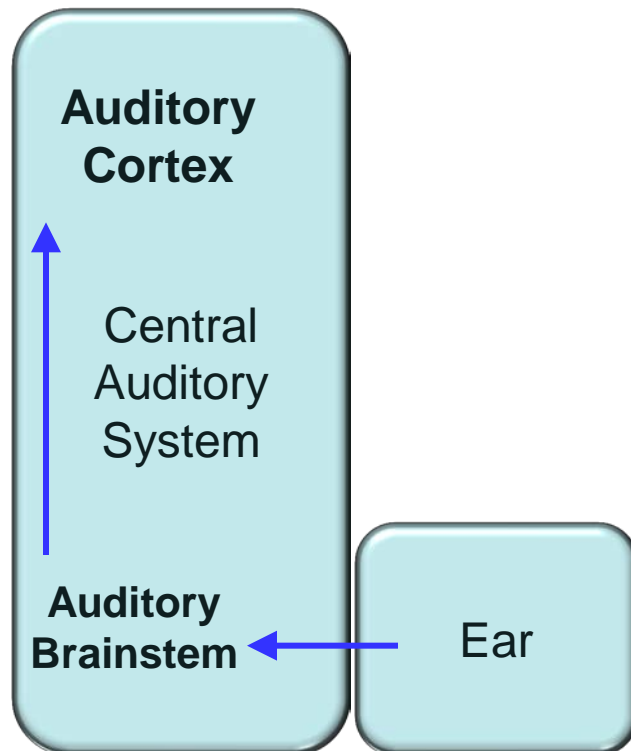
International Journal of Audiology 'White Paper' 2012

- Developmental APD: Presents in childhood. Normal hearing. No known aetiology
- Acquired APD: Associated with neurological evidence and/or event (e.g. brain scan, trauma) that could explain the APD
- Secondary APD: Occurs as a result of peripheral hearing loss

<http://www.thebsa.org.uk>

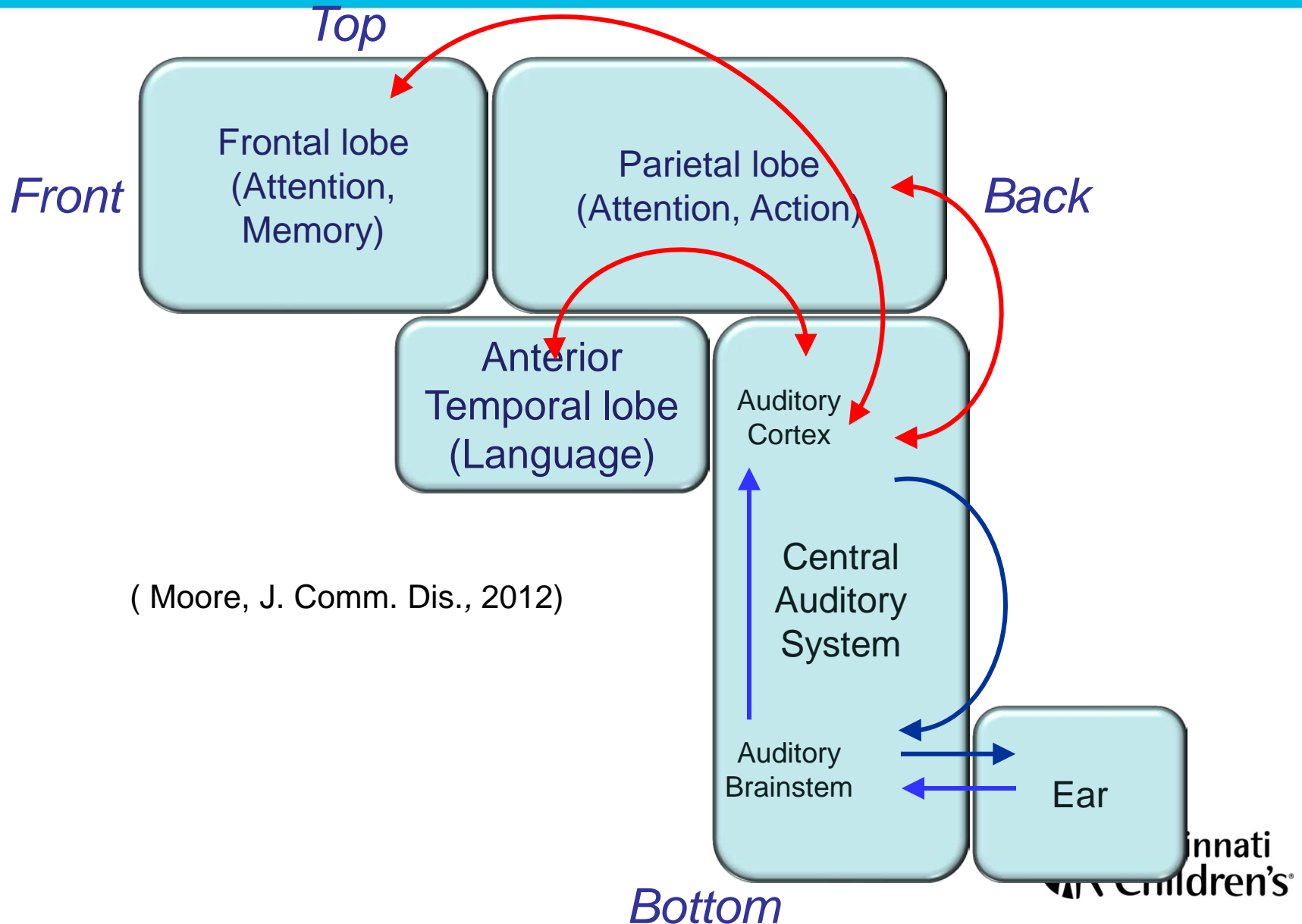
Follow link to 'Procedures and publications'

Traditional View of the Auditory Brain



(Moore, J. Comm. Dis., 2012)

The Real Auditory Brain

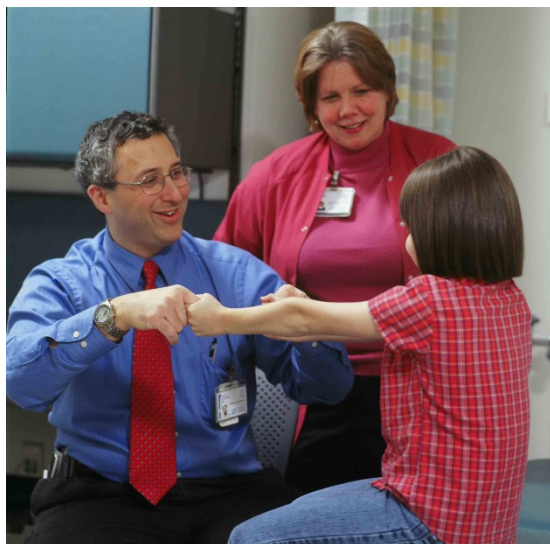


Multidisciplinary APD Assessment

- Multidisciplinary assessment complements audiologic diagnosis by revealing functional deficits associated with the (C)APD, identifying co-morbid conditions, and informing intervention plans.
- Likewise, intervention typically requires a multidisciplinary team given the potential impact of (C)APD on listening, communication, academic success, job performance, and social function, as well as the frequent comorbidity of this disorder with related language, learning, and cognitive disorders.
- ***From the AAA Guidelines for the Diagnosis, Treatment and Management of Children and Adults with Central Auditory Processing Disorder***

APD Program at Cincinnati Children's Hospital Medical Center

- Approximately 300 children referred each year
- Referred by Developmental & Behavioral Pediatrics, General Pediatrics, Parents, Speech Pathology, Psychology
- Multidisciplinary approach used to assess APD



