

2010 Visionary Conference

Fit Brains Learn Better

*March 18, 19 & 20, 2010
The Westin Gaslamp Quarter, San Diego*



Fagan Center 
for Communication
Communication is the Beginning of Understanding

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www.fagancenter.com

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Jerger and Museik 2000

- Children and adults with CAPD are a heterogeneous group of people who have difficulty using auditory information to communicate and learn. CAPD is a set of problems that occurs in different listening tasks. It is a deficit in the processing of auditory input, which may be exacerbated in unfavorable acoustic environments and is associated with difficulty in listening, speech understanding, language development and learning.


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ASHA definition

- (Central) Auditory Processing (CAP) is the efficiency and effectiveness in which the central auditory nervous system (CANS) utilizes auditory information. More specifically, CAP refers to the perceptual processing of auditory information in the CNS and the neurobiological activity that underlies that processing and gives rise to electrophysiologic auditory potentials. ASHA (2005)

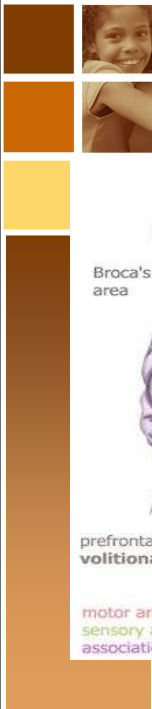
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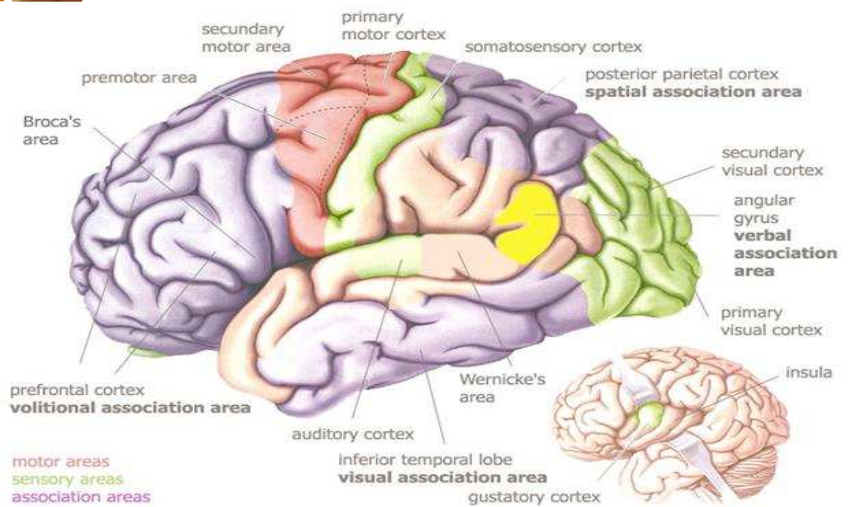
Prevalence & Etiology

- 1/2 of LD children
 - 2.5% of school aged population
- Lack of prevalence data - ADHD
- Trauma, Neurological insult
- Immaturity of the CANS
 - Inefficient neuropsychological representation
 - Imprecise temporal processing
 - Abnormal hemispheric representation & transfer

