Cognitive and Linguistic Development

Slide 1) Cognitive and Linguistic Development

Slide 2) The Brain and Development

Slide 3) Neural Bases of Cognitive Development

- **Role of the brain in advancing cognitive development**
  - **Neurons and synapses**

Neurons send and receive chemical messages (neurotransmitters) to other neurons. Messages are received either through the senses and sent to the brain OR from the brain and sent to the body.

Types of neurons

- sensory neurons—receive sensory information, sends it to the brain, and the brain directs the body; information is sent to the central nervous system (spinal cord and brain)
- motor neurons—carry information/messages from the central nervous system
- interneurons—internal communicators; carry messages from the sensory input to the motor output

All neurons are unique, much like a fingerprint. But they have several structures in common as well as functions. Bundles of neurons' axons form nerves. Neurons are held in place by glial cells which surround neurons and serve an insulating function to maintain the integrity of neurons' messages. This way neurons' messages do not get jumbled. Glial cells also provide energy for neurons and can restore damaged neurons.

The human body may have as many as a trillion neurons.

Slide 4) Neuron Anatomy

- **Dendrites**
- **Cell body**
  - **Nucleus**
- **Axon**
  - **Myelin sheath**
- **Axon terminals**
- **Synapse**

Dendrites—detect, receive, and carry signals into the neuron

Cell body—receives information from the dendrites

Nucleus—determines if there is enough stimulation to act or proceed

Axon—carries signals away from the cell body

Myelin sheath—covers the axon, provides insulation and increases speed of neuronal transmission

Axon terminals—release neurotransmitters (chemical messages) across the synapse to the next neuron

Synapse—gap or space between the axon terminal of one neuron and the dendrite of the next neuron; the messages must cross this gap or space

Slide 5) Review and Discuss

- **What is the function of dendrites, axons, and axon terminals?**
- **How might lesser amounts of myelin affect neuronal transmission?**
- **What would be the effect on cognition?**

Slide 6) Cerebral Cortex (and a few other structures)

Graphic

Slide 7) Structure of the Brain

- **Hindbrain**
  - **Medulla**
  - **Pons**
  - **Cerebellum**
- **Midbrain**
  - **Reticular formation**
- **Forebrain**
  - **Thalamus**
  - **Hypothalamus**
  - **Limbic system**
  - **Amygdala**
  - **Hippocampus**
  - **Cerebral cortex**

The brain stem continues from the spinal cord and includes the hindbrain and its structures. These are primitive structures needed for survival.

- Medulla—controls essential automatic bodily functions such as respiration and heart rate
- Pons—also involved with respiration, movement, and controls waking/sleeping and dreaming
- cerebellum—coordination of fine muscle movements, balance, and deals with perception, cognition, and language

Midbrain—collection of brain structures in the middle of the brain; coordinates eye and body movement patterns, sleep, and arousal

- reticular formation—screens incoming information and arouses the cerebral cortex

Forebrain—collection of higher level brain structures

- thalamus—sensory relay station

- hypothalamus—regulates emotions and basic drives including hunger, thirst, and aggression; influences the pituitary gland
- limbic system—regulates emotion, motivation, and memory
- amygdala—involved with fear, and aggression
- hippocampus—involved with memory, particularly recalling recent events
- cerebral cortex—two cerebral hemispheres which lie above the lower-level brain structures, control higher level thinking

Slide 8) Structure of the Cerebral Cortex

- **Hemispheres**
  - **Corpus callosum**
- **Lateralization or specialization**

Hemispheres—two sides (left and right) of the cerebral cortex

The hemispheres are connected by a thick band of nerve fibers called the corpus callosum.

Each hemisphere controls the opposite side of the body; left hemisphere controls the right side, right hemisphere controls the left side

The hemispheres are specialized. The left hemisphere specializes in verbal language and analytical skills, including speaking, reading, writing, understanding language, and problem solving step by step procedures. The right hemisphere specializes in nonverbal skills, such as artistic and musical skills, visual and emotional tasks and is superior to the left hemisphere with tasks involving spatial relationships and human face recognition. The right hemisphere plays a role in problem solving by combining different aspects of the problem or solution into a whole.