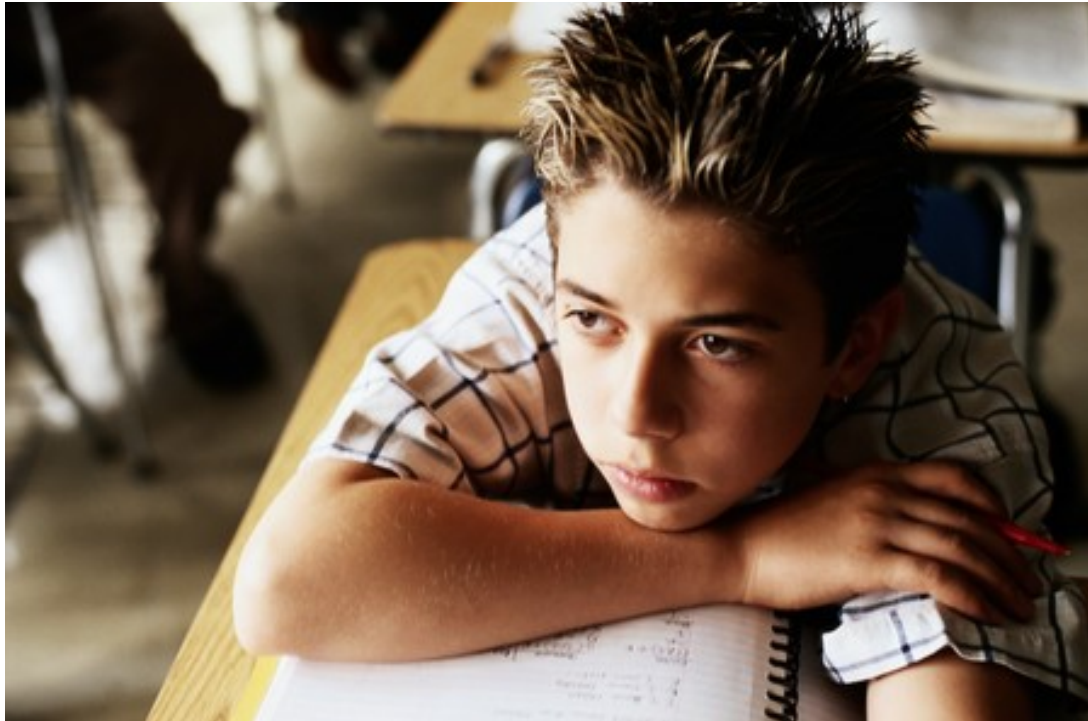
Audiologic APD Protocol

- Multifactored Case History
- Basic audiometric testing to rule out peripheral hearing loss, including acoustic reflexes, OAE when indicated
- SCAN-3 (Auditory Figure Ground, Filtered Words, Competing Words and Competing Sentences)
- Staggered Spondaic Word Test (SSW)
- Phonemic Synthesis Test
- Pitch Pattern Sequence Test
- Dichotic Digits and Dichotic Sentences
- ABR and Bio-MARK when indicated

APD Diagnosis Criteria

- Criteria for APD Diagnosis:
 - Tests results considered valid and relatively free of attention, cognitive, behavioral and speech-language problems as the primary cause of poor test performance
 - APD tests in the abnormal range outside established norms) for at least 2 measures or in severe range for one measure
 - Testing should be done with medication when prescribed for AD/HD

Case 1: Auditory Processing Disorder or AD/HD?



AD/HD and APD

- For over 30 years, there has been recognition that APD, if it exists as a separate clinical entity, overlaps with other neuro-maturational disorders.
- Modified procedures and use of reinforcement or other methods of maintaining attention and motivation are often required when testing those with comorbid conditions.
- In cases where medication has been prescribed for attention, anxiety, or other cognitive disorders, testing should be completed while the patient is on his/her prescribed medication (Chermak, Hall, & Musiek, 1999).

Patient “Sam”

- 16 year-old male referred by Developmental and Behavioral Pediatrics due to learning and attention problems, question of auditory processing difficulties.
- Referred to rule out APD and recommend treatment if indicated.

Sam's Case History

- Normal pregnancy and birth, full-term
- Developmental milestones age-appropriate except for delayed speech/language
- No history of chronic or recurrent OM
- Diagnosed with AD/HD-inattentive type
- Takes Concerta for AD/HD
- Academic concerns in reading and math
- Attends a private college-preparatory academy

Sam's Case History

- Question of “slight” autism, never diagnosed
- Behavioral questionnaire (parents)
 - Sensitive to loud sounds – needs quiet to study
 - Forgetful
 - Daydreams
 - Restless, problems sitting still
 - Short attention span
 - Does not complete assignments

Behavioral questionnaire (parents)

- Prefers to be alone
- Lacks motivation
- Easily frustrated
- Uncooperative, sometimes “unpleasant”
- Sam’s perspective: “It’s a bad day when....someone gets in my face, and starts talking crap to me like in the hallway or cafeteria”
- When a teacher yells at him for talking in class

Initial Evaluation

- Audiologic Evaluation: Normal hearing sensitivity bilaterally (borderline low frequency thresholds)
- Normal tympanometry and acoustic reflexes (ipsi and contra)
- Excellent word recognition in quiet
- Appeared tired, attention was variable
- Through questioning, determined Sam had forgotten to take his Concerta that morning, didn't admit in front of parent

SCAN-III Test Results

- Filtered Words: RE=20, LE=15, SS=12

Atypical RE advantage

- Auditory Fig-Ground: RE=15, LE=14, SS=9

- Competing Words: RE=15, LE=15, SS=10

- Competing Sentences: RE=33, LE=24, SS=6,

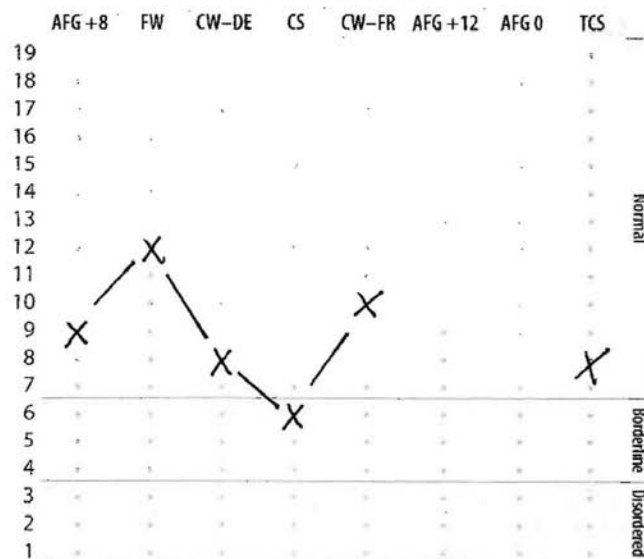
Atypical RE advantage

SCAN-III Summary

Diagnostic Score Summary

Test	Raw Score	Scaled Score	Scaled Score Points +/-	Confidence Interval 90% Level	Percentile Rank
AFG +	29	9	2	7 to 11	37
FW	35	12	2	10 to 14	75
CW-DE Total	41	8	2	6 to 10	25
CS	57	6	2	4 to 8	9
Sum of Scaled Scores		35			
Auditory Processing Composite		90		83 to 98	25

Scaled Score Chart



Supplementary Score Summary

Test	Raw Score	Scaled Score	Scaled Score Points +/-	Confidence Interval 90% Level	Percentile Rank
CW-FR	30	10	2	8 to 12	50
AFG +12				to	
AFG 0				to	
TCS	57	8	3	5 to 11	25

Ear Advantage Summary

Test	Ear Advantage (+ or - value)			Typical	Cumulative Prevalence
	RE Score	- LE Score	= EA		
AFG +8	15	- 14	= 1	N	If No, _____ %
CW-FR	15	- 15	= 0	N	If No, _____ %
FW	20	- 15	= 5	Y	If No, 15 %
CW-DE Directed RE	10	- 8	= 2	N	If No, _____ %
CW-DE Directed LE	10	- 13	= -3	Y	If No, 5 %
CS	33	- 24	= 9	Y	If No, 5 %
AFG +12	-	-	=	Y	If No, _____ %
AFG 0	-	-	=	Y	If No, _____ %
TCS	29	- 28	= 1	Y	If No, _____ %