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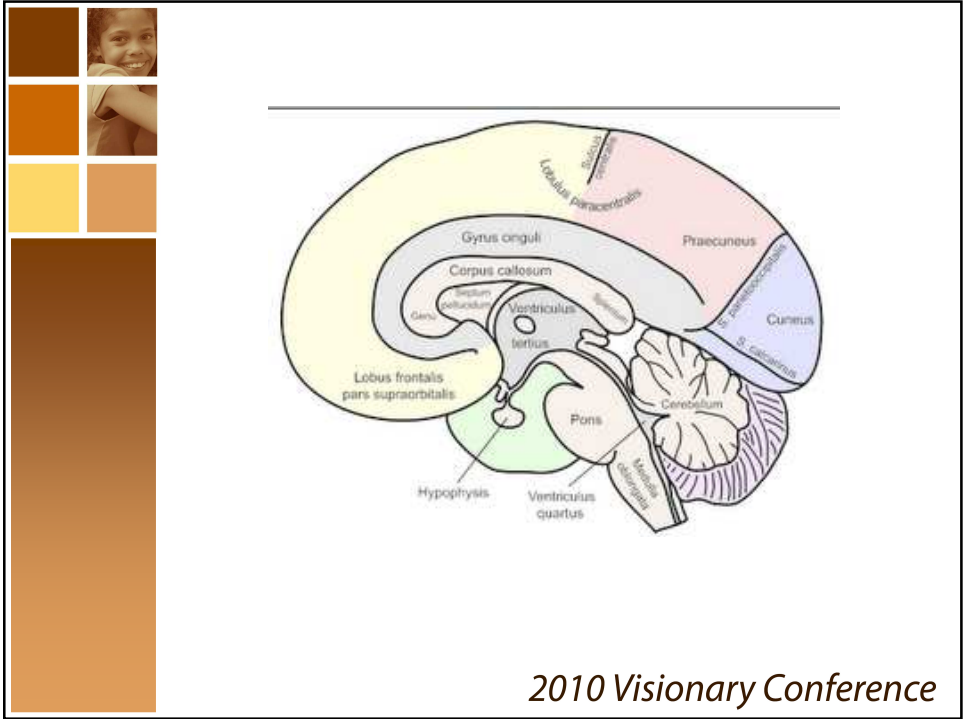


Central Auditory Nervous System (CANS)

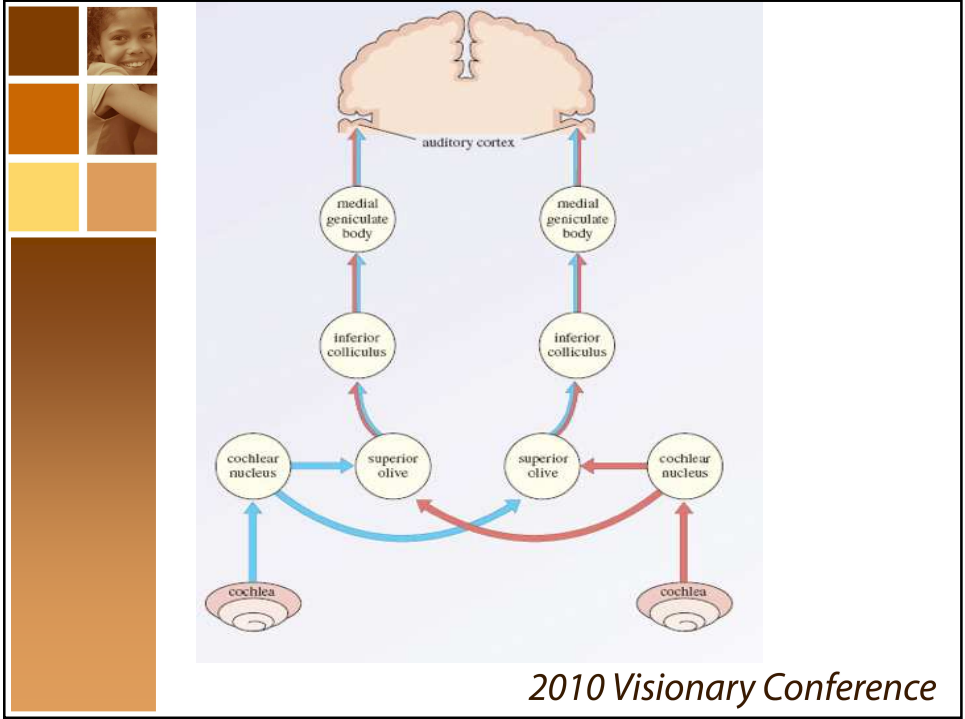


motor areas
sensory areas
association areas

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Auditory Processing

- Auditory discrimination
 - Pitch, loudness, duration
- Auditory closure
- Auditory pattern recognition
- Temporal processing
 - Pattern recognition, resolution, masking, integration, ordering
- Auditory localization & lateralization (TLP)
- Auditory performance with competing or degraded signal - including dichotic tasks
- Auditory figure-ground
- Binaural integration & separation