All complex behaviors require the cooperation of both hemispheres. Communication and cooperation between the hemispheres occurs via the corpus callosum.

Slide 9) Cerebral Cortex Structures

- **Lobes**
  - **Frontal**
  - **Parietal**
  - **Temporal**
  - **Occipital**
- **Specialty Areas**
  - **Somatosensory cortex**
  - **Motor cortex**
  - **Wernicke's area**
  - **Broca's area**
  - **Auditory cortex**
  - **Visual cortex**

Each hemisphere contains the same four lobes.

- Frontal lobes—located at the front of the brain and head; receive and coordinate messages from other lobes; responsible for motor control, speech production, and higher mental processes such as thinking, personality, emotion, memory, judging, planning, and reasoning
- Parietal lobes—located at the top of the brain, directly behind the frontal lobes; responsible for interpreting bodily sensations, such as pressure and pain, reading, and writing
- Temporal lobes—located on each side of the brain above the ears; responsible for hearing, language comprehension, memory, and some emotional control
- Occipital lobes—located at the back of the brain; responsible for vision and visual perception

Specialty Areas

- Somatosensory cortex—receives sensory messages regarding touch from throughout the body, located in parietal lobes
- Motor cortex—controls voluntary movement, located in frontal lobes
- Wernicke's area—controls language comprehension, located in temporal lobe in the left hemisphere only
- Broca's area—controls speech production, located in frontal lobe in the left hemisphere only
- Auditory cortex—receives auditory information from ears, located in temporal lobe
- Visual cortex—receives and processes visual information, located in occipital lobe

Slide 10) Graphic of the brain's lobes and major purposes

Slide 11) The Brain and Learning

- **With learning**
  - **Changes in neurons and synapses occur**
- **With development**
  - **Complex thought increases**
  - **More efficient use of memories**
- **Neuroplasticity**

When information is learned, synapses may be strengthened, formed, or deleted. (Merzenich, 2001)

Developmental changes in the brain occur with maturation. Neurons begin to form many synapses and then they gradually deteriorate as they're not needed (Byrnes, 2001). Additionally, myelin is increased, thereby increasing the efficiency of neuronal transmission (Merzenich, 2001).
Neuroplasticity—brain's ability to change, adapt, and reorganize structures and functions as a result of experience (Romero, McFarland, Faust, Farrell, & Cacace, 2008).

Slide 12) Review and Discuss

- **Describe the major functions of the frontal, parietal, temporal, and occipital lobes.**
- **How might research have been used to foster the development of left-brain and right-brain curricula and materials?**

- **Do these materials seem valid?**
- **How can you be sure you are using research supported techniques and materials?**

Slide 13) Piaget's theory of Cognitive Development

Slide 14) Piaget's Theory of Cognitive Development

- **Assumptions**
  - **Maturation underlies development**
  - **Children are active and curious**
  - **Interaction with the environment is essential**
  - **Complex thought emerges through process of equilibration**
  - **Cognitive development progresses through stages**

Maturation is the basis for all development, genetic unfolding

Children actively construct their knowledge; they are motivated to learn

Children learn through interactions with their physical environment as well as interactions with others, including peers and adults

Equilibration is the explanation of the shift from one stage of thought to another; through a process of experiencing equilibrium and disequilibrium, cognitive ability progresses

Cognitive development occurs through a series of age-related stages. In each stage, children have a distinct way of thinking and understanding their world. Each stage is qualitatively different from the others. Cognitive development progresses universally through a unidirectional pattern.

Slide 15) Piaget's Theory of Cognitive Development

- **Processes**
  - **Schemas**
  - **Adaptation**
  - **Assimilation**
  - **Accommodation**
  - **Equilibration**
    - **Equilibrium and disequilibrium**

Experiences are cognitively organized to create higher order "filing" system for isolated behaviors, thoughts, and experiences.

Schemas are the basis building blocks of thinking. They organize interactions with the environment and knowledge such that similar thoughts, events, and objects are grouped together. Schemas grow and change to reflect experience. Piaget's schemas are the most basic unit of intellect, which act as patterns that organize interactions with the environment.