Note. A positive (+) value = right ear advantage; a negative (-) value = left ear advantage

Behavioral Observations:

SCAN-III Summary

Ear Advantage Summary

Ear Advantage (+ or - value)							Cumulative Prevalence	
Test	RE Score	-	LE Score	=	EA	Typical		
AFG +8	15	-	14	=	1	Y	N	If No, _____ %
CW-FR	15	-	15	=	0	(Y)	N	If No, _____ %
FW	20	-	15	=	5	Y	(N)	If No, <u>15</u> %
CW-DE Directed RE	10	-	8	=	2	(Y)	N	If No, _____ %
CW-DE Directed LE	10	-	13	=	-3	Y	(N)	If No, <u>5</u> %
CS	33	-	24	=	9	Y	(N)	If No, <u>5</u> %
AFG +12		-		=		Y	N	If No, _____ %
AFG 0		-		=		Y	N	If No, _____ %
TCS	29	-	28	=	1	(Y)	N	If No, _____ %

Note. A positive (+) value = right ear advantage; a negative (-) value = left ear advantage

Staggered Spondaic Words Test

- RNC: 2 errors (norm <1)
- RC: 9 errors (norm <9)
- LNC: 2 errors (norm <1)
- LC: 3 errors (norm <4)

Staggered Spondaic Words Summary

1.

R-SSW

Enter totals from page 3.

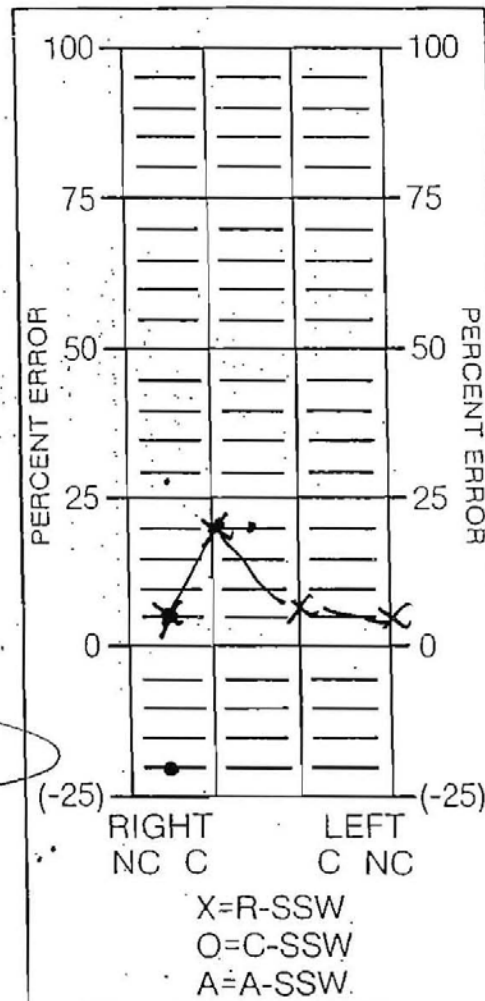
CONDITION	RNC	RC	LC	LNC	TOTAL
Total Errors	2	9	3	2	16
Multiplier	x2.5	x	x	x	
R-SSW % Error	5	22.5	7.5	5	
EAR	RE		LE		
R-SSW % Error	27.5		12.5		
TOTAL		T			
C-SSW % Error		40			
NOE NORMS	1	2	4	1	6

Circle any Significant Total Errors/Total

3.

A-SSW

Enter least biased errors from page 3.



Phonemic Synthesis Test

- 14 correct (norms for age >23 correct)

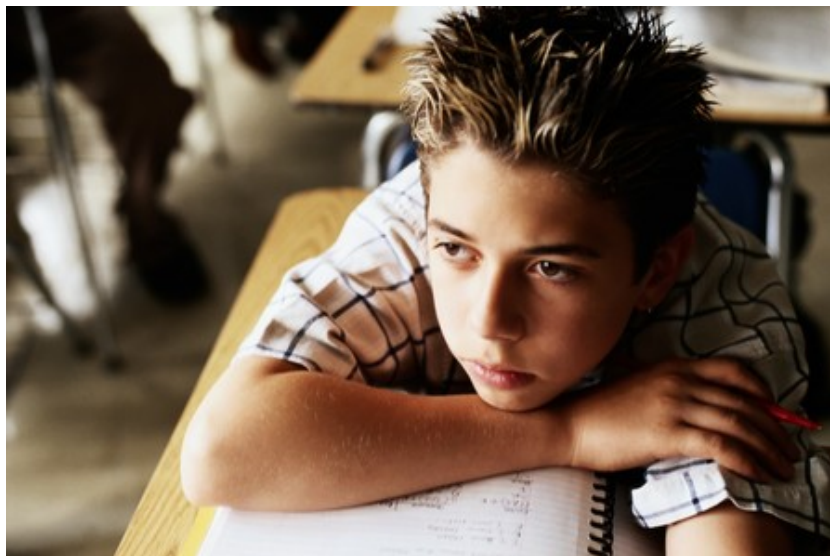
Markedly below norms

Pitch Pattern Sequence Test

- Verbal response = 80% correct
(within norms for age)

Sam's Overall Results

- Meets criteria for APD in areas of dichotic words and sentences (SCAN-III and SSW), and in phonemic synthesis
- Due to medication not taken, recommend re-test with medication before diagnosis



Re-Test 6 weeks later with Medication

- Auditory Figure Ground SS improved from 9 to 12
- Competing Sentences SS improved from 6 to 9, no ear advantage
- SSW improved to within normal range all conditions, no ear asymmetry
- Phonemic Synthesis improved from 14 to 21, now mildly below norms
- No longer meets criteria for APD Diagnosis

Multidisciplinary Assessment

- Speech-Language Assessment:
 - Moderately delayed expressive language skills
 - Mildly delayed receptive language skills
 - Pragmatic language skills average
- Psychological Testing:
 - Average cognitive ability
 - Discrepancy between verbal (lower) and nonverbal (higher) cognitive functioning

Multidisciplinary Assessment

- Academic skills moderately delayed across all areas (reading, math, writing)
- Attention questionnaires revealed significant difficulties
- OT evaluation: Difficulty with execution of coordinated movement patterns, cognitive processing skills and fine motor skills

Sam's Diagnoses

- Mixed receptive-expressive language disorder
- AD/HD, predominantly inattentive type
- Learning disability (language processing and speed)



Intervention Recommendations

- You are the Audiologist or SLP on Sam's IEP Team.
- What questions would you want addressed?
- What about classroom acoustics, performance and any auditory supports?
- What interventions would you recommend, if any?

Team Intervention Recommendations

- Continue current medication regimen (Concerta)
- Speech-language therapy privately, not qualified for school services
- Modified educational support, 504 Plan
- Consider day program at local school for AD/HD and learning disabilities
- Math and reading tutoring
- Earobics, adult version, to support phonological awareness skills at home
- Orton-Gillingham tutoring for phonological development

Take-Home Messages

- Question parents as well as child carefully about medications day of testing
- Repeat abnormal tests with medication before making APD diagnosis
- Do not assume that typical APD pattern of ear asymmetry means APD
- Do not assume that dichotic testing is immune to attention effects
- Coordinate eval and recs with other disciplines



Patient “Annie”

- 9 year-old female in 3rd grade referred by Developmental and Behavioral Pediatrics due to learning and attention problems, question of auditory processing difficulties.
- Referred to rule out APD and recommend treatment if indicated.



