INTEGRATIVE AUDITORY-SPEECH-LANGUAGE SYSTEMS AND OTHER FUNDAMENTAL PROCESSES

COGNITION EMOTIONS EXECUTIVE FUNCTIONS
VISION BALANCE SENSORY INTEGRATION

JAY LUCKER, ED.D., CCC-A/SLP, FAAA

KAVITA KAUL M.S., AU.D., CCC-SLP/A

SPEAKERS: DR. LUCKER AND DR. KAUL

- **Dr. Lucker** is a Professor in the Dept. of Communication Sciences and Disorders at Howard University in Washington, DC
- He also has a private practice specializing in assessment of children for auditory processing and language processing disorders
- **Dr. Kaul** is a private practitioner is Richmond VA, specializing in Auditory Processing Disorders assessment and intervention

DISCLAIMERS

- **Dr. Lucker** has no financial interests in making this presentation. However, he does have a private practice, and participants might make referrals to his private practice. He is also a researcher, and much of his work is based on his evidence based research and publications.
- **Dr. Kaul** has no financial interests in making this presentation, however will accept referrals made by participants.

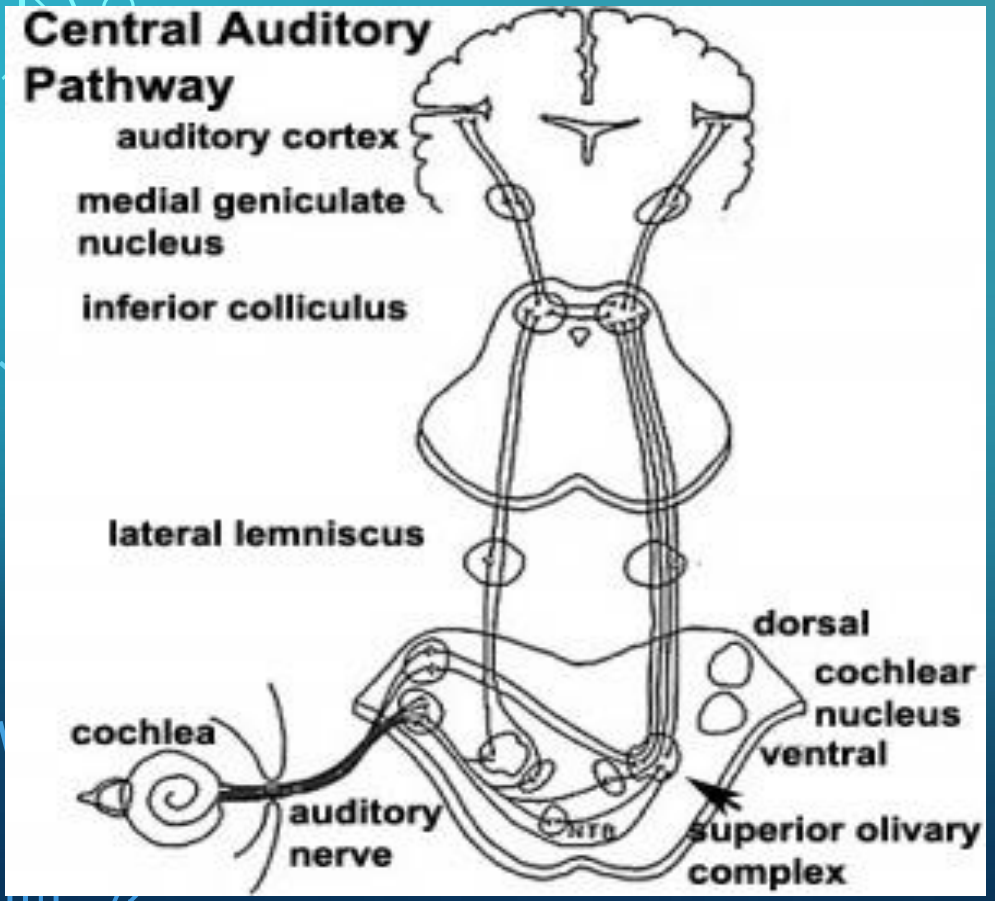
LEARNER OBJECTIVES

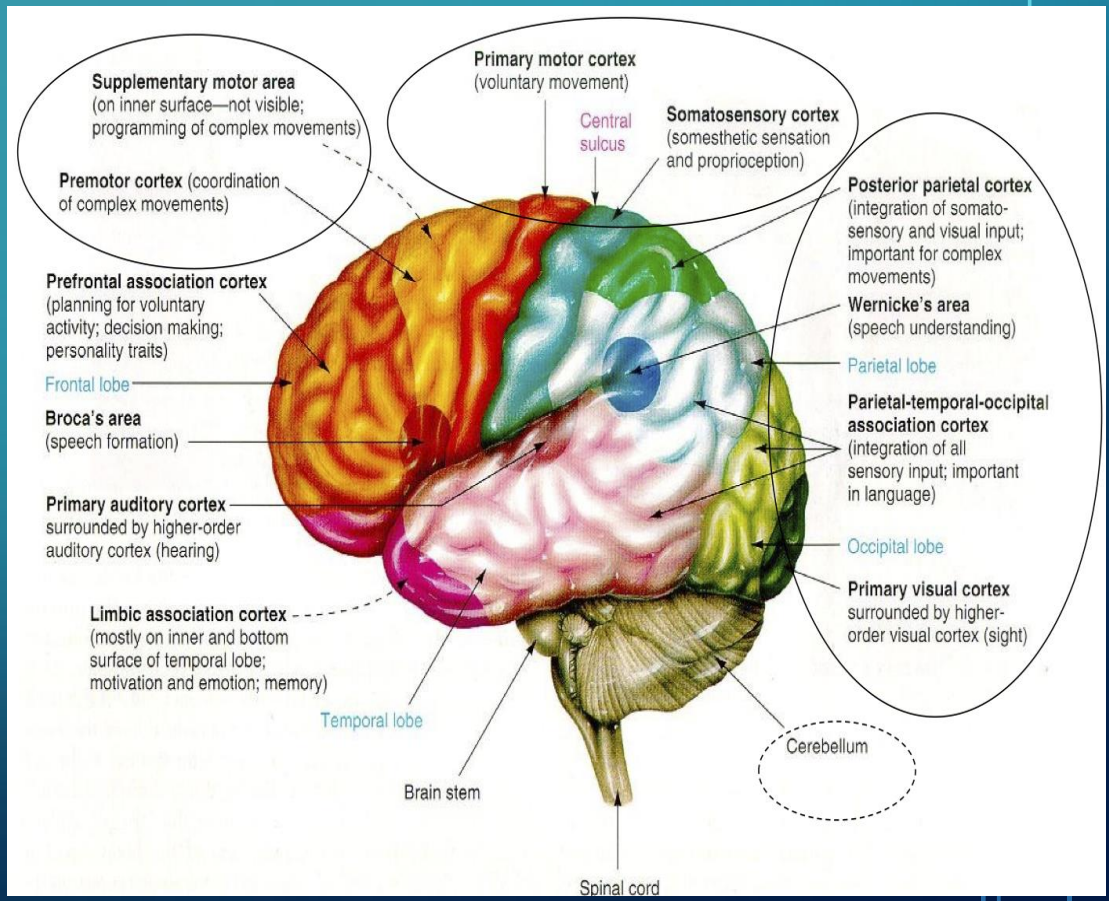
- Explain similarities between auditory processing and language processing
- Explain some specific differences between auditory processing and language processing
- Describe how auditory processing deficits (APD) can lead to language processing problems
- Describe how the information gathered from reports can be used make appropriate referrals to rule out or rule in deficits in other fundamental processes.