Schemas change in order to adapt to the environment which consists of new or conflicting information.

Assimilation: absorbing new information into existing schemas

When children encounter new information/experiences, they use assimilation; they use their existing schemas to understand or make sense of their experience. The new information is added to their existing schemas.

Accommodation: adjusting old schemas or developing new ones to better fit with new information

When new information/experiences are encountered, children try to use their existing schemas to understand the situation. But that does not always work. They must adjust, alter, or modify their existing schemas in order to understand the experience. Other times, new schemas need to be developed in order to understand the new information.

Equilibration is a balancing act between equilibrium and disequilibrium. With equilibrium, children can comfortably explain their experiences with existing schemas. Disequilibrium is mental discomfort that occurs when children do not have an appropriate schema to understand their experience. It is this process that promotes cognitive development

Slide 16) Sensorimotor Stage

- **Age range: Birth–2 years**
- **Characteristics:**
  - **Learning through five senses**
  - **Move from reflexes to goal directed actions**
  - **Object permanence**
  - **Symbolic thought**

Infants explore their environments by using their senses. With greater mobility, they use those skills as well to explore their worlds.

Infants begin by having only reflexive movements to gaining greater control over their bodies and become capable of engaging in goal directed actions.

The hallmark of this stage is the emergence of object permanence, that is realizing that objects and people in their environments exist even they cannot see/hear/touch them.

In addition children learn about cause and effect relationships through their interactions with the environment. They learn how to reverse their actions. For example, they may build a block tower, knock it down, and rebuild it.

Symbolic thought emerges as the end of this stage when children are capable of thinking about external events and objects.

Slide 17) Preoperational Stage

- **Age range: 2—7 years old**
- **Characteristics**
  - **Lack operations**
  - **Language develops**
- **Characteristics**
  - **Intuitive thought**
  - **Difficulty with centering and conservation**
  - **Egocentrism**

Operations are actions that are carried and mentally reversed. Children at this stage cannot mentally reverse their actions.

Language development occurs rapidly. Children use words to represent their experiences. They move from action-oriented experiences to using symbols to mentally represent objects that are not present.

Children use intuitive thought to explain answers to many questions. They are certain of their reasoning in the absence of rational thinking.

Difficulty with centering refers to the child's ability to only consider one perspective or one aspect of a situation, while excluding all others. In addition, children have difficulty with conservation, that is understanding that if nothing is added or taken away, then the amount/number/volume remains constant despite changes in appearance.

Further, children in this cognitive stage are egocentric, meaning that they cannot see the world or understand experiences from another person's perspective. They can only view situations from their own perspective.

Slide 18) Conservation Tasks and Egocentrism

Slide 19) Concrete Operations

- **Age range: 7—11 years old**
- **Characteristics**
  - **Perform concrete operations or "hands on" thinking**
  - **Reversibility**
  - **Logical thinking emerges**
  - **Conservation**
  - **Develop seriation, transitivity, and classification**

Children can now perform operations IF they have concrete experiences to draw upon. They are not able to apply their logic or knowledge to abstract concepts or ideas.
Children are able to mentally reverse their physical actions.

Logical thinking emerges and replaces intuitive thinking. However, the logic must be applied to concrete examples. They are now able to consider multiple characteristics at one time.
Conservation emerges over time.
Seriation includes arranging objects sequentially along quantitative dimensions.
Transitivity is the use of logic to determine relationships between objects: if a equals b and b equals c, then a must equal c.
Classification refers to the ability for students to recognize that objects can simultaneously belong to multiple categories: a mother can be a sister, cousin, doctor, and spouse

Slide 20) Pictures of seriation and transitivity

Slide 21) Formal Operations

- **Age range: 11—15 years old**
- **Characteristics**
  - **"Scientific" reasoning**
  - **Hypothetico-deductive reasoning**
  - **Adolescent egocentrism**
    - **Imaginary audience**
    - **Personal fable**
  - **Not all individuals reach this stage**

Adolescents move from trial and error to thinking more like scientists. Adolescents use hypothetico-deductive reasoning where they mentally develop multiple hypotheses regarding a problem and mentally test/contemplate the best way to solve the problem. Adolescents are capable of thinking about abstract concepts and ideas with which they have not had direct experience.