Annie's Case History

- Normal pregnancy and birth, full-term
- Developmental milestones age-appropriate except for delayed speech/language
- No history of chronic or recurrent OM
- Diagnosed with AD/HD-inattentive type
- Takes Strattera for AD/HD
- Academic concerns – learning disabilities, memory and language processing problems
- Math and reading skills below grade level

Multidisciplinary Developmental Evaluation

- Language skills in moderate-severe range, age equivalent scores ranged from 4 years, 9 months to 6 years, 9 months
- Cognitive status: Full scale IQ=83, deficits in working memory and perceptual reasoning.
- OT evaluation: Deficits in fine motor skills and sensory processing.
- Behavioral assessment: AD/HD, inattentive type and anxious coping style.

Behavioral questionnaire (parents)

- Anxious, unsure in verbal communication
- Afraid of being alone, sleep issues
- Enjoys school, no behavioral problems
- Has reading tutoring 3 times per week including Orton-Gillingham
- Has speech therapy once a week

Audiologic Evaluation

Word Recognition in Quiet

- NU-6 monosyllabic words:

RIGHT:

92% at 40 dB SL

LEFT:

72% at 40 dB SL

80% at 50 dB SL

92% at 70 dB SL

Audiologic Evaluation

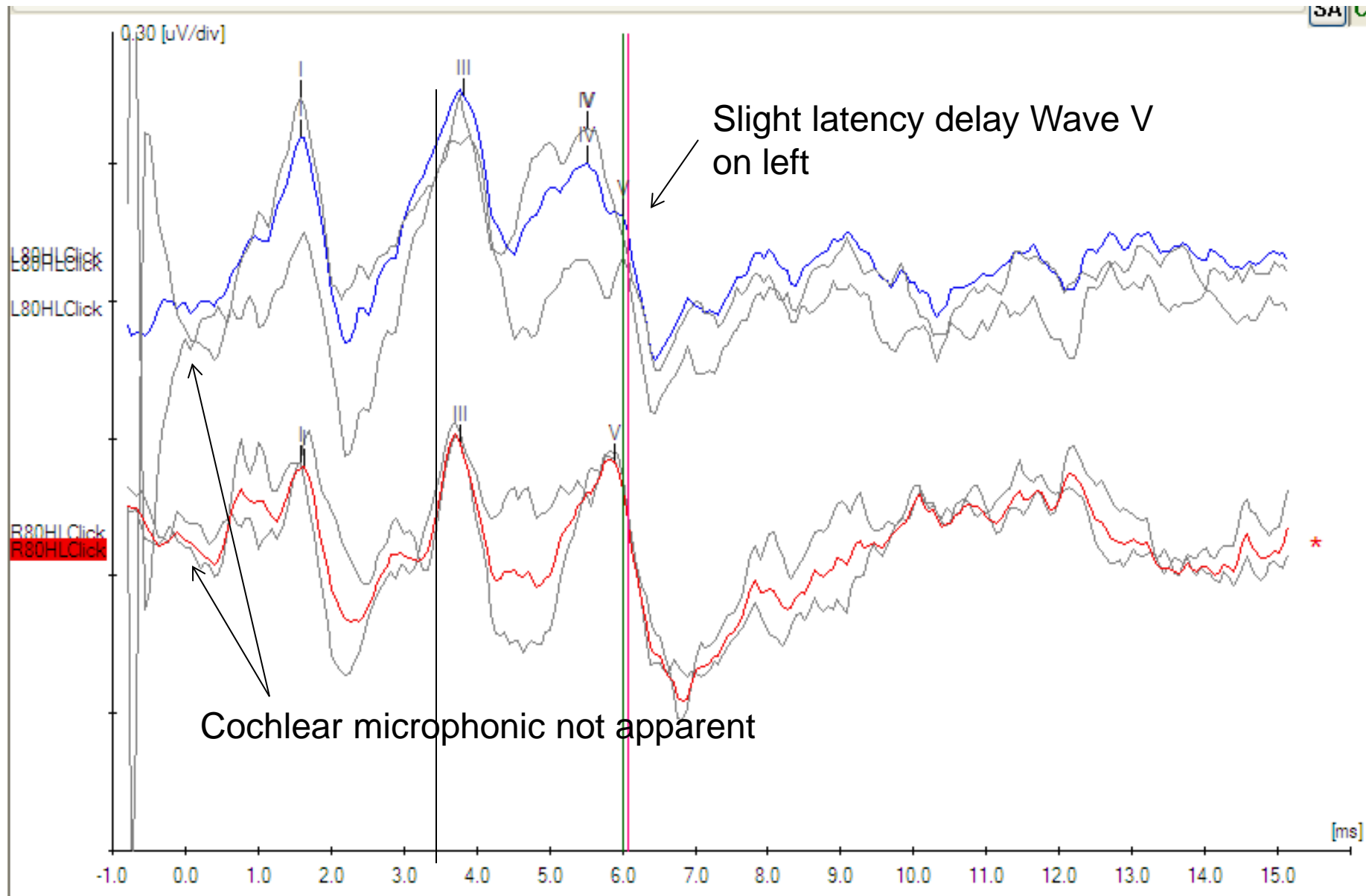
DPOAE Results

- SNR > 8 dB at all frequencies tested in both ears
- Signal level at 2, 3, 4 and 5 kHz within normal range for right
- Signal level at 2, 4 and 5 kHz within normal range for left

SCAN-3c Test Results

- Gap Detection: RE and LE passed (10 msec)
- Filtered Words: RE=12, LE=12, SS=9
(37th percentile)
- Auditory Fig-Ground: RE=16, LE=14, SS=4
(2nd percentile)
- Competing Words FR: RE=8, LE=8, SS=7
(16nd percentile)
- Competing Words DE: RE=28, LE=13, SS=7
(16nd percentile)
- Competing Sentences: RE=33, LE=24, SS=6,
(9th percentile)

