2009 Summer Conference Handout

Session Title: Model for a Processing Continuum

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Presenter: Gail J. Richard, Ph.D. CCC-SLP
Model for a Processing Continuum

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Introduction to Processing

**Historical Perspective**
- 1954 - Myklebust “auditory processing”
- 1962 - Vygotsky “processing”: relation between thought and words not a thing but process - continuous back and forth movement from thought to word and word to thought
- 1973 – Rees – “The view from Procrustes’ bed
- 1978 - Weisenberg & Katz “central auditory processing”: ability to receive & integrate auditory info
- 2005 – ASHA Working Group on Central Auditory Processing Disorders: perceptual processing of auditory information in the CNS and neural activity that underlies that processing

**Impact of Processing on Learning**
- 1967 - Johnson & Myklebust: LD-processing disturbance interferes w/ language comp. & verbal expression
- 1966 - Cruickshank: most LD result of processing deficits
- 1981 - Gerber & Bryen: processing difficulties result in school failure
- 2005 – ASHA Working Group: processing deficits may lead to or be associated with difficulties in learning

**Major Points to Consider**
- The problem is NOT in reception of signal
- Repeating the signal is minimally helpful
- Individuals process stimuli in different ways
- Cues provide orientation, not the answer
- Processing occurs ‘on top’ of basic knowledge

**DEFINITIONS**

Processing: Ability to abstract meaning from an acoustic stimulus (Massaro, 1975)
Processing: Ability to interpret or attach meaning to auditorily received information to then formulate an expressive response (Richard, 2001)

**PROCESSING MODELS**

**Continuum of Processing**

<table>
<thead>
<tr>
<th>Acoustic Processing</th>
<th>Phonemic Processing</th>
<th>Linguistic Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audiologist</td>
<td>Transition of A/SLP</td>
<td>Speech-Language Pathologist</td>
</tr>
</tbody>
</table>
Peripheral Auditory System Function
Hearing sensitivity and reflex action
- Signal collection – outer ear
- Signal transmission – middle ear
- Signal detection – inner ear
- Signal transformation – 8th nerve

Brainstem level Central Auditory Nervous System
- Binaural interaction – how the two EARS work together
  - “additive” functions – provide a more robust signal for higher centers
  - “difference” functions – help with localization and hearing in noise
- Dichotic listening – interaction between the two HEMISPHERES

Neuropsychology
Science of understanding how behaviors are related to brain function
- All behavior mediated by CNS
- CNS composed of brain, brainstem, and spinal cord
- Impairment in CNS will interfere with learning process
- Brain dysfunctional = interference in behavior
- neurological model of diagnosis more objective
- intervention only as effective as diagnosis
- need to understand interference to remediate

A.R. LURIA  Functional Organization of the Brain
- Brain structures all play highly specific role & all under coordinated control
- Every mental activity affected through joint activity of discrete cortical systems
- When one system fails, behavior fails – but other parts secondarily resume that function
- behavior returns in limited way
- localization in diagnosis remediation
- individual differences as opposed to labels

FIRST FUNCTIONAL UNIT = RETICULAR FORMATION
- Neurological readiness to interact with environment
- Energy system for cortex
- Brainstem = midbrain, pons, medulla oblongata
- Maintain attentive state to incoming signals
- Awakens brain; keeps it alert; directs neural traffic

SECOND FUNCTIONAL UNIT = PARIETAL, OCCIPITAL, TEMPORAL LOBES
- Isolate neural impulses into discrete areas for analysis, storage, coding, organization
- Visual stimuli = Occipital
- Tactile stimuli = Parietal
- Auditory stimuli = Temporal
- Each cortical section further delineated into three zones

THIRD FUNCTIONAL UNIT = FRONTAL LOBES
- Active response through motoric expression to stimuli processed in second functional unit
- Planning, managing person’s behavior in relation to perceptions and knowledge – through motor response
PRIMARY ZONE
- Reception of incoming neural impulses
- Visual stimuli = Occipital
- Tactile stimuli = Parietal
- Auditory stimuli = Temporal
- Not involved in interpretation of meaningfulness of stimuli; only sensation
- Impairment = sensory impairment; not higher order processing

