Auditory and Language Processing Disorders: Assessment & Intervention

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Speaker Disclosure

- *Financial*
  - Receive royalties from ProEd publications
    - The Source - Processing Disorders
    - The Language Processing Test
    - Language Processing Treatment Activities
    - Differential Screening Test for Processing Disorders
    - That's Life Language Cards
  - Revenue share from MedBridge courses
  - Royalties from Dynamic Resources
  - Honorarium and travel reimbursement
- *Nonfinancial*
  - *Author of several book chapters and articles on processing*

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Adequate Processing Involves Continuum of Skills

- Intact peripheral auditory system – perceive and receive acoustic stimulus
- Intact CANS – transmit through brainstem to upper cortex
- Phonemic knowledge to discriminate aspects of the acoustic stimulus
- Linguistic knowledge to decode message
- Executive function skills to attend, organize, execute behavioral response

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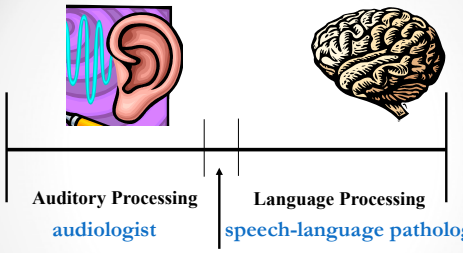
Continuum of Processing



Richard, 2017, 2001

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AUD and SLP = Team Approach

- **Differentiate auditory versus language aspects of disorder**
- **Auditory aspects assessed by audiologist**
- **Language aspects assessed by speech-language pathologist**
- **Need to determine level of breakdown to program effective intervention**

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Philosophy of CAP

- CANS responsible for transferring auditory signal through brainstem to cortex
- Signal reaches brain intact = normal CAP
- Signal distorted or compromised when reaches brain = CAPD

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The geography of the auditory system

- Peripheral system
  - Hearing sensitivity and acoustic reflexes
- Brainstem system
  - Acoustic reflexes
  - Binaural interaction
- Cortical system
  - Discrimination
  - Dichotic listening
  - Temporal processing

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Peripheral auditory function

- Hearing sensitivity and reflex action
  - Signal collection – outer ear
  - Signal transmission – middle ear
  - Signal detection – inner ear
  - Signal transformation – 8th nerve

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Central Auditory Nervous System (CANS)

- Transfer stimulus from inner ear to cortex
- Extremely complex system
  - Six different points to deal with auditory information
  - Four different pathways
  - Four cross-over points
  - One million cells
  - Eight different cellular responses
  - Six different cell types

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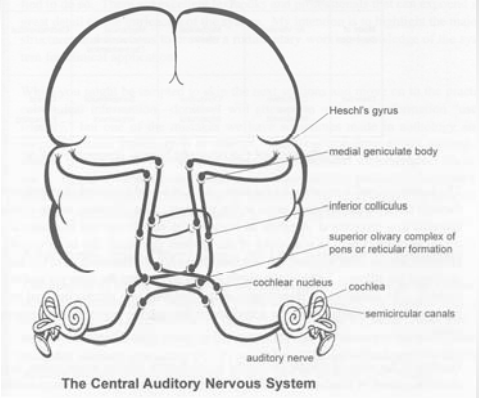

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Central Auditory Processing

- **Purpose**
  - Assess brainstem and cortical function
  - Stress the system by eliminating redundancy or compromising the signal
- **Premise**
  - Brain looks for consistency in processing auditory signal
  - If confusing signal, abnormal behavioral response
  - Meaning derived from signal not dependent on receiving every formant
  - Acoustic info combines with linguistic context to attach meaning

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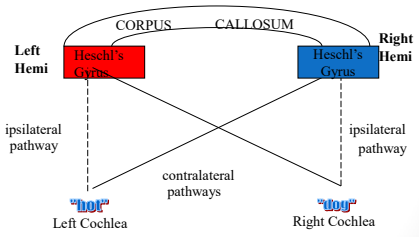
AUDITORY SYSTEM DOMINANCE



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CAPD Test Battery

- ***Minimize*** **influence of language, cognition & other sensory skills on performance**
- ***Maximize*** **function of CANS**
- **Results examined re:**
  - **central auditory processes being taxed**
  - **anatomical sites subserving those skills**

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Example Acoustic Skills

- Binaural processing
  - Auditory Localization
  - Speech in Noise
- Temporal processing
  - Temporal pattern discrimination/recognition
  - Temporal recognition/manipulation of multiple targets
- Auditory Vigilance