OVERVIEW

- We believe that auditory processing should be approached using a multisystem or multimodal approach
  - One such approach: Lucker's MultiSystem Integrative Approach
- The growth, development, and functions of all these systems overlap
- Auditory processing and Language processing are inter-dependent
- There are factors in all these areas needing to be trained to improve auditory processing abilities in people

OVERVIEW OF THE BRAIN





NEURO-CONNECTION ACTIVITY

GAME

LANGUAGE SKILLS DEFINITION

- **Language** is a system that consists of the development, acquisition, maintenance and use of complex systems of communication, particularly the human ability to do so; and **a language** is any specific example of such a system.
- Language can include verbal and non-verbal modalities

LANGUAGE PROCESSING

- Language involves a **set of rules** that allow the person to know
  - The organization and rules that tell what sounds are linguistic sounds, and which linguistic sounds (phonemes) are vowels and consonants and what distinctive features are involved with each phoneme
  - The meaning of words (semantics)
  - The grammatical meaning of words (morphology)
  - The grammatical meaning of sentences (syntax)
  - Social/Pragmatic uses of language for social communication

LANGUAGE PROCESSING

- Is an internal process only
- We take the EXTRACTED and INTEGRATED auditory stimuli sent from the auditory system to the receptive language system (first the phonemic analysis area = Luria's area) to EXTRACT meaning words and find the meaning of the words (also connecting with and from the memory parts of the cognitive system)
- We INTEGRATE the meaning- (mostly key words) and identify to what they relate and connect (again) with memory and cognitive system for thinking/decision making about the meaning of the words

LANGUAGE PROCESSING
CONTINUED

- Integrate individual words together to analyze them for their "grammatical" meaning
- We also extract and integrate time factors- physical timing of message to understand language nuances and context- requires cognition
- Also have to have memory to organize and sequence information for analysis and response

LANGUAGE PROCESSING
CONTINUED

- use cognitive and memory systems and executive functioning for thinking/decision making/ social meaning of the linguistic communication
- use memory to decide on appropriate communicative response (pragmatic)

SPEECH DEFINITION

- **Speech** is the vocalized form of communication used by humans and some animals, which is based upon the syntactic combination of items drawn from the lexicon. Each spoken word is created out of the phonetic combination of a limited set of vowel and consonant speech sound units (phonemes). These vocabularies, the syntax that structures them, and their sets of speech sound units differ, creating many thousands of different, and mutually unintelligible, human languages. The vocal abilities that enable humans to produce speech also enable them to sing

SPEECH PROCESSING

- Motor productions of speech sounds specific to the language
- The auditory patterns of the speech sounds translate precisely to the muscle motor patterns in the mouth to produce specific sounds- articulation which is dependent on precise placement of the muscles and the manner of production of the sounds
- The speech motor skills are sequenced precisely as they smoothly change the placement and manner of production to make words- coarticulation

AUDITORY SKILLS DEFINITION

- **Auditory Skills** is to give one's attention to sound. It involves complex affective, cognitive, and behavioral processes. Effective processes include the motivation to attend to others; cognitive processes include attending to, understanding, receiving, and interpreting content and relational messages; and behavioral processes include responding with verbal and nonverbal feedback.

AUDITORY PROCESSING

- The ability to receive sound vibrations with our peripheral system clearly
- The ability for this information to be transferred to the brain via patent neural pathways to the brain efficiently
- The ability to decode the spectral patterns of these sound vibrations and pair them with specific sounds
- The ability to recognize the speech rhythm-rime-rhyme patterns
- The ability to discriminate speech and non speech sounds
- The ability to make strong memory patterns of these sounds
- The ability to hear and listen to information without aversive emotional response

AUDITORY PROCESSING

- The ability to recognize and discriminate sounds with or without background distractions
- The ability to attach meaning to the various sound patterns with increased familiarity
- The ability to attach meaning to the familiar speech sounds to connect it to the spoken message
- The ability to use or integrate information coming from both ears to make coherent patterns related to the message
- The ability to use previous knowledge or resources to make corrections mentally of misheard information or to be able to ask for clarifications