SECONDARY ZONE
- Process incoming information and attach meaning to input received
- Visual meaning = Occipital
- Tactile meaning = Parietal
- Auditory meaning = Temporal
- Interpretation through coding, organizing, associating, storing
- Integrate into meaningful experiences

TERTIARY ZONE
- Multisensory neural integration between sensory secondary zones
- Integrate newly organized stimuli with stored information
- Integrate discrete neural impulses between modality areas
- Coordinate higher level processing
- Integrate information from all cortices
- Transfer passive receptive input into active expressive output

MODEL CONCLUSIONS
- Model supports hierarchical integration of processing following neuromaturational order of zones
- Zones develop maturationally in order – primary, secondary, tertiary
- Tertiary zone last to mature and most fragile
- Progressive attachment of meaning to stimuli supports contribution of each level in hierarchy
- Concept integrates entire nervous system in thinking process

SLPS and AUDs are primarily interested in activity of Second Functional Unit – Left Temporal Lobe

PREMISE OF USING NEUROPSYCHOLOGICAL MODEL FOR EVALUATION
- Behavior is function of CNS activity
- Assuming CNS functions systematically AND dysfunctions systematically – possible to measure skills in children which reflect systematic CNS patterns
- Selected subtests can be used to sample subset of behaviors reflecting CNS function
- Deficits in particular skills should be demonstrated on more than one subtest
### Neurological Continuum of Processing

<table>
<thead>
<tr>
<th>Anatomic Structure/Site Type of Processing</th>
<th>Type of Processing</th>
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<tbody>
<tr>
<td>Peripheral Auditory System</td>
<td>Auditory Acuity; Reception of Signal</td>
</tr>
<tr>
<td>Central Auditory Processing</td>
<td>Neurological Transfer of signal; Discrim of acoustic characteristics of signal</td>
</tr>
<tr>
<td>Phonemic Processing</td>
<td>Discrim of phonemic characteristics of signal</td>
</tr>
<tr>
<td>Language Processing</td>
<td>Discrim of linguistic characteristics of signal; attach meaning using code</td>
</tr>
<tr>
<td>Executive Functions</td>
<td>Planning and executing response</td>
</tr>
</tbody>
</table>

**ASSESSMENT**

- Differential Screening Test of Processing (LinguiSystems)
  - Screen 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 LinguiSystems

- 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

**Intervention for Auditory Processing Disorders**

- Test results help professionals develop *deficit-specific* management strategies
- Effective intervention of PDs includes: Remediation, Management, Neuroscientific Foundations
**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

**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

- Preliteracy foundation
  - Sound-symbol correspondence
  - Spelling
  - Reading
  - Written Language

**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

**Language /Linguistic Processing**

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

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

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

- Ability to plan, organize, manage, execute response
- Coordinate and integrate the foundation skills from the temporal lobe
- Orchestra analogy

**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

**Teacher Strategies**

- Introduce information using multi-modality approach for sensory stimulation
- Supplement auditory info w/ visual materials
- Introduce new material in context-rich associative environment
- Provide cues, prompts, hints to help focus student and facilitate retrieval
- Allow “thinking time” and monitor external pressure when latencies occur
- Limit timed activities and performance tasks; provide extra time
- Vary type of responses expected on exams and class discussion
- Shorten length of assignments to promote focus on accuracy rather than efficiency
- Refresh stimuli with repetition, re-phrasing, and expansion clarifications
- Teach with stories and examples to associate main points of auditory information

**Student Strategies**

- Request additional time when needed
- Request cues, prompts, associative info
- Ask specific questions rather than generic
- Apply strategies taught in therapy that work to facilitate retrieval
• Learn to state what you know, then the source of confusion
• Tape record to provide repetition or permanent record of lecture
• Learn to use rehearsal, paraphrasing, and writing key words to keep processing on track
• Be an active learner, rather than passive
• Be patient; take your time and don’t give up or become frustrated
• Seek out study buddies to check information