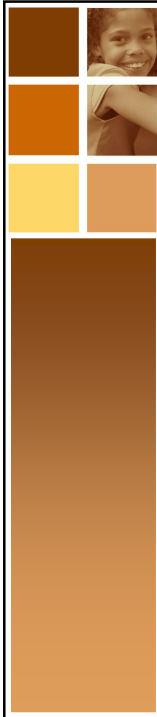
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Features

- Otitis media - auditory deprivation
- Co-morbidity - ADHD
- Hyperbillirubin (jaundice)
 - Bilirubin toxicity at different neurodevelopmental stages
 - Variety of neurological problems
 - Auditory neuropathy (outer hair cells within cochlea - dysynchrony at CANS level)
 - CAPD

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CAP

- Auditory system mechanisms and processes generate electrical brain waves and auditory evoked potentials in response to acoustic stimuli
 - Auditory brainstem response
 - Mid-latency response
 - Late-latency response
 - Event-related response
 - (Latency - Time between occurrence of a physiologic event and a stimulus)


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- SUBject - subJECT
- NITrate - nightRATE
- It SPRAYS - Its Praise
- A MINI skirt - AMEN, ask Kurt
- Pair o' DOCS - PARAdox
- Sarcasm


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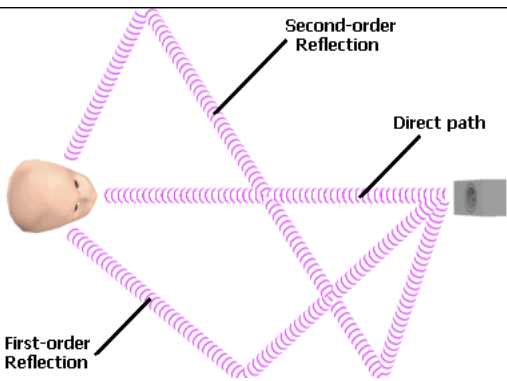
Speech in Noise

- Abnormal perception and cortical representation of speech in noise similarly are linked with potential sources of deficit as low as the brainstem.
- Cortical processing is more susceptible to the degraded effects of background noise compared to the normal population
 - Speech in noise - aging - high frequencies

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Reverberation



The diagram shows a speaker on the left and a listener on the right. A horizontal line represents the direct path of sound. A path that reflects once off a surface is labeled 'First-order Reflection'. A path that reflects twice off surfaces is labeled 'Second-order Reflection'.

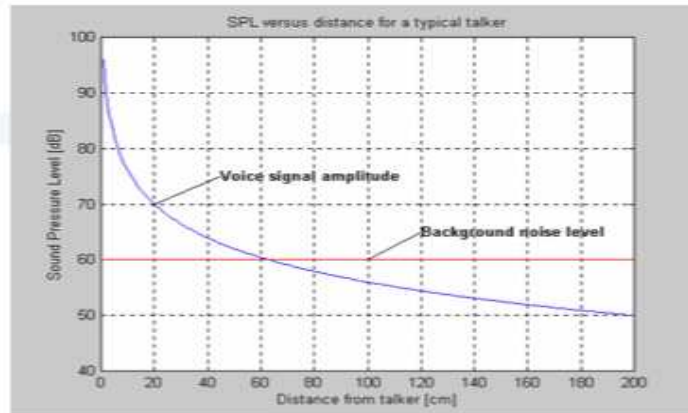
The difference in time between the reception of direct sound and reflected sound from room surfaces

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Inverse Square Law

Voice level is reduced by 50% with every doubling of the distance



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Directionality of voice information