AUDITORY PROCESSING

- Auditory system alone includes:
- auditory (input) processing involves how sound is picked up by the outer ear, resonated by the external auditory meatus (canal),
- mechanical transmission
- “processed” in the cochlea into frequencies at specific intensities over time,
- then neurologically “coded” into the auditory (eighth) nerve and transmitted to the next brainstem levels and on to the cortex and through intercortical (inter hemispheric}connections)
- Auditory processing also involves the input from other systems and output from the auditory system to other systems (total integration)

SWITCH

COGNITION DEFINITION

- **Cognition** is "the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses".[1] It encompasses processes such as knowledge, attention, memory and working memory, judgment and evaluation, reasoning and "computation", problem solving and decision making, comprehension and production of language. Human cognition is conscious and unconscious, concrete or abstract, as well as intuitive (like knowledge of a language) and conceptual (like a model of a language). Cognitive processes use existing knowledge and generate new knowledge.

COGNITIVE PROCESSING

- Cognition is complex, thinking which, essentially, involves:
- Knowing the meaning of things (not merely their linguistic meaning)
- Making decisions
- Higher level processing, reflection, revision, knowing from where or why you made a decision
- Placing into memory and recalling from memory things
  - Memory involves immediate (working memory), short-term (for a short period of time), and long-term memory (true storage)

COGNITIVE PROCESSING

- This is a critical part of what we call auditory processing (or what LMSIA calls auditory information processing)
- As stated already, at the language level we have input to and from the cognitive system – also at the auditory level there is input to and from parts of the cognitive system
- In the auditory connections, we make decisions as to what phonemes were are accepting that we heard, or have questions about needing clarification

COGNITIVE PROCESSING
CONTINUED

- The cognitive system was also identified in helping make decisions about the linguistic meaning of the words we processed and the social meaning of the situation in which the language communication is occurring
- The decisions are constant and send impulses down to modify upcoming auditory processing (such as what to enhance and what to filter out and not let pass through to higher levels
- At the language level this is metalinguistic processes or higher level language

EXECUTIVE FUNCTION DEFINITION

- **Executive functions** (collectively referred to as **executive function** and **cognitive control**) are a set of cognitive processes that are necessary for the cognitive control of behavior: selecting and successfully monitoring behaviors that facilitate the attainment of chosen goals. Executive functions include basic cognitive processes such as attentional control, cognitive inhibition, inhibitory control, working memory, and cognitive flexibility. Higher order executive functions require the simultaneous use of multiple basic executive functions and include planning and fluid intelligence(i.e., reasoning and problem solving).

EXECUTIVE SKILLS PROCESSING

- This is the level of self-**monitoring; regulating; and correcting**
- We monitor how we think, on what we should attend, importance of message
- Involves: Attention, self-regulation, emotional regulation, organizing, planning, behavior monitoring and regulation, controlling how we make decisions
- It is a scaffolding process- development starts at birth and modifications continue throughout life. Majority of the development should occur by age 25

EXECUTIVE FUNCTION PROCESSING

- This is a critical area since it monitors and regulates everything the brain does
- We monitor if we are attending appropriately, have made appropriate decisions regarding to what we should attend, make appropriate decisions as to what to enhance and what to filter out
- We also regulate what and how to organizer, how much energy is needed for each system involved in the processing, and to what we should put our energy and attention when processing

EMOTION DEFINITION

- **Emotion** is any conscious experience characterized by intense mental activity and a certain degree of pleasure or displeasure. Emotion is often intertwined with mood, temperament, personality, disposition, and motivation. In some theories, cognition is an important aspect of emotion. Those acting primarily on the emotions they are feeling may seem as if they are not thinking, but mental processes are still essential, particularly in the interpretation of events

EMOTION PROCESSING

- We also interpret what we hear based on the emotional overtone of the message. This has a lot to do with connections in the non-classical auditory system (high brainstem directly to the limbic system bypassing the right and left cortical auditory centers
- We interpret the “tone of voice” (pragmatic), meaning of words based on things like sarcasm, emphasis which makes some words more important than others, phonological processing (such as foreign words/names), etc.
- All communication connects to emotional system in a positive, negative or neutral way- negative reactivity is not conducive for learning and development