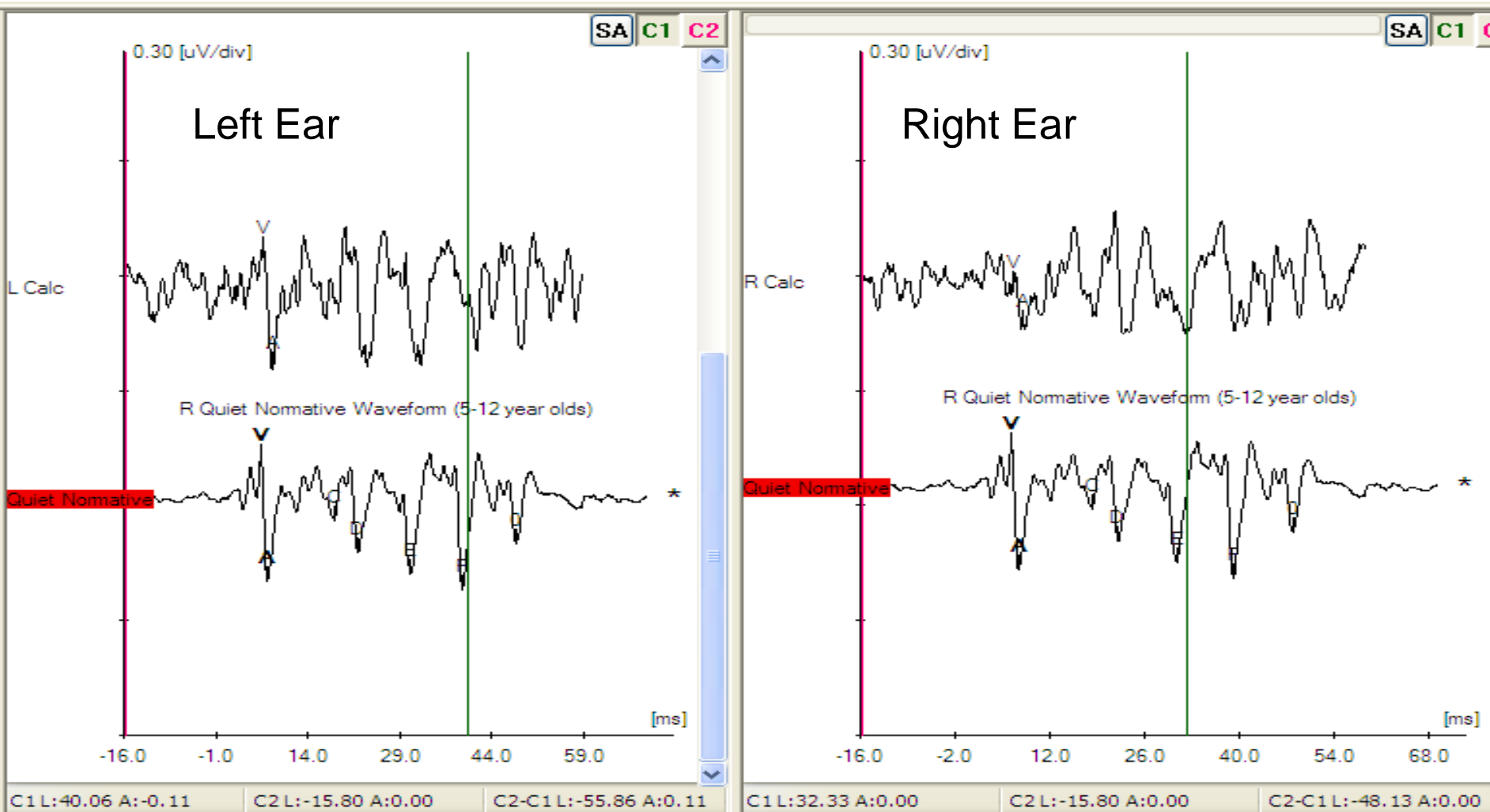
ABR Test Results



Auditory Brainstem Response Test

- Right Ear:
 - Wave I-V: 4.27 msec
- Left Ear:
 - Wave I-V: 4.48 msec*
- Interaural Latency Difference: 0.21 msec

Bio-MARK Test Results



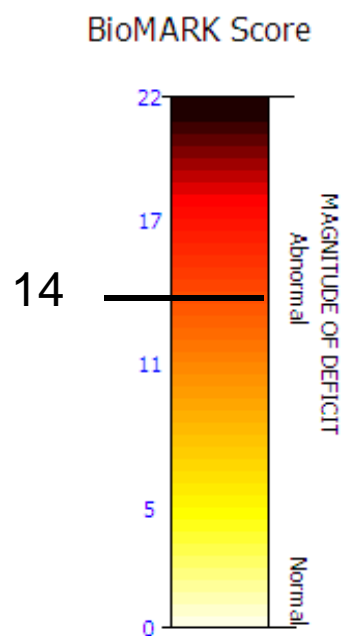
Bio-MARK Test Results

BioMARK

BioMARK (biological marker of auditory processing) objectively assesses the neural processing of sound. Unlike traditional brainstem evoked responses using clicks and tone bursts, BioMARK uses a speech syllable that reflects the phonetic characteristics of sounds that present difficulties for some individuals with reading and auditory processing disorders.

Score: 14 (abnormal BioMARK)

The results of the speech-evoked brainstem response are interpreted as abnormal.



The results are based on the following information:

Measure	Result	Within Normal Limits
Wave V Latency	6.66 ms	Yes
Wave A Latency	7.97 ms	No
VA Slope	-0.08 uV/ms	No
First Formant Frequencies	0.82	No
High Frequencies	0.26	No

Annie's Audiologic Summary

- Mild asymmetric sensorineural hearing loss
- Asymmetric word recognition in quiet
- Normal tympanometry, reflexes and OAE
- Mildly delayed I-III and I-V interpeak latencies on left
- Abnormal Bio-MARK test on right (left norms unavailable)
- SCAN-IIc test abnormal for Figure-Ground, Dichotic Sentences
- Dichotic words were borderline and symmetric

What would you recommend?

- Any additional audiologic tests?
- Referral for medical work-up?
- If so, ENT or neurology?

Let's Put our Heads Together!

- What is your diagnostic interpretation?
- APD?
- Retrocochlear hearing loss?
- ANSD?
- Other?



ANSD Diagnostic Criteria

- Diagnostic criteria for AN (Sininger and Oba, 2001):
 - Elevated pure tone thresholds by air and bone
 - Very poor speech discrimination
 - Absent or elevated middle-ear muscle reflexes
 - Absent ABR to any level of stimulation
 - Present cochlear microphonic
 - Present otoacoustic emissions
- Today the criteria are not as clear (Sininger, 2008, NHS Lake Como)

Does Annie meet ANSD Criteria?

- Diagnostic criteria for AN (Sininger and Oba, 2001):
 - ✓ Elevated pure tone thresholds by air and bone
 - ✓ Very poor speech discrimination
 - ✓ Elevated/absent middle-ear muscle reflexes contra only
 - ✓ Present otoacoustic emissions
 - ✗ Absent ABR to any level of stimulation
 - ✗ Present cochlear microphonic

Referral to Pediatric Otologist

- Normal ENT exam
- Ordered MRI
- MRI results: Normal with exception of small 1.5 cm by 8 mm CSF fluid structure along inferior aspect of left CPA consistent with a small arachnoid cyst.
- Does not appear to exert adjacent mass effect. Seventh and eighth nerve complexes normal and well seen. Labyrinthine structures normal.
- No recommendations for medical or surgical treatment

Intervention Recommendations

- You are the Audiologist or SLP on Sam's IEP Team.
- What questions would you want addressed?
- What about classroom acoustics, performance and any auditory supports?
- What interventions would you recommend, if any?

Team Multidisciplinary Recommendations

- Continue current medication regimen (Strattera)
- Follow-up Audiology Evaluations
- Modified educational support for attention deficits
- Consider use of FM system in school
- Math and reading tutoring
- Earobics at home to improve phonological awareness skills
- Orton-Gillingham tutoring for phonological development

Evaluating Auditory Processing Disorder in a Complex Neurodevelopmental Case

Lisa L. Hunter, Ph.D.

Lisa Hilbert, Au.D.

Diane Geiger, Ph.D.

Fawen Zhang, Ph.D.

Robert Keith, Ph.D.



Patient “Ryan”

- 9 year-old male referred by PMD due to learning and attention problems, question of auditory processing difficulties.
- Referred to assess for APD and recommend treatment.
- Patient had received multiple assessments in other states by audiologists, SLPs and neurologists.
- Mother is seeking a diagnosis of APD, because she believes this diagnosis is key to obtaining appropriate services in his school.

Case History

- Normal pregnancy and birth, full-term
- Gross and fine motor milestones were age-appropriate
- Delayed speech/language – First word 3 years, 9 months, 2-word sentences 4 years.
- Reading was accelerated, but verbal language slow
- Decoding and visual memory normal, auditory memory very poor
- Speech therapy since age 2 ½ through EI

Case History

- Behavioral questionnaire (completed by mother)
 - Hyperactive, impulsive, short attention span, easily frustrated, disorganized, trouble finishing tasks, has few friends, poor social skills, good memory, competitive, easy to anger
 - Does not play sports – activity moves too fast and he cannot process spoken directions
 - Prefers to read and play alone on video games, likes solitary activities
 - Fearful of loud sounds, uses noise cancelling headphones to do work and reduce agitation

Neuropsychologic Evaluation

- **Attention**: Difficulty focusing on tasks but will over-focus on activities he enjoys, such as video games.
- **Language**: Severe receptive and expressive language disorder, poor pragmatic use of language, tends to repeat (echolalia) and atypical use of pronouns: “Her sister name Emily” instead of “His sister’s name is Emily”. Seems to understand and use written language better than verbal language.
- **Motor**: Low muscle tone, needs to be taught new motor skills by steps and practice

Neuropsychologic Evaluation

- **Academics**: In 3rd grade, regular classroom with special education support. Good single word and phonemic decoding, poor comprehension. Difficulty with overall concepts, good memory for details.
- **Social Skills**: Very poor, few friends, difficulty with peer interactions. In a social skills group at school. Needs predictable daily routines.
- **Sensory**: Trouble tolerating sensory stimuli, especially auditory. Follows “sensory diet” to increase tolerance of environmental stimuli.
- **Auditory processing**: Able to listen, recall and repeat simple information, but poor memory for words, sentences and sequences.