- For every -3dB, sound decreases by 50%

50-55 dB

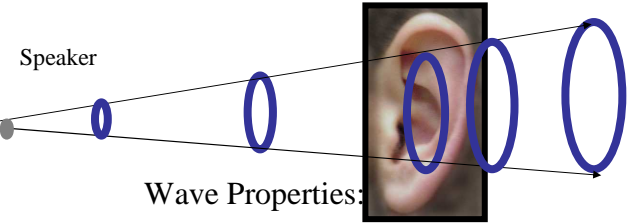


• 60-65 dB

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Wave Properties: Propagation

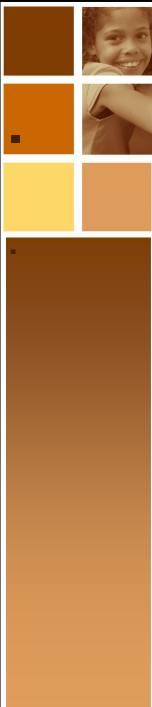


Speaker

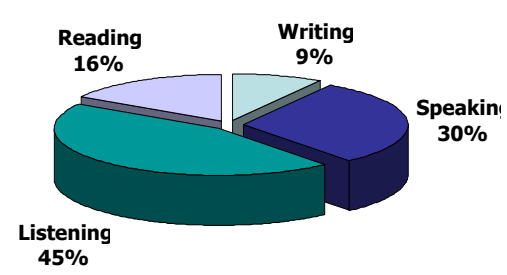
Wave Properties:

- Frequency** - how often the particles of the medium vibrate when a wave passes through the medium (air)
- Period** - the time for a particle on a medium to make one complete vibration cycle. Period, being a time, is measured in units of time such as seconds
- Speed** - the speed is the distance traveled by a given point on the wave (such as a crest) in a given period of time
- Wavelength** - the distance which a disturbance travels along the medium in one complete wave cycle.

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Adult Processing



Activity	Percentage
Listening	45%
Speaking	30%
Reading	16%
Writing	9%

Children and Listening

75% of the school day (Dahlquist, 1998)

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Right Ear Advantage Structural Theory

- REA for verbal stimuli by the fact that the right ear is connected to the language dominant left hemisphere through contralateral pathways
- Contralateral pathways are more preponderant than ipsilateral pathways.
- Maturation ages 10-12 years

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REA Attentional Theory

- Maintains the basis of laterality effect is lateralized cortical functions but emphasizes the influence of attention in priming a particular hemisphere
- An expectation of verbal stimuli serves to prime the language dominant hemisphere and make it extra sensitive to stimuli

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Cognitive Tests

- Low scores on verbal subtests with higher scores on non-verbal subtests
- Low scores on subtests requiring extensive verbal responses
- May do better on verbal subtests that tap information in long-term memory such as Vocabulary and Information than on verbal subtests that test information on short-term memory such as Arithmetic or Digit Span


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Academic Tests

- Low scores on subtests posing extensive verbal questioning and/or requiring extensive verbal responses
- Poor spelling and/or pronunciation of words while reading
- Poor performance on subtests requiring extensive auditory memory and/or multi-step processes

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Auditory Processing Screening

- Screening Test for Auditory Processing Disorders - SCAN-C, SCAN-A, SCAN-3
- Selective Auditory Attention Test - SAAT
- The Listening Inventory - TLI
- Clinical Evaluation of Language Fundamentals - CELF-4
- Comprehensive Test of Phonological Processing - (CTOPP)
- Comprehensive Assessment of Spoken Language (CASL)
- The Token Test


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Teacher Checklists

- Children's Auditory Processing Performance Test (CHAPPS)
- Fisher's Auditory Problems Checklist
- Evaluation of Classroom Listening Behaviors (ECLB)
- The Listening Inventory
- Screening Instrument for Targeting Educational Risk (SIFTER)


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Pitch Pattern Sequences

- Series of 3 tones (low, low, high)
- Subject to maturational effects
- Patient can hum or sing the responses
- Sensitive to lesions of the cerebral hemisphere and corpus callosum dysfunction
- Assesses the ability to recognize prosodic aspects of speech including intonation