Adolescent egocentrism reflects idealistic logic in which based on the students' logic a problem should be solved. However, adolescents cannot separate their logic from other's perspectives as well as practical constraints. Further, adolescents realize that others have thoughts and feelings but they fail to differentiate between their thoughts/feelings and what others may truly think/feel.

Adolescents also experience an imaginary audience where they believe that others are watching them and interested in hearing their ideas/thoughts. Some adolescents engage in attention-seeking behavior for this audience. Others do not like feeling like they are certain of attention.

Adolescents also experience a personal fable in which they believe that they are invincible and completely unique. They believe that they difficulties, thoughts, and feelings are unique unto them alone. The personal fable also leads to adolescent risk-taking behaviors because they believe that they are not vulnerable and that they are the "exception to the rule." This may be partially due to the lack of development of the pre-frontal cortex which controls emotions, planning, and judging.

Slide 22) Summary of Piaget
<u>Limitations</u>

- **Stage theory inconsistencies**

- **Underestimation of preschool children's abilities**
- **Overestimation of adolescents' abilities**
- **No discussion of cultural impacts**

There are inconsistencies with a stage theory. Children move back and forth between stages. Development is not as discrete as the stages indicate.

Piaget underestimated the abilities of preschool children. A basic sense of numbers and conservation seems to be genetic. Further, Piaget did not consider the effects of training and children's interests guiding that training (e.g., expert).

Piaget overestimated the abilities of adolescents. Many adolescents do not achieve formal operations so early in their development.

Finally, Piaget did not consider the effects of culture or simply individual differences in children.

Slide 23) Modifying Piaget's Theory

- **Changes from one stage to the next are less consistent and global than Piaget suggested.**
- **Children are not always egocentric.**
- **Children's knowledge and mental strategies develop at different ages in different areas.**
- **Cognitive development as changing frequencies in children's use of different ways of thinking, not sudden, permanent shifts from one way of thinking to another.**

Slide 24) Piaget's Influence

- **Correct in that children's thinking becomes more systematic, consistent, and integrated as they get older.**
- **Children now viewed as active explorers and constructors of knowledge.**
    - **Not passive recipients of input from environment.**
- **Inspired others to experimentally test his findings and theories.**

Slide 25) Implications of Piaget's Theory of Cognitive Development for Education

- **Learning is an active process**
    - **Children actively explore and construct their own knowledge.**
    - **Learning should take place in an authentic, meaningful situations instead of isolated skills**
- **Thinking becomes more systematic and integrated over time**
    - **Consider the cognitive stage of students with respect to presentation strategies, examples, and assignments**
- **Use disequilibrium to motivate**
- **Use social interactions**

Slide 26) Review and Discuss

- **Discuss the major assumptions underlying Piaget's theory.**
- **Describe the major characteristics of Piaget's four stages of cognitive development.**

- **The best way to determine a student's current level of cognitive development is to watch him/her solve a problem. Why is this so?**
- **How can Piaget's concepts and theory assist you in the classroom on a day-to-day basis?**

Slide 27) Vygotsky's sociocultural theory of cognitive development

Slide 28) Vygotsky's Sociocultural Theory of Cognitive Theory

- **Assumptions**
  - **Children actively construct knowledge**
  - **Origin of higher mental processes is social interaction**
  - **Culture provides tools for learning**
  - **Language is integral in cognitive development and learning**
  - **Children can perform beyond their ability levels when given help**
  - **Children should be challenged to promote cognitive development**

Children actively construct their knowledge. Just like Piaget, Vygotsky believed that children incorporated information based on their interactions with the environment and others.

Social interactions guide cognitive development. Cognitive development is furthered through social activities, which typically begin with conversations. The interaction begins between a child and a more knowledgeable person. Then that conversation is internalized.

Cultures provide tools for children to interpret and learn about their worlds. These tools may be real or symbolic, including language, signs, symbols, and interpretations.

Through dialogue, adults teach children about their culture, how their culture interprets and responds to the world.

When provided with help, children can perform beyond their actual level of development to where they potentially will be.