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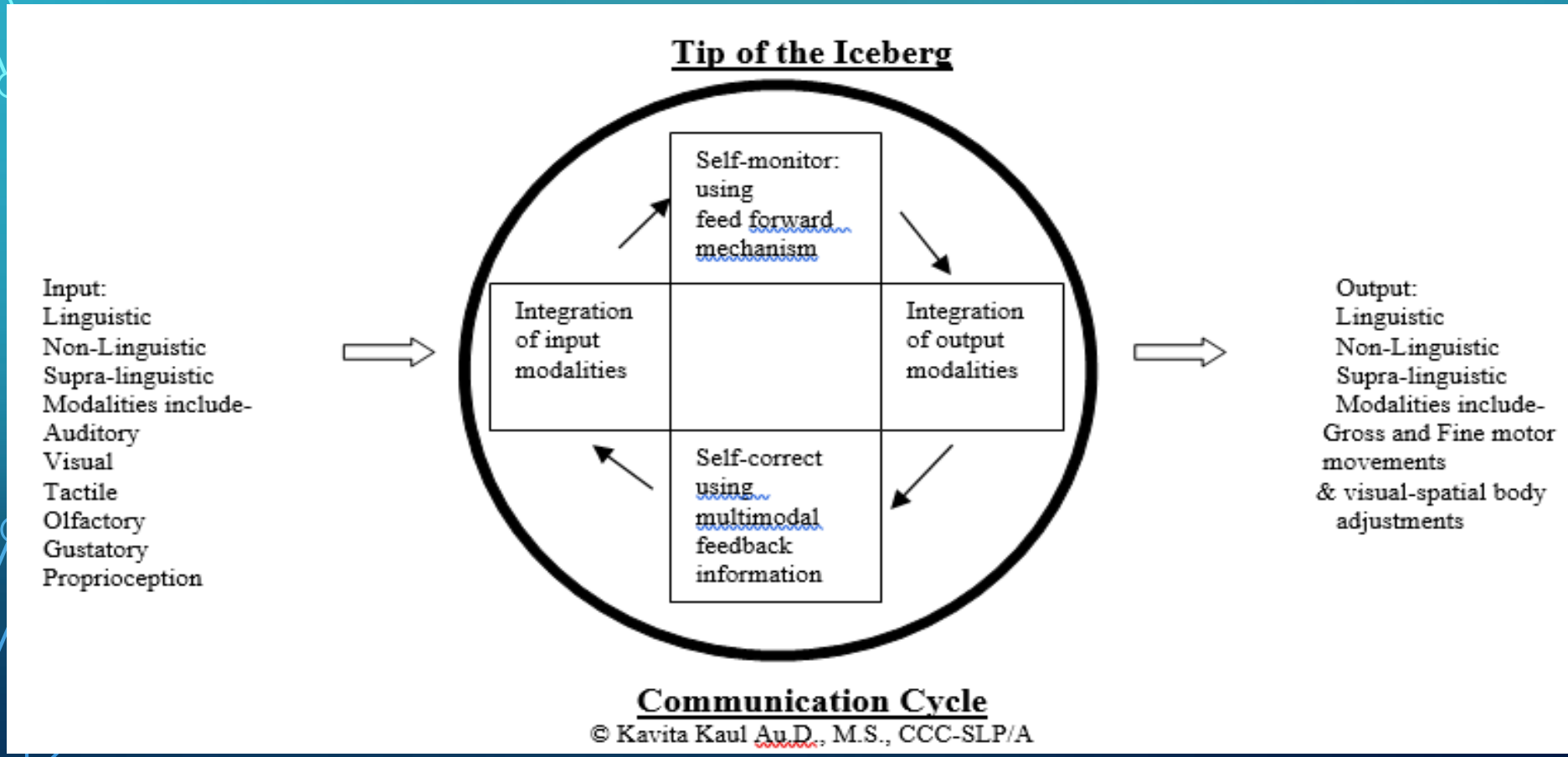
BREAK