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Duration Pattern Sequence

- Series of 3, 1000Hz tones - either 250 msec or 500 msec long in duration. Pt reports long-short-long.
- Can be used with Pt with peripheral hearing loss as the tones can be presented at sufficient intensity.
- Sensitive to cerebral lesions.
- Assesses temporal ordering including syllable stress and key word detection and linguistic labeling
- Subject to maturational effects


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Staggered Spondaic Words (SSW)

- Decoding -Associated with poor receptive language, difficulty with phonics, poor reading word accuracy, articulation errors, and confusion with instructions.
- Tolerance-fading memory- Associated with poor reading comprehension, short-term memory, expressive language, auditory figure ground, distractibility.
- Integration - Associated with reading, spelling, phonics, auditory visual integration, auditory figure-ground, short-term memory, response time.
- Organization - Associated with sequencing and organizing auditory information.

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SSW

- 40 test items made up of two-syllable words
- Competing conditions - 2 spondees overlapping
- Presented in 4 listening conditions
 - Right non-competing (RNC)
 - Right competing (RC)
 - Left competing (LC)
 - Left non-competing (LNC)

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Dichotic Digits

- Carries a lighter linguistic load than SSW - less susceptible to maturation effect (REA).
- Ears are scored individually in children
- Can be used with patients with some hearing loss.


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Competing Sentences

- 20 pairs of sentences presented simultaneously, 1 right, 1 left
- Primary sentence @35 dB SL (re: SRT)
- Competing sentence @ 50 dB SL
- (SL-sensation level)

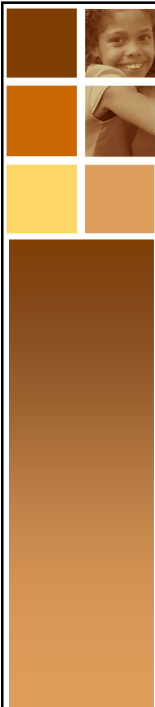
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Time-Compressed Speech

- Temporal aspects of speech are altered without changing frequency characteristics.
- Sensitive to lesions involving the primary auditory cortex (Heschl's gyrus).
- Monaural low-redundancy speech test, assessing auditory closure - the ability to fill in information when part of the auditory signal is missing or distorted (speech in noise, dialect).


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Time Compressed Speech

- Monaural low-redundancy procedure
- Rate of presentation of sentence increases.
- Reduced redundancy
- 10 sentences at a rate of 40% compression, then to each ear at 60% compression

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Gaps In Noise (GIN)

- Process of temporal resolution
- Gaps of silence embedded within auditory stimulus
- 4 lists of up to 36m 6-sec segments of white noise
- Embedded 0,1,2,3,gaps of varying duration

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Dichotic Interaural Intensity Difference Training (DIID)

Directs stimuli to the stronger ear at a reduced level while maintaining a higher intensity level to the poorer ear

Based on split brain research 1970s, 1980s

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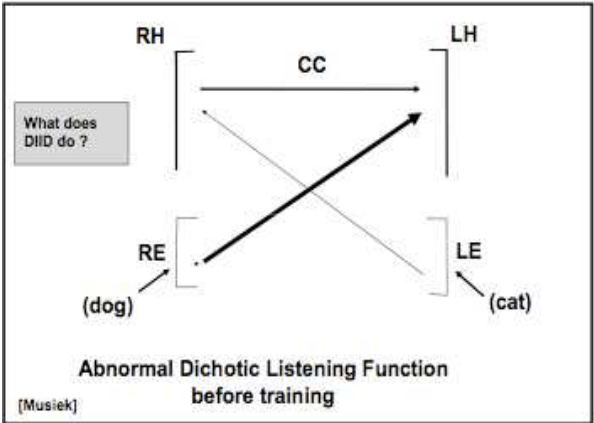



DIID Tasks

- Binaural separation/integration
 - Directed/free recall
 - Trains inter-hemispheric transfer
- Analysis of ear directed targets
 - Place, time, kind, word, etc.
- Ear directed judgments
 - Intensity differences, clarity, etc.
- Cross modality
 - Auditory-tactile
 - Left ear deficits

Present @ comfortable listening level - or slightly louder & lower

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What does DIID do ?