Play provides opportunities for children to challenge their thinking due to interactions with peers.

Slide 29) Vygotsky's Sociocultural Theory of Cognitive Theory

- **Processes**
  - **Zone of proximal development**
  - **Scaffolding**
  - **Co-construction of knowledge**
  - **Language**

Slide 30) Zone of Proximal Development (ZPD)

- **Theoretical space between tasks children can perform independently and more challenging tasks which children can perform with assistance**

Accurate assessment of the ZPD permits children to be successful on tasks they can perform independently and work collaboratively with more competent peers or adults on challenging tasks and still be successful.

It is believed that within the ZPD is where true learning occurs and where instruction should be aimed.

Slide 31) Scaffolding

- **Guidance and support needed for cognitive development to proceed**
- **Provided by more competent peer or adult**
- **Typically provided through the use of language**

Scaffolding is guidance necessary for success in learning tasks. This support is withdrawn as the child learns the skills needed for independent success.

Language is the tool typically used to provide assistance

Slide 32) Co-construction of Knowledge

- **Knowledge is first encountered in shared activities with a more skilled partner**
- **Knowledge gained from social interaction is internalized**

Knowledge is a shared process in which children first encounter new ideas and concepts while interacting with a competent, skilled, or knowledgeable person. After the interaction, the process is internalized and made one's own.

Slide 33) Role of Language

- **Cultural tool**
- **Guides thinking and learning**
- **Private speech**

Language is a tool which cultures use to communicate. Parents teach children how to use language to express themselves. Over time, children learn to merge their language and thoughts in order to plan, guide, monitor, and alter behaviors.

Private speech is a way for children to talk to themselves in order to regulate their behavior. Vygotsky's viewed private speech as external thinking. Children at first will talk to themselves aloud. As tasks become more difficult, private speech or self talk should increase. As children become older, they internalize the private speech and engage in self talk without speaking aloud.

Slide 34) Implications of Vygotsky's Theory of Cognitive Development for Education

- **Collaborative and assisted learning**
    - **Utilize activities requiring language, especially dialogue**
- **Scaffolding**
- **Individualized instruction**
    - **Allow all students to experience success at challenging tasks**

- **Alternative assessment**
- **Self-regulation**
    - **Consistent implementation of rules and consequences**
    - **Work toward and achieve goals**

Collaborative and assisted learning—students work with more capable or skilled peers and/or adults; more competent partner provides prompts, reminders, and feedback

Scaffolding—provide guidance and support to further cognitive development; typically through dialogue

Individualized instruction—identify each child's zone of proximal development, provide independent work within their capabilities and instruction and group work just beyond current capabilities

Alternative assessment—move beyond paper and pencil

Self-regulation—regulate own behavior by knowing the rules, talking to one's self in order to follow rules, remain in control of behavior, and stay on task

Slide 35) Review and Discuss

- **Describe the basic assumptions underlying Vygotsky's theory.**
- **Compare and contrast Piaget and Vygotsky's theories.**
    - **How can both theories be helpful to teachers in understanding and furthering the cognitive development of their students?**

Slide 36) Information processing

Slide 37) Information Processing Theory

- **Based on computer metaphor**
    - **Cognition is the software**
    - **Encoding**
    - **Storage**
    - **Retrieval**

Slide 38) Information Processing Model Graphic

Information from environment enters through your senses to the sensory memory

You try to make sense of the information, give it meaning—perception
Information enters working memory where you can use the information temporarily or learn it and store it in long term memory

From working memory, if learned, information enters long term memory where it is permanently stored; from here information is retrieved

Throughout the process, the executive control processes guide how and when information will flow through the system as well as how much and well information is processed (decision making)

Slide 39) Sensory Memory

- **The five senses**
- **Sensory register**
- **Capacity: large**
- **Duration: brief**
- **Contents**
- **Roles of attention and perception**

Incoming information from five senses stimulates sensory receptors in the sensory register (filter) for only a few seconds or less

Sense specific—there are specific places within the sensory register for information from each sense
Large capacity—lots of information bombards the sensory register but stays there for only 1-3 sec.; fragile memories