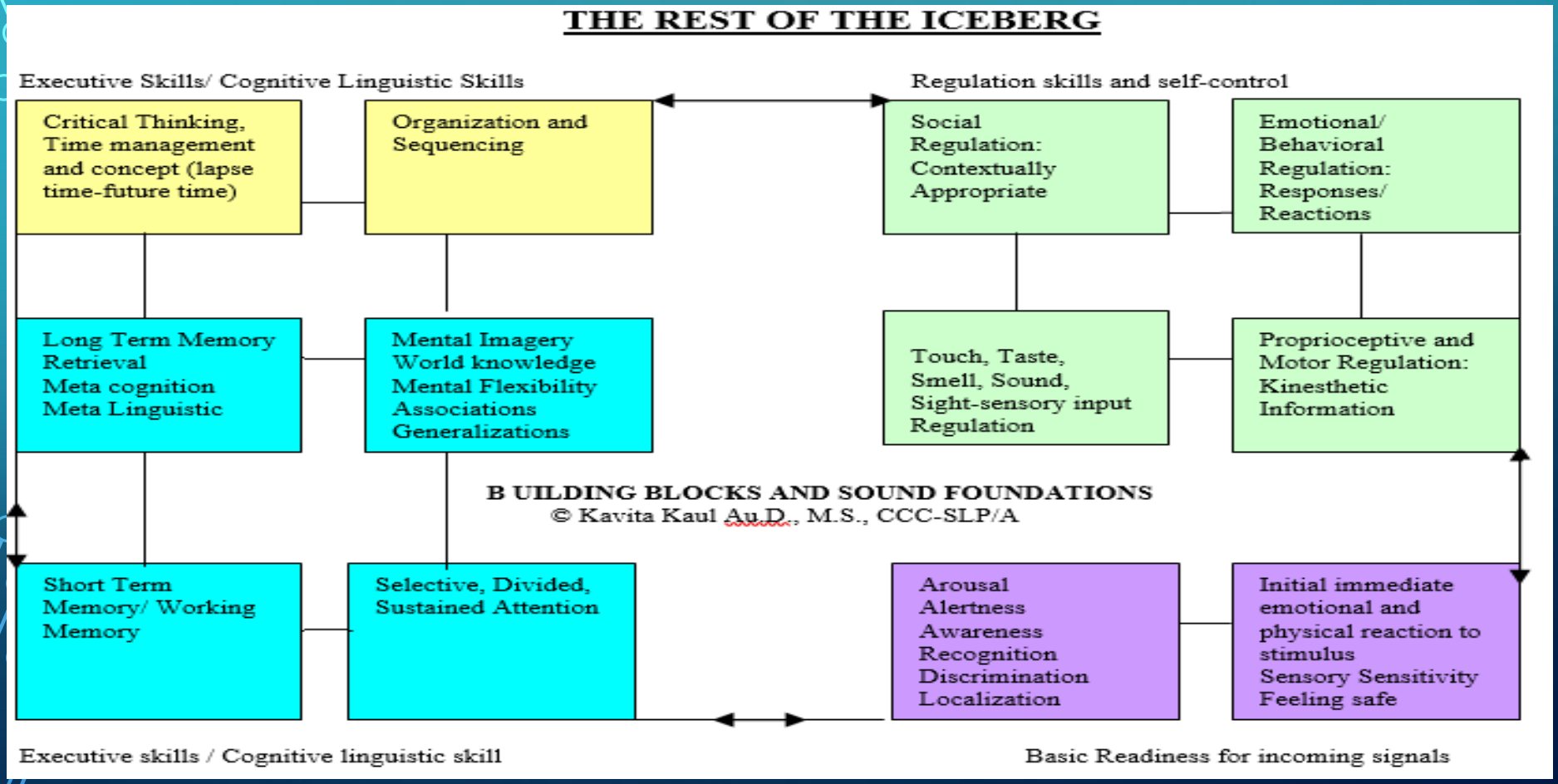
PROCESSING: WHAT IS INVOLVED

- We can divide processing into three parts
- One is input – the processing of incoming information through the specific sensory channel in which that stimuli comes in from the outside world to the brain (it is more than just auditory in auditory processing)
- One is output – how we respond, how we formulate and organize a response to input whether the input is external or from within
- Internal processing – what is going on in the different systems in the brain