RH [CC] LH


RE [(dog)] LE [(cat)]

Abnormal Dichotic Listening Function before training

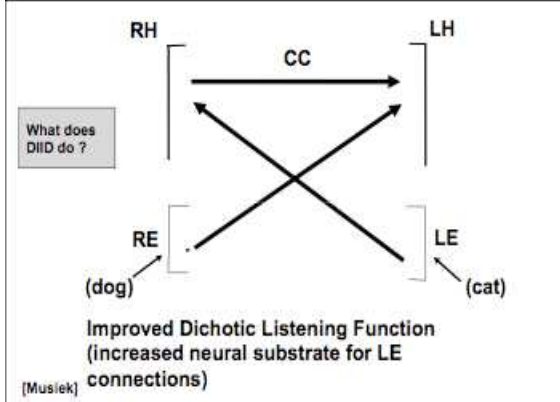
[Musiek]

The diagram illustrates the brain's hemispheric organization and the initial state of a subject before training. It shows four hemispheres: Right Hemisphere (RH), Left Hemisphere (LH), Right Ear (RE), and Left Ear (LE). A horizontal arrow labeled 'CC' (Cerebral Cortex) connects RH and LH. A diagonal arrow points from RE to LH, and another diagonal arrow points from LE to RH. The text 'Abnormal Dichotic Listening Function before training' is centered below the diagram, and '[Musiek]' is written at the bottom left.

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What does DIID do ?



Improved Dichotic Listening Function
(increased neural substrate for LE connections)

[Musiek]

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	D. Digits		F. Patt.		LPFS		C. Sent.		D. Rym.		SSW	
	LE	RE	LE	RE	LE	RE	LE	RE	LE	RE	LE	RE
%	100	100	100	100	100	100	100	100	100	100	100	100
	●	●	●	●	●	●	●	●	●	●	●	●
	○	○	○	○	○	○	○	○	○	○	○	○
	■	■	■	■	■	■	■	■	■	■	■	■
	×	×	×	×	×	×	×	×	×	×	×	×
Normal Range for Adults	[shaded box]		[shaded box]		[shaded box]		[shaded box]		[shaded box]		[shaded box]	

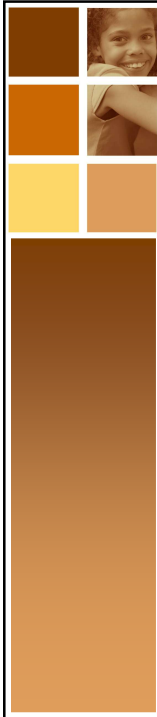
DIID TRAINING

13 Y.O. auditory & academic difficulties

CaseZAM

○=right, ●=right retest
 ×=left, ■=left retest


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Sarah 17 y.o.

- Agenesis of corpus callosum
- Hydrocephalus
- Fetal alcohol syndrome
- Cognitive and Learning Disorders
- ADHD
- SCAN-A - Total 113
 - Filtered Words 7
 - Figure-Ground 15
 - Competing Words 13
 - Competing Sentences 12