**Thirty great games/books to enhance auditory processing and related skills**

Dr. Jeanane Ferre, Ph.D., CCC-A

<table>
<thead>
<tr>
<th>Game</th>
<th>Auditory processing or related skill(s)</th>
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<tbody>
<tr>
<td>A Rhyme in Time®</td>
<td>speech sound discrimination, auditory closure</td>
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<tr>
<td>Battleship®</td>
<td>active listening, visual patterning, integration</td>
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<tr>
<td>Blind Man’s Bluff</td>
<td>localization, binaural interaction</td>
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<tr>
<td>Boggle®</td>
<td>pattern recognition, integration</td>
</tr>
<tr>
<td>Bopit®, Bopit Extreme®</td>
<td>integration, vigilance</td>
</tr>
<tr>
<td>Brain Warp®</td>
<td>vigilance, integration, problem-solving</td>
</tr>
<tr>
<td>Card games (e.g., Rummy)</td>
<td>pattern recognition, sequencing</td>
</tr>
<tr>
<td>Catch Phrase®</td>
<td>integration, vocabulary development, output</td>
</tr>
<tr>
<td>Clever Endeavour®</td>
<td>metalinguistic strategies, critical listening</td>
</tr>
<tr>
<td>Feely Bag</td>
<td>interhemispheric communication</td>
</tr>
<tr>
<td>Hanna’s last-sound game²</td>
<td>auditory discrimination</td>
</tr>
<tr>
<td>Mad Gab®</td>
<td>temporal patterning, metalinguistic skills</td>
</tr>
<tr>
<td>Marco Polo</td>
<td>localization, binaural interaction</td>
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<tr>
<td>Musical Chairs (also Cake Walks)</td>
<td>vigilance</td>
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<tr>
<td>Name that tune</td>
<td>interhemispheric transfer of function</td>
</tr>
<tr>
<td>Password®</td>
<td>vocabulary building, metalinguistic skills</td>
</tr>
<tr>
<td>Plexers®</td>
<td>metalinguistic strategies</td>
</tr>
<tr>
<td>Rags to Riches*</td>
<td>metalinguistic skills (idioms)</td>
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<tr>
<td>Read My Lips®</td>
<td>lipreading/speechreading</td>
</tr>
<tr>
<td>Red Light- Green Light</td>
<td>vigilance, active listening</td>
</tr>
<tr>
<td>Rummikub®</td>
<td>patterning, problem solving, integration</td>
</tr>
<tr>
<td>Scattergories®</td>
<td>vocabulary building, metalinguistic strategies</td>
</tr>
<tr>
<td>Scrabble®</td>
<td>integration, linguistic skills, visual patterning</td>
</tr>
<tr>
<td>Simon®</td>
<td>auditory-visual patterning</td>
</tr>
<tr>
<td>Simon Says</td>
<td>vigilance, active listening</td>
</tr>
<tr>
<td>Taboo®</td>
<td>vocabulary building, metalinguistic strategies</td>
</tr>
<tr>
<td>Processing Differential Levels</td>
<td>Behavioral Objective / Goal</td>
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</table>
| Acoustic (AUD)                | Receiving the signal – intact transmission | * Word Repetition  
* Tone Discrimination          (high-low sequences)  
* Pattern Repetition          (clapping patterns) | * FM System  
* Preferential Seating  
* Lip Reading  
* Tape Recording  
* Figure Ground |
| Phonetic/Phonemic (AUD & SLP) | Analyzing the signal – discrimination of acoustic segments | * Word segmentation  
* Rhyming  
* Sound Discrimination | * Sound Blending  
* Word Analysis (first, middle, last sound)  
* Grapheme-phoneme Correspondence |
| Linguistic (SLP)              | Understanding the signal – attaching meaning | * Identifying objects  
* Identifying concepts  
* Semantic Relationships          (synonym, antonym, homonym) | * Concept Development  
* Word/Object Association  
* Answering wh questions  
* Compare/Contrast Tasks |
| Executive Functions           | Managing and organizing a response to the signal | * Pragmatic language  
* Problem solving/reasoning  
* Prosodic Interpretation | * Role play pragmatic situations  
* Work on impulse control  
* Judgment and interpretation |

**Resources**