INPUT-OUTPUT



HIDDEN PROCESSES



TYPES OF PROCESSES

- Multilevel (completion of a task from beginning to end- school projects)
- Multiple Directions (completing chores)
- Multi-Tasking (texting and driving) Not efficient or effective
- Multimodality (listening to music or watching TV while cooking) simultaneous processing- this can be efficient and effective if integrative processes are strong

INTER-HEMISPHERE VS. INTRA-HEMISPHERE PROCESSES

- We do not merely process between hemispheres, but we process between parts of the brain even within the same hemisphere
- Inter-hemisphere typically refers to the auditory and language centers of the brain.
- The dominant hemisphere processes the cognitive and linguistic meaning
- The non-dominant hemisphere processes music, rhythm, and then, the emotional meaning of the auditory-linguistic message

INSIDE-OUT VS OUTSIDE-IN PROCESSES

- We typically think of only processing signals coming from the outside (ignoring the irrelevant information and focusing on the relevant information)
- But, we also regulate information internally based on what we have processed at higher levels (suppressing mental noise and allowing only the relevant information to be emphasized)
- In reality, both occur simultaneously and continuously.

TOP DOWN VS. BOTTOM UP PROCESSES

- Auditory processing: Bottom up- analytical processing-processing the parts
- Cognitive-Linguistic processing: Top down- Contextual processing- processing the whole

INTERPRETATION

- Very seldom can just one weakness stand out
- Other related processes will be affected
- It is most beneficial to look at the child from all these perspectives
- It may be a disservice to wait to evaluate the auditory skills after all other therapies have been provided

SAME BRAIN PRINCIPLE-AN INTEGRATED PROCESS

(HOW DO THEY FIT TOGETHER)

- In an integrated approach, none of these processes occurs in isolation. (decisions are always based on a variety of factors and contexts)
- Integration is between ALL parts of the brain not merely right and left parts

HOW DO LANGUAGE SKILLS RELATE TO APD

Speech-Language Skills	Buffalo Model	Lucker's Model	Bellis Model
Phonology	Decoding	Auditory Sensitivity Auditory-Hypersensitivity Attention Auditory Distraction Phonemic Extraction Memory Input Output Encoding	Decoding
Semantics	Decoding Organization Short-Term Memory	Memory Recall Phonemic Integration Lexical Integration Sound-Symbol Association Output Encoding	Associative Organization-Output

HOW DO LANGUAGE SKILLS RELATE TO APD

Speech-Language Skills	Buffalo Model	Lucker's Model	Bellis Model
Syntax	Working Memory Short Term memory Decoding Integration Organization	Lexical Integration Temporal Extraction Auditory Sensitivity General Attention Auditory Distractibility Memory Input Memory Span Memory Recall Organization-Sequencing Output Encoding	Associative Organization-Output Integration Prosody
Pragmatics	All of the above	All of the above	All of the above

SWITCH

ROLE OF AUDIOLOGIST-TESTING

- Evaluation and diagnosis of auditory processing disorders falls solely within the scope of practice of the audiologist (ASHA, 2005/ AAA, 2010)
- The audiologist
  - Rules out hearing as a contributing factor (audiological evaluation)
  - SHOULD provide comprehensive evaluation of ALL areas of auditory processing
  - At minimum, SLPs should look for at least two measures of each factor identified at deficient to ensure that a proper diagnosis of that area being an APD problem
  - Some kids may just have a very poor score in any one area- may need to use professional judjement