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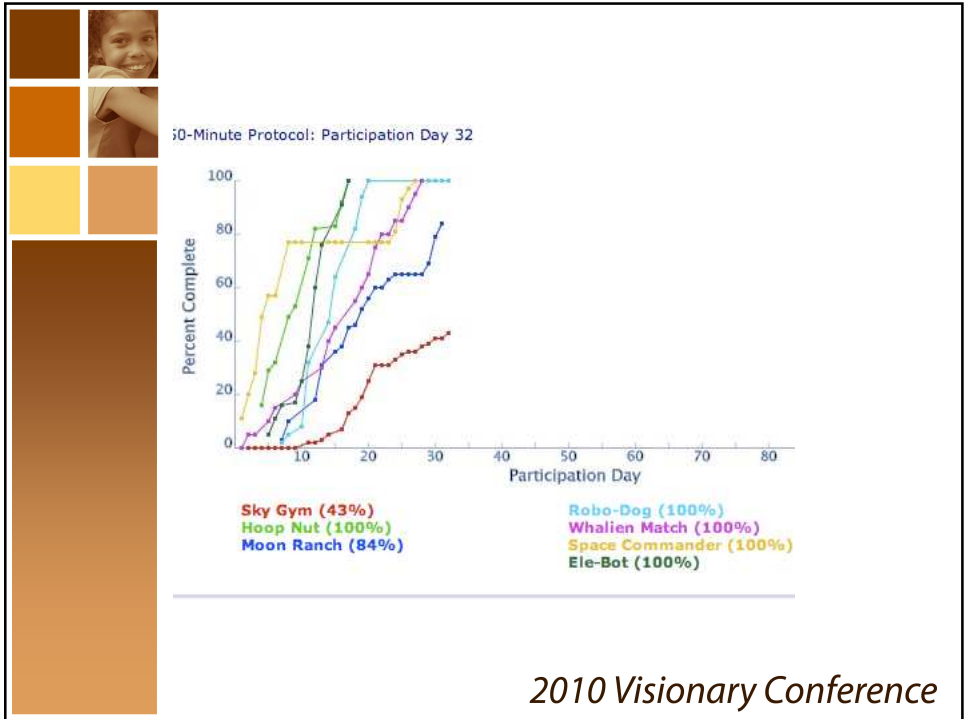


Regina 9-1 y.o.

- Reading, math, language
- School services
- Not ADD
- No medication

CAPD - temporal patterning

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Regina	2009	2010
• Core	78	102
• Receptive	73	88
• Expressive	83	110
• Lang. Content	70	92
• Lang. Memory	80	106
• WM	80	88

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Michael 9-2 y.o.

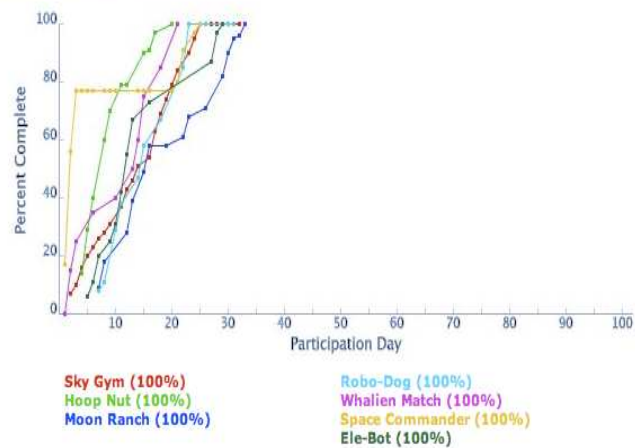
- Tx for language and cognition
- ADHD
- Focalin pre-test - no meds post-test
- 504 plan
- OT (dismissed) vestibular function, dyspraxia, incoordination, muscular weakness
- Poor spelling and writing
- CAPD -
 - temporal processing
 - binaural separation/integration

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Fast ForWord Language v2 Completion History

50-Minute Protocol: Participation Day 33




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CELF4	July 08	Oct 09
• Core Language	87	102
• Rec Language	79	88
• Exp Language	91	114
• Lang Content	84	119
• Lang Memory	92	101
• Working Memory	72	80
• RAN	Slow	Normal

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Michael ~ Post Treatment

- “The results obtained on 10-12-2009 indicate that Michael is no longer considered to have disordered auditory processing. It should be noted that Michael was not on medication at the time of testing and was easily able to follow directions and stay on task”.

Helstrom, 2009 13 mo after initial evaluation


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Cameron 8-11 y.o.