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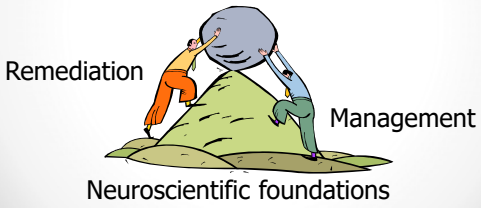
- **Test results help professionals develop *deficit-specific* management strategies**
- **Effective intervention of CAPDs includes:**



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Management	Remediation
➢ Modification of the communicative environment	➢ Formal and informal therapy to develop deficient skills AND
➢ Use of compensatory strategies	➢ Teach compensatory strategies
➢ Minimizes adverse effect of disorder of client's life	➢ Designed to reduce or resolve deficit

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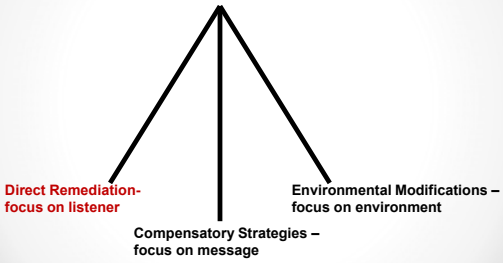
Intervention Tripod



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Focus on the listener: remediation

- Based on neural plasticity research
  - Plasticity is brain's ability to organize/ reorganize in response to stimulation
- Includes bottom-up programs to improve specific skills and top-down programs to teach/reteach compensatory strategies

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Remediation for CAPDs

- Auditory skills training: *bottom-up* therapy
  - based on plasticity theory
  - stimulus-driven, adaptive, repetitive
- Teaching strategies: *top-down* therapy
  - based on neurocognitive theory
  - concept-driven, use metacognitive and metalinguistic strategies

For most CAPDs - will likely use a combination of bottom-up AND top-down therapies

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Example Acoustic Skills

- Binaural processing
  - Auditory Localization
  - Speech in Noise
  - Dichotic listening
  - Interhemispheric integration
- Temporal processing
  - Temporal pattern discrimination/recognition
  - Temporal recognition/manipulation of multiple targets
- Auditory Discrimination
  - Frequency related tasks
  - Timing related tasks

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Improving auditory discrimination

- Designed to improve auditory system's ability to extract acoustic cues from within speech spectrum
- Targets include CVs/VCs, words, spondees/trochees, multisyllabic words, words in sentences, nonsense and real sentences, connected discourse, nonspeech targets
- Uses adaptive minimal pairs discrimination, identification and recognition training with targets altered to "tax" system
  - Temporal and/or frequency discrimination, recognition in noise
- Computer-assisted programs
  - Fast ForWord
  - Earobics and HearBuilder
  - Customized Learning: Exercises for Aural Rehabilitation (clEAR)
  - Listening and Communication Enhancement (LACE)

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Resources for therapy

- www.linguisystems.com - Differential Processing Training Program – auditory, phonologic and linguistic goals
- www.acousticpioneer.com – dichotic listening and temporal patterning training
- www.neurotone.com – LACE: Listening & Communication enhancement – for adults
- www.clearworks4ears.com – activities that enhance an array of auditory & related skills
- www.brainHQ.com- activities to enhance auditory, visual and thinking/reasoning skills

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Computer Applications

- Auditory Discrimination
  - HearBuilder www.hearbuilder.com; www.superduperinc.com
  - cLear – Customized Learning: Exercises for Aural Rehabilitation www.clearworks4ears.com
  - Fast ForWord www.scilearn.com
- Temporal Processing
  - Zoo Caper Skyscraper dichotic listening program www.acousticpioneer.com
  - CAPDOTS dichotic listening training www.capdots.com
  - Insane Earplane www.acousticpineer.com
- Listening Skills
  - www.smartyearsapps.com
  - www.hamiguchiapps.com
  - www.interactivemetronome.com

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Focus on the environment

- Noise & reverberation (echo)
- Distance & lighting
- Direct signal enhancement via assistive listening technology (ALDs)

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Focus on the message

- **Clear speech**
- **Visual cues**
- **Clear Language**

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Acoustic Processing – Modifications and Strategies

- Gain visual attention before beginning to present verbal directions
- Position yourself in good light and facing the student
- Eliminate/reduce distracting background noise
- Direct signal enhancement via assistive technology
- Use Clear Speech
- It's all about improving access to acoustic signal

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Effective intervention of CAPDs Summary

- **Deficit in skills subserved by CANS**
- **Can affect academics, communication, well-being and can co-exist with other conditions**
- **Diagnostic results help define nature and clarify impact of deficit**
- **Intervention MUST be deficit-specific AND include modifications, compensation, remediation to be effective**
- **Should reassess skills at periodic intervals to monitor**

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CAP Therapy research summary

- Studies note improved performance pre- and post AT in specific auditory skill trained (i.e., "if you drill it, it will come")
- Some evidence of improved phonologic awareness
- Virtually all report improved "hearing" and listening
- Very few reports of generalization of improved auditory-specific processing to academic and/or learning skills (Fey, et al., 2011)
- Some reports of improved language-learning-cognition following use of multi-modal training programs

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SLP Assessment Concerns

- Does child accurately receive signal?
- Does signal accurately transfer through the Central Auditory Nervous System to upper cortex?
- Can child retain signal long enough to analyze signal (e.g., identify sound segments)?
- Does child comprehend/understand what the signal means?