Neuropsychologic Evaluation

Reynolds Intellectual Assessment

Verbal Index: 70 (Borderline)

Nonverbal Index: 92 (Average)

NEPSY-2: Language

Comprehension of Instructions 0.1%ile

Phonological Processing 1%ile

Repetition Nonsense Words 37%ile

Speeded Naming 9%ile

Word Generation – Semantic 50%ile

Social Perception 0.1%ile

Visual Design Copying >75%ile

Geometric Puzzles 0.1%ile

Neuropsychologic Evaluation

BRIEF (Behavior Rating Inventory of Executive Function)

All subscales within normal limits

Child Behavior Checklist (Parent/Teacher Ratings)

All subscales within normal limits

WIAT-III: Academics

Below grade level in listening comprehension, reading skills, at grade level in other areas.

Neurodevelopmental Pediatrics

- Several Diagnoses:
 - Specific learning disabilities, including executive functioning and social difficulties
 - Oromotor dyspraxia
 - Hypotonicity
 - Mixed expressive receptive language disorder
 - Pragmatic language disorder
 - Right hemisphere, electrographic dysfunction on EEG
 - Question of PDD, NOS but appears to be severe language disorder with compensatory mechanisms.

Audiologic Evaluation

Audiologic Evaluation

SCAN-3 Test Results

SCAN-3 Results	Standard Score	Percentile Rank
Auditory Figure Ground	5	5%
Filtered Words	9	37%
Competing Words	4	2%
Competing Sentences	3	1%
Composite Test Score	68	2%

SCAN-3 Supplemental Results

Subtest	Standard Score	Percentile Rank
Competing Words- Free Recall	4	2%

SCAN-III Summary

<i>Subtest</i>	<i>Ear Adv</i>	<i>Prevalence</i>
Auditory Figure Ground (+8 SNR)	-1	Typical
Filtered Words	-2	Typical
Competing Sentences	19	5%ile
Competing Words	7	Typical

Phonemic Synthesis Test

- **19 correct (norms for age >18 correct)**

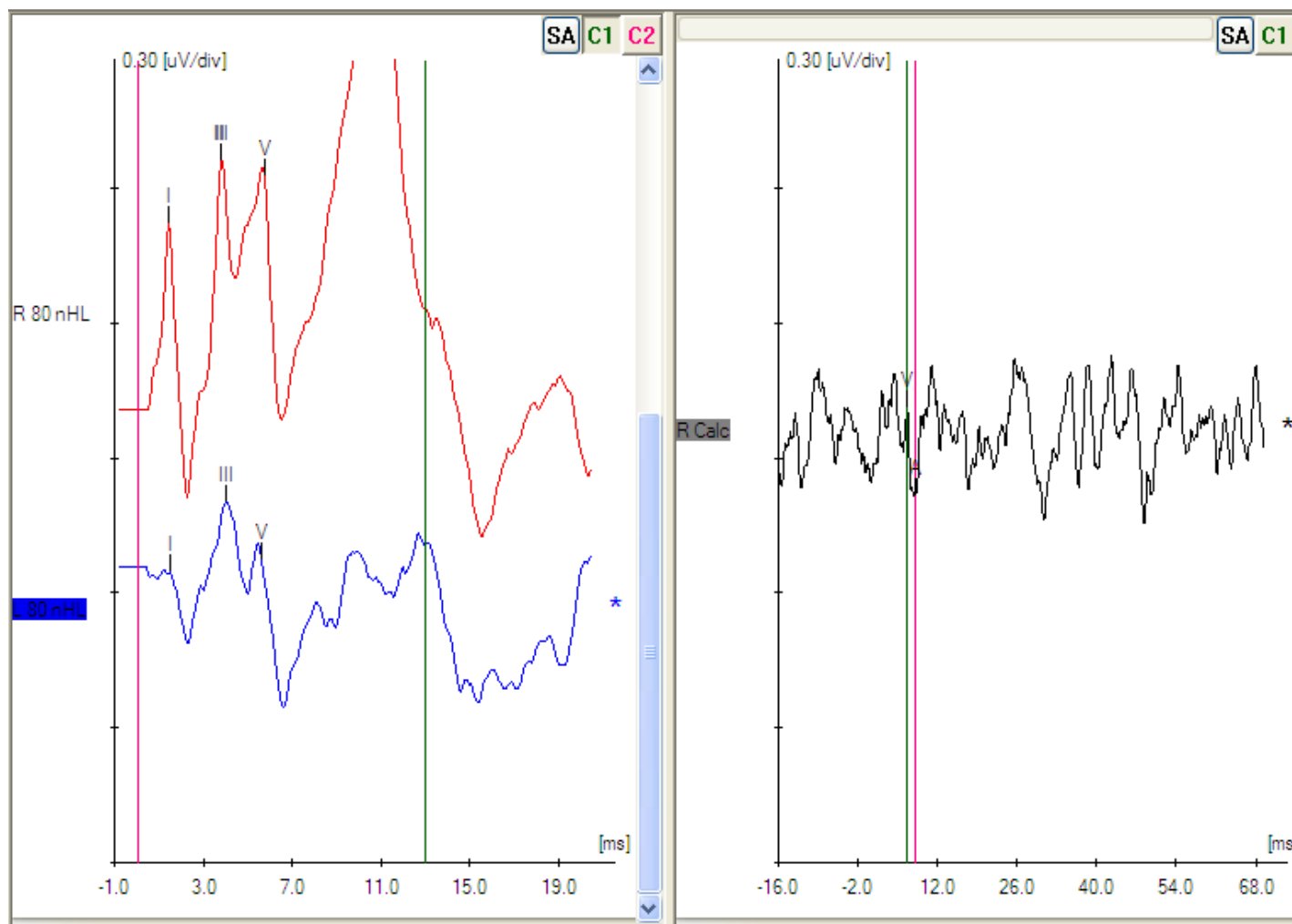
His response patterns were not typical. Many of his responses were Non-Fused, meaning he would say each individual phoneme after the presenter. He would then blend the sounds together after this initial practice. It was difficult to stop him from using this strategy. When the strategy was taken from him with the use of a reward system, he was not able to provide the correct response.

Pitch Pattern Sequence Test

- Verbal response = 80% correct (within norms for age)

He had great difficulty providing the appropriate linguistic label for these patterns. Many of his verbal responses were reversed. He was able to hum his responses with accuracy.

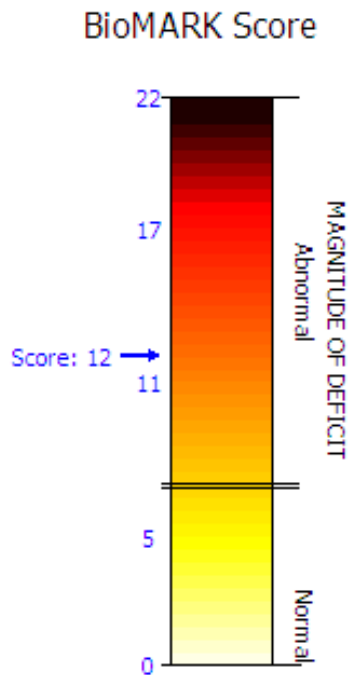
ABR and Bio-MARK Results



Bio-MARK Score

Score: 12 (abnormal BioMARK)

The results of the speech-evoked brainstem response are interpreted as abnormal.