ROLE OF AUDIOLOGIST-THERAPY

- Some audiologists do therapy
- Most states do not see audiologists as providers of therapy, and most medical insurance companies will not reimburse for audiological therapy services
- But, some audiologists are very well trained and proficient in providing therapy
- Those who feel they are competent in providing therapy, especially for the auditory based problems, should provide such auditory processing therapy

ROLE OF SPEECH PATHOLOGIST-TESTING

- The SLPs role is two-fold
- Most important is to evaluate language and communication factors
- Language should be evaluated both for language knowledge (vocab, grammar) and language processing (metalinguistic processes and social/pragmatic communication skills)
- Speech-Language Pathologist should be consciously looking for signs of auditory skills weaknesses for appropriate referral to the audiologist-preferably one who is trained in APD

ROLE OF SPEECH PATHOLOGIST-THERAPY

- When the audiologist cannot provide therapy, it is usually done with the SLP
- Many SLPs are not trained or know how to provide appropriate therapy for children for their different types of auditory processing disorders
- Therapies differ for each type of APD so that things for dichotic listening are not appropriate for speech in noise auditory distractibility or for auditory phonological problems

ROLE OF THE OCCUPATIONAL THERAPIST FOR TESTING

- Sensory processing is one of the areas of auditory processing (i.e., auditory sensory processing
- OTs usually do not have objective measures to assess auditory sensory processing such as over sensitivity to sound and noises
- So the OT is able to SCREEN for the possibility of an auditory sensory processing problem, but the audiologist can see if a child actually can or cannot tolerate sounds, noises, distractions during testing

ROLE OF OCCUPATIONAL THERAPIST

- Some children with APD have underlying sensory processing deficits and benefit from work with the OT who is familiar with and trained to do listening therapies such as The Listening Program or TLP (www.advancedbrain.com), Therapeutic Listening or Vital Links (www.vitallinks.net), Integrated Listening Systems or iLS (www.integratedlistening.com)
- Other than these listening therapies, specific to APD, there is not much more an OT has to offer (specific to APD remember)

ROLE OF PSYCHOLOGIST FOR TESTING

- Many APD and language problems are secondary or made worse by underlying cognitive, emotional, behavioral, executive functioning deficits
- All these are assessed by an appropriate clinical/neuropsychological evaluation
- Be sure that the psychological testing is done by a licensed or school certified psychologist
- Be sure all areas listed above are assessed – mostly by objective means

ROLE OF VISION THERAPIST (DEVELOPMENTAL OPTOMETRIST)

- Some children with reading, spelling, and writing problems have auditory phonological processing difficulties as well as visual processing problems
- Some specialists, such as Developmental Optometrists, provide vision therapy to help the eyes better processing and coordinate
- Outcomes are better visual processing to go along with better phonological processing work by the audiologist or SLP to help the children with APD problems related to reading, spelling, and writing

WHAT CUES SHOULD LEAD TO RELEVANT REFERRALS

- Quantitative test results: Test results outside norms
- Qualitative test results:
- Replay of repeat items because of extraneous or intraneous reasons
- Reinstruction: To follow the directions of the test accurately
- Cue: To repeat response because of unintelligible or partial responses
- Facial expressions- discomfort or flat affect

WHAT CUES SHOULD LEAD TO RELEVANT REFERRALS

- Number of breaks
- Discomfort using headphones
- Redirections
- Difficulty with sustained attention to task
- Fatigue

FINITE MENTAL RESOURCES/ ENERGY

- Depletion of mental resources can cause extreme fatigue
- Low energy can be misconstrued as other disorders or disabilities

CONCLUSION- GAME

- Timing and Coordination
- Synchrony-Nerves that fire together wire together and nerves that fire apart wire apart (Brain that Changes Itself)
- Synergy- Net effect of all functions wired together is greater than the sum of the individual functions

DISCUSSION

Thank you for your participation

Jay R. Lucker – apddrj@gmail.com – 301-254-8583

Kavita Kaul – kkaul@Hotmail.com – 804-519-6460

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All definitions obtained from Wikipedia