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SLP Assessment

- Audiology has been neurological in assessment approach
- Speech-language pathology has been very behavioral in assessment approach
- SLP needs to become more neurological in approach; realize that brain mediates behavior

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Processing Assessment

- Receptive Language Developmental Level
- Primary Zone - Functional Auditory Skills
- Secondary Zone - Hierarchy of Language Complexity
- Tertiary Zone - Integration of Language into Executive Functions
- Supplemental - Memory; Word Retrieval

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SLP Assessment

- Auditory only; visual adds compensatory
- Begin in overlap area
  - If fail, refer for central auditory assessment
  - Assess phonemic awareness of signal
- Hierarchy of language complexity
  - Begin simple and discrete
  - Increase language demand
- Battery of tasks/tests

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Phonetic /Phonemic Processing

- Preliteracy foundation
  - Sound-symbol correspondence
  - Spelling
  - Reading
  - Written Language
- Weak area for this generation
  - Visual learners
  - "Text speak"

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Phonemic Processing Skills

- Auditory Analysis / Segmentation
- Auditory Attention
- Auditory Association
- Auditory Closure
- Auditory Discrimination
- Auditory Figure Ground
- Auditory Localization
- Auditory Memory
- Auditory Sequential Memory
- Auditory Synthesis / Sound Blending/Closure

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Phonemic Processing Modifications & Strategies

- Use visual phonics or gestures to represent various auditory sounds
- Play games using visual-motor actions to represent auditory sounds or segments
- Play detective to analyze and segment sound aspects of words
- It's about structure and quantity of incoming information

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Example Assessment Instruments for Functional Auditory Skills

- Illinois Test of Psycholinguistic Abilities (ITPA)
- SCAN Screening test for auditory processing
- Differential Screening Test for Processing (DSTP)
- Goldman-Fristoe-Woodcock
- Phonological Awareness Test (PAT)
- Comprehensive Test of Phonological Processing (CTOPP)
- Test of Auditory Processing Skills (TAPS)

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Linguistic Processing

- Language Foundation for metalinguistic skills
- Ability to comprehend and express ideas through auditory to verbal modality
- Conceptual basis for higher level, more complex language

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Language Processing Components

Lower Level Processes
- Semantics
- Syntax
- Phonology
- Pragmatics

Higher Level Processes
- Printed
- Pragmatics
  - Intentions
  - Presuppositions
  - Conversation Rules
  - Conversation Violations
- Metalinguistic Awareness
  - Degree of Directness
  - Humor
  - Idioms
  - Polite Forms
  - Figurative Language
  - Knowledge of Grammar
- Discourse
  - Everyday
  - Printed
  - Instructional

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Language Processing Skills

- Labeling
- Stating Functions
- Association
- Categorization
- Antonyms
- Synonyms
- Idioms
- Analogies
- Multiple Meanings
- Stating Attributes

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Sample Secondary Zone Hierarchy – Language Processing Test

- Labeling – nouns
- Functions – verbs
- Association
- Categorization
- Similarity
- Difference
- Multiple Meaning
- Attributes

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Secondary Zone Assessment

- Language Processing Test
- WORD
- Comprehensive Assessment of Spoken Language
- Bracken Basic Concept Scale

- Caution: Be sure you are assessing temporal lobe/auditory skills; monitor influence of other modalities (e.g., visual, motor)

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Tertiary Zone Assessment

- Test of Problem Solving
- CELF
- Listening Test
- Detroit Test of Learning Aptitude

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Language Processing Treatment Principles

- Work from multiple modality to one
  - Motor, visual, verbal
  - Visual, verbal
  - Verbal only
- Develop competency in language skill, not one specific task
  - Categorization Example

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Language Processing Remediation

- Determine level of language processing develop
- Begin at earliest level of difficulty
- Use entire second functional unit for intervention
- Order language goals in cognitive complexity hierarchy
- Start with discrete – work toward integrated
- Think "hierarchy" – level of language difficulty
- Use neuropsychological model to guide goals
- Use compensatory cues & strategies
- Examine therapy materials carefully

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Linguistic Processing Modifications & Strategies