Based on normative data for:
age 5-12 years

The results are based on the following information:

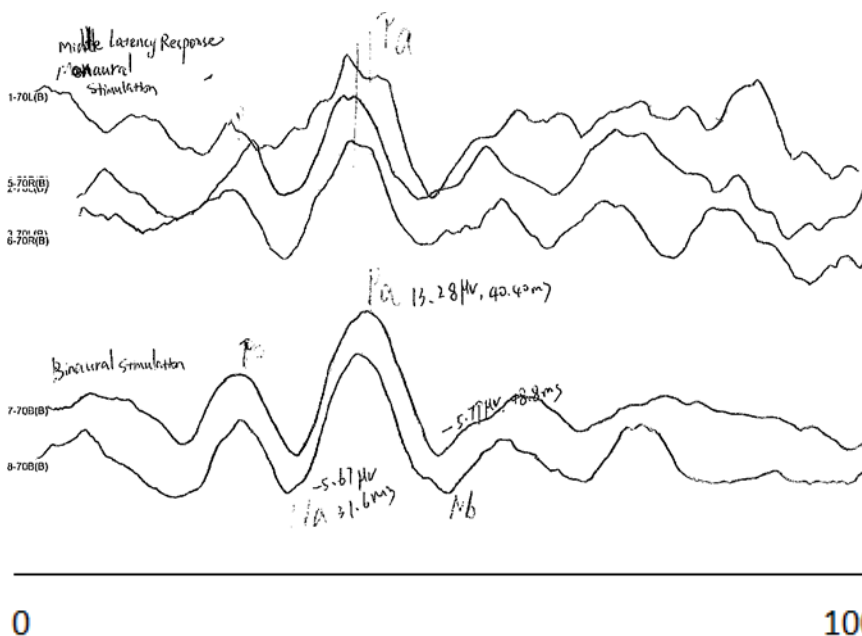
Measure	Result	Within Normal Limits
Wave V Latency	6.62 ms	Yes
Wave A Latency	7.95 ms	No
VA Slope	-0.15 uV/ms	No
First Formant Frequencies	0.90	No
High Frequencies	0.52	No

Middle Latency Response

MLR data from electrode Cz-Cv2 (neck). Data were collected with left ear stimulation, right ear stimulation, and binaural stimulation.

Peak latencies appeared to be in the range of normal peers: Na latency: 32 ms; Pa latency: 41 ms; Nb latency: 50 ms.

However, the peak-to-peak amplitude is much larger (more than 10 μ V) than normative data (less than 2 μ V) (normative data from Mason & Mellor, 1984; Kraus et al., 1985, Purdy et al., 2002).



Data in the literature (Purdy et al., 2002) from electrode Cz-Cv2 (neck) in normal group and subjects with learning disabilities. Stimuli were 0.1 ms rarefaction clicks presented at 8.7/s with a level at 70 dB nHL.

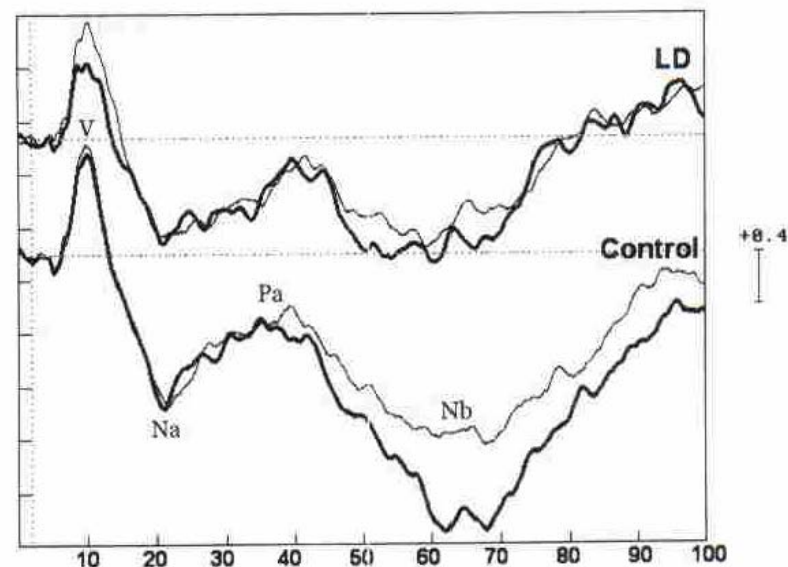
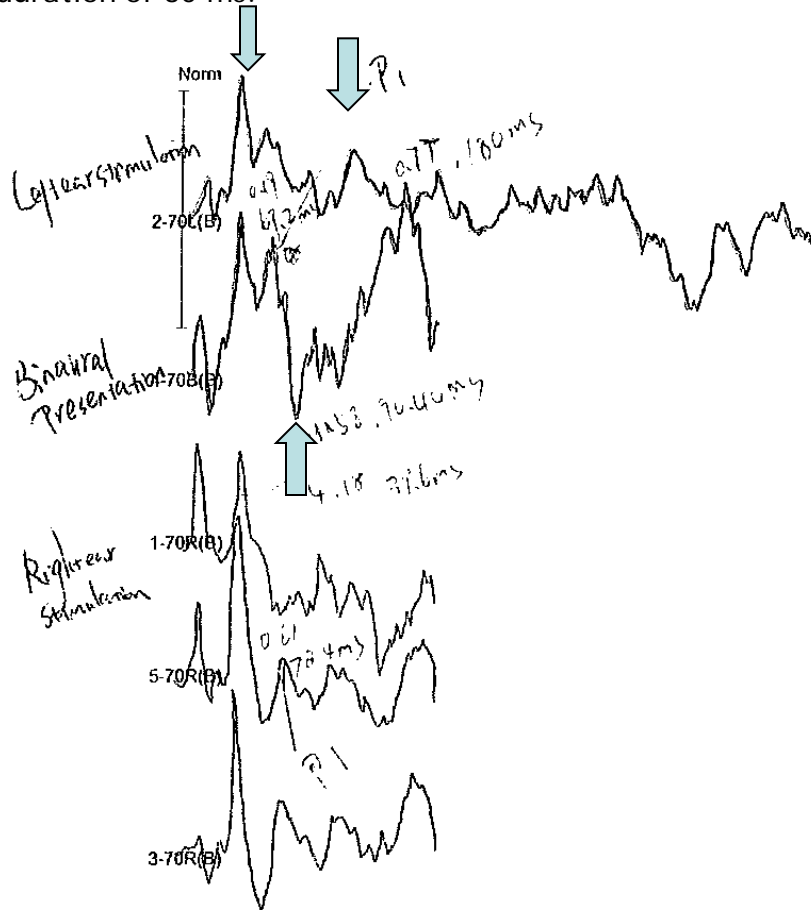


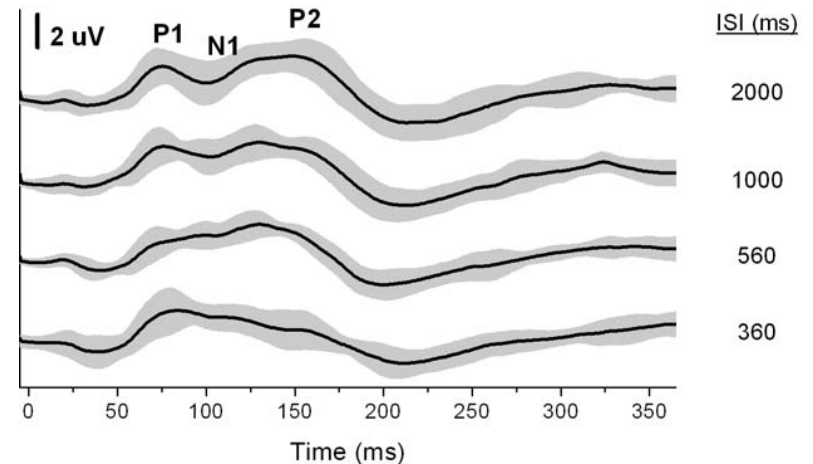
Figure 3 Grand-averaged right ear (*thick line*) and left ear (*thin line*) middle latency response waveforms recorded using Cz-Cv2 electrode montage. Responses of the learning-disabled (LD) and control children are shown at the top and bottom, respectively.