- CAPD -Temporal Sequencing
- No school services
- Earobics and Simon at home
- Pre-test CELF4
 - Core 100
 - Receptive 86
 - Expressive 108
 - Content 90
 - Structure 99
 - WM 85

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Fast ForWord Language v2 Completion History

50-Minute Protocol: Participation Day 26

Activity	Completion Percentage
Sky Gym	8%
Hoop Nut	75%
Moon Ranch	53%
Robo-Dog	52%
Whalien Match	100%
Space Commander	100%
Ele-Bot	57%

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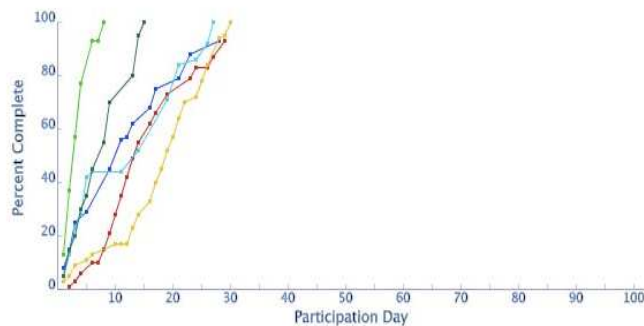
Emma 13-2 y.o. Literacy and Advanced

- Focal activity left frontal lobe
- Receptive/expressive language
- Emotional Disturbance - medication
- Private school
- CAPD - reported

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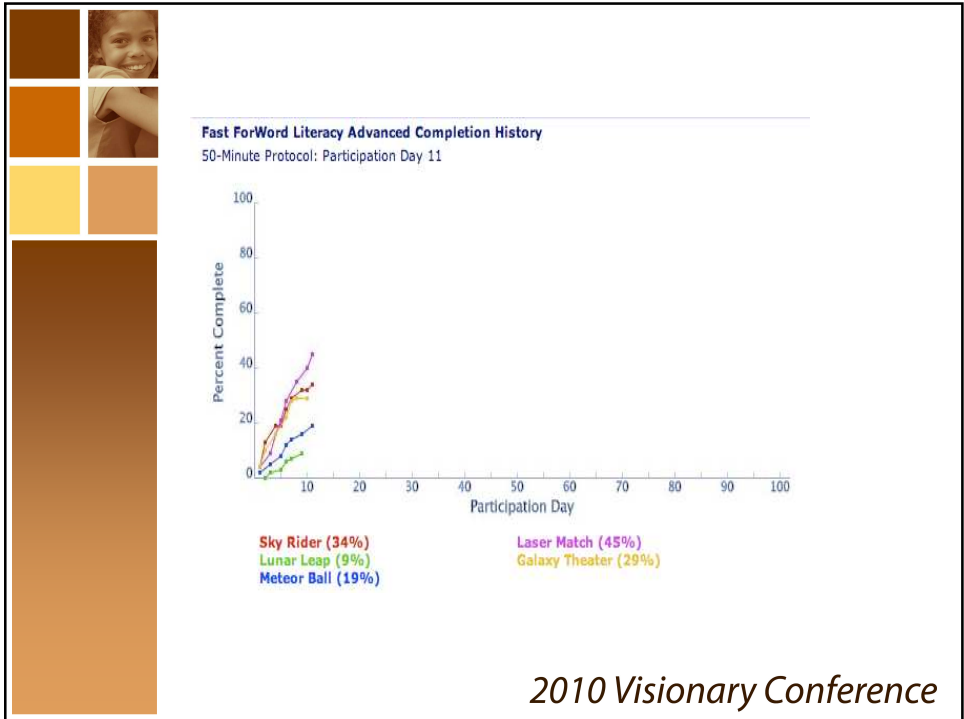


Fast ForWord Literacy Completion History
40-Minute Protocol: Participation Day 30



Space Racer (93%)
Spin Master (100%)
Galaxy Goal (93%)
Star Pics (100%)
Lunar Tunes (100%)
Stellar Stories (100%)

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Nick 22 y.o.

- Asperger Syndrome
- Language/Learning Disabled
- College student - film
- CAPD - reported

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