- Repetition, rehearsal, restatement, and confirmation of auditory information
- Provide clear, succinct verbal directions
  - Use clear language
- Supplement verbal with visual stimuli
- Play compare contrast games with visual-motor to supplement auditory input
- Use visual cues or prompts for 'listen' and 'do' to promote careful listening before initiating a task
- It's all about linguistic clarity

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Executive Functions

- Ability to plan, organize, manage, execute response
- Coordinate and integrate the foundation skills from the temporal lobe
- Under frontal lobe, pre-motor, motor cortex control
- Orchestra analogy
- Computer isn't spooling to the printer

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Executive Functions Skills

- Attention
- Inhibition
- Planning and Organizing
- Initiation and Persistence
- Flexibility Self-Regulation
- Goal Selection
- Problem Solving
- Working Memory
- Impulsivity
- Abstract Reasoning

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Example Assessments for Executive Functions

- Behavioral Rating Inventory of Executive Functions (BRIEF)
- Behavioral Assessment of Dysexecutive Syndrome in Children (BADS-C)
- Functional Assessment of Verbal Reasoning and Executive Strategies (FAVRES)
- Stroop Color and Word Test – children
- Diagnostic Analysis of Nonverbal Accuracy 2 (DANVA 2)

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Executive Functions

- Ability to plan, organize, manage, execute response
- Coordinate and integrate the foundation skills from the temporal lobe
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Executive Functions Modifications & Strategies

- Physical, visual organization in environment
- Use pictures, symbols, words for task sequence/analysis to identify the steps
- Use checklists, chore logs, routines
- Generate a plan of steps BEFORE beginning task
- Role play and practice interactions in various situations
- Prepare student for transitions and distractions

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Adjunct Areas of Assessment

- Auditory Memory-related/unrelated
  - ITPA: Auditory Sequential Memory
  - ACLC
  - TOLD, CELF – Sentence Imitation/Repetition
- Word retrieval
  - Test of Word Finding
  - Northwestern Word Latency Test
  - Informal

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Types of LP Procedures

- Auditory input
- Subtest complexity
- Discrete language skills
- Increase processing demand
- Multimodality tertiary integration skills

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CAP Assessment Summary

- Auditory/acoustic processing occurs before you "know" the target
- Auditory processing is "adult-like" by early teens
- Auditory processing can affect and be affected by language, learning, social-emotional health, neurocognitive skills
- Differential diagnosis MUST be used to find the level of breakdown
- Audiologists DIAGNOSE specific CAPD using controlled, norm-referenced BATTERY of tests
- Assess all skill sets - auditory discrimination, temporal processing and binaural processing – get multiple "looks"
- Consider effects of age/test construction on reliability
- Look for patterns to make diagnosis

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LP Assessment Summary

- Language develops in hierarchy of cognitive complexity
- Language progresses from concrete functional to more abstract
- Language processing is imposed 'on top of' basic language foundation
- Language processing continues to develop and refine throughout life
- Language processing can affect and be affected by sensory processing and executive skills

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Differential Screening Test of Processing

- Screens continuum
- 8 subtests delivered via CD rom
- 3 auditory processing
- 2 phonemic/phonic
- 3 language
- Identifies where to refer and/or spend more time in assessment
- Available from www.proedinc.com

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Listen carefully!

- Did you hear that?
- Can you repeat it?
- Can you tell me the first sound you heard?
- Can you tell me another sound you heard in the phrase?

If yes….

- Can you tell me what the phrase meant?
- Will repeating it multiple times help?
- Will amplifying the phrase help?
- Will saying it slower help?

If no….

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Neurological Continuum of Processing

	Anatomic Structure/Site	Type of Processing
Peripheral Auditory System	External, Middle, Inner Ear, Auditory Nerve	Auditory Acuity; Reception of Signal
Central Auditory Processing	Central Auditory Nervous System ; Brainstem through primary auditory cortex	Neurological Transfer of signal; Discrimination of acoustic characteristics of signal
Phonemic Processing	Heschl's gyrus – temporal lobe	Discrimination of phonemic characteristics of signal
Language Processing	Temporal Lobe – Wernicke's area and angular gyrus	Use linguistic characteristics of signal; attach meaning using code
Executive Functions	Prefrontal/Frontal lobe areas; Motor Strip	Planning and executing response

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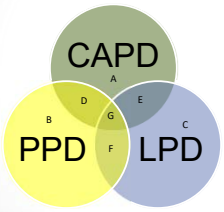
Confluence of Processing Disorders



A. CAPD only
B. PPD only
C. LPD only
D. CAPD & PPD
E. CAPD & LPD
F. PPD & LPD
G. CAPD, PPD, & LPD

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The practical importance of making a correct diagnosis is that children having different types of problems vary significantly in their needs and unless a differential diagnosis is made, their potentialities are lost.

-H. Myklebust, 1954

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Questions

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