Late Evoked Potentials

Ryan's LAEP data from electrode Cz. Data were collected with left ear stimulation, right ear stimulation, and binaural stimulation. Stimuli for LAEP: 1 kHz; rate at 1.1/s; Intensity at 70 dB nHL; duration of 30 ms.

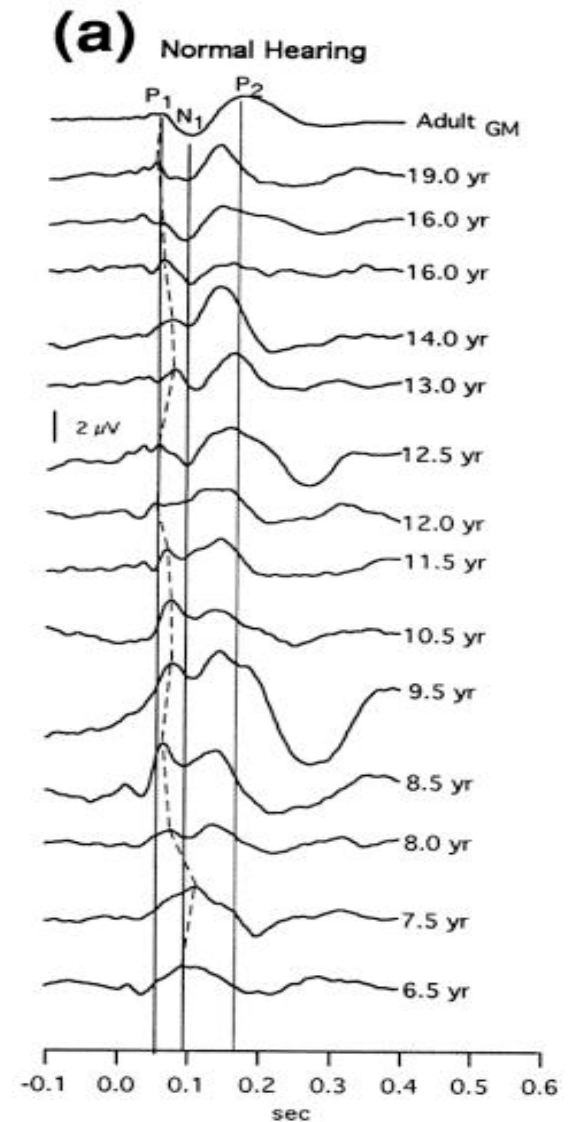


Data in the literature: Grand average LAEPs in a group of normal-hearing children 9-10 years. LAEPs for four interstimulus interval (ISI) conditions are represented (black line) plotted over the ± 1 standard deviation regions (shaded). Stimulus is a natural speech syllable [uh] with a 23 ms. The intensity level is 70 dB SPL.



More normative data from the literature (Ponton et al., 1996).

- LAEP from Cz-Fpz for NH subjects. Solid vertical lines represent the peak latencies for the $P_1/N_1/P_2$ components of the adult responses. Broken vertical lines represent peaks identified as P_1 . The number of subjects for 9.5 years is 14. Stimuli consisted of 0.1 ms clicks. The clicks were presented monaurally to the left ear through a headphone at approximately 65 dB nHL.

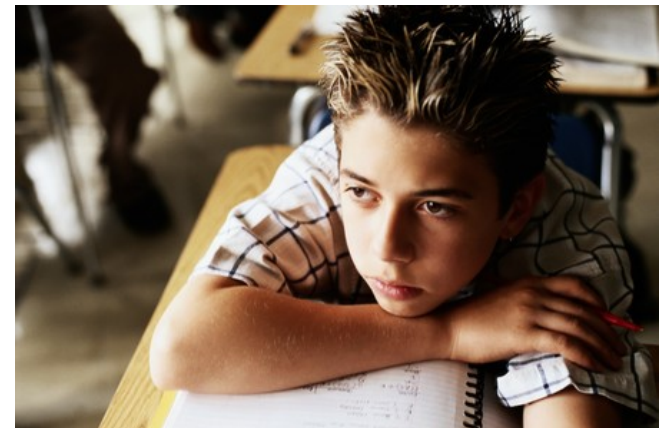


Late Evoked Potentials

- Ryan's LAEP: the response for binaural stimulation seems to have better morphology than the responses for monaural stimulation.
- P1, N1 and P2 can be seen for binaural stimulation.
- Unfortunately, we are lacking repeated recordings because Ryan pulled the electrodes off.

Audiologic Summary

- Meets criteria for APD in area of dichotic listening for words and sentences, with a right ear advantage.
- Appears to have severe phonemic synthesis deficit, but uses sounding-out strategy.
- Bio-MARK and late auditory potentials indicate possible deficits in neural processing of auditory and speech stimuli.



Multidisciplinary Assessment

- Speech-Language Assessment:
 - Severely delayed expressive language skills
 - Severely delayed receptive language skills
 - Poor Pragmatic language skills
- Psychological Testing:
 - Discrepancy between verbal (lower) and nonverbal (higher) cognitive functioning

Speech-Language Scores

- Clinical Evaluation of Language Fundamentals-4
 - Receptive Language: SS 50, Percentile <1
- Difficulty:
- Understanding complex commands
 - Understanding word relationships
 - Retaining detail in spoken information/passages

Speech-Language Scores

- Expressive Language: SS 61, Percentile <1
 - Difficulty:
 - Recalling complex sentence structures
 - Talking about word relationships
 - Strength:
 - Formulating complex sentences from given words

Speech-Language Results

- Difficulty in Informal Language:
 - Difficulty sequencing an event
 - Often understood language concretely
 - Difficulty with pronoun usage

Pragmatic Language:

- Unusual:
 - Use of Rote Phrases
 - Perseveration on language that was taken from film scenes
 - Difficulty initiating and continuing topics

Language Processing Skills

- Test of Auditory Processing-2 (TAPS-3)
- Phonological Processing: SS 68, Percentile 2
 - Difficulty:
 - Discerning phonological differences in word pairs
 - Manipulating sounds in words
 - Synthesizing sounds into words

Language Processing Skills

- Memory Processing Skills
 - Difficulty:
 - Retaining and manipulating simple sequences
- Cohesion Skills
 - Difficulty:
 - Retaining detail in spoken information
 - Understanding inference and implication

Ryan's Diagnoses

- Mixed receptive-expressive language disorder and difficulty with pragmatic language skills
- Learning disability (language processing and speed)



Multidisciplinary Recommendations

- Continued Speech-Language Intervention
- Use of visual cues in home and at school
- Modified educational support
- Consider day program at local school for learning disabilities
- Continued use of FM System at school

Take-Home Messages

- Coordinate evaluation and recommendations with other disciplines
- When behavioral APD assessment is challenging due to severe deficits, modification of the assessment may be necessary
- Evoked potentials can provide a useful cross check to behavioral APD tests



Take-Home Messages

- Diagnostic pictures can overlap among SNHL, AD/HD, LD, APD, ANSD
- Do not assume ANSD until structural abnormalities are ruled out
- When cognitive and attention are co-morbid factors, consider electrophysiologic tests
- Coordinate eval and recs with other disciplines
- Interdisciplinary test battery approach is still valid