Contents—resembles sensations from original stimulus

Decide whether or not to pay attention to the stimuli—attention is limited and you can only pay attention to one demanding task at a time; so sensory register is selective; achieve automaticity with attention

Perception—once decide to pay attention, need to attribute meaning to the sensory memory

Slide 40) Perception

- **Bottom-up processing**
- **Top-down processing**
- **The role of attention**
- **Automaticity**

Perception—making sense of the incoming stimuli

Bottom up processing—notice features and assemble them into something meaningful; inductive

Top down processing—based on knowledge and expectation; use what already know about situation or stimulus; deductive

Attention limits the possibilities of perception simply because some stimuli are ignored

Automaticity—some perceptions become automatic, not having to think about them

Slide 41) Picture

Slide 42) Picture

Slide 43) Applications of Sensory Memory

- **Must have students' attention**
  - **Use signals**
- **Make purpose of lesson/assignment clear**
- **Discuss value of assignment**
- **Use variety and capitalize on curiosity**
- **Developmental differences**

Younger children need more structured tasks; difficult to maintain attention for long periods of time

Slide 44) Working Memory

- **Distinction between short term memory (STM) and working memory (WM)**
- **Capacity: 5 to 9 separate items**
- **Duration: 5 to 20 seconds**
- **3 Components of Working Memory**
  - **Central executive**
  - **Articulatory loop rehearsal system**
  - **Visuospatial sketchpad**

Short term memory (STM) old label for this portion of the information processing system; it only referred to temporary storage

However, it is now known that not only is information stored temporarily but it is also actively processed; this is why it is called working memory

Holds what you are thinking about right know: consciousness; holds information from sensory memory as well as long term memory

Capacity: holds 7 +/- 2 pieces of information (5-9 pieces of information)

Duration: holds pieces of information for short amount of time (5-20 sec) for processing; discuss ways to do this next

Communicates with long-term memory

Temporary storage and active processing

3 components

- Central executive—supervisor and decision maker as seen earlier; jobs include supervising attention, making plans, retrieve information from long term memory, integrate new information with information already know (make it meaningful), language comprehension, and reasoning; these are your mental resources

- Phonological or articulatory loop—rehearsal system for verbal and auditory information (words and sounds); holds as much as you can rehearse in 1.5-2 sec; way of remembering temporarily new information
- Visuospatial sketchpad—holds visual and spatial information
- Use both phonological loop and visuospatial sketchpad simultaneously; taxes working memory

Slide 45) Retaining Information in WM

- **Rehearsal can increase duration**
  - **Maintenance rehearsal**
  - **Elaborative rehearsal**
  - **Chunking**
- **Forgetting**
  - **Interference**
  - **Decay**

Can keep information in working memory indefinitely so long as you rehearse it

Maintenance—repeat information in mind; useful for information with an immediate need or purpose; formula, phone number

Elaborative—connect information with something you already know in long term memory; this is information that you need to know in the future

Chunking—group individual bits of information together

Forgetting—in short term memory

Interference—new information enters the working memory and old information is lost if not elaboratively rehearsed and sent to LTM

Decay—loss due to time; when attention is diverted, activation level drops where information cannot be reactivated

Slide 46) Long Term Memory

- **Storage takes more time & effort**
- **Capacity: unlimited**
- **Duration: unlimited**
- **Contains visual or verbal or a combination of codes**
- **Retrieval may be troublesome**

Goal of teaching: have students store well learned information

Storage takes time and effort—must connect new information with old information in order to keep the memory; need background information to interpret and store new information accurately

Relatively permanent storage

Seemingly limitless capacity

Information stored by meaning, sound, familiarity, relevance

Can store images

Network model—information is stored in connected schemas; schemas are the files that tell you information about a particular event, object, or concept; add new information to schemas (assimilation) or adapt your schemas to fit with the new information (accommodation); schemas are connected so recalling information about one concept will also help you to recall information about related concepts: When I mentioned assimilation and accommodation, what did you remember?

Permanent structural changes when information is stored in LTM

Slide 47) Graphic: Sensory Memory, Working Memory, Long Term Memory

Slide 48) Information Processing During Childhood

- **Gradual quantitative changes in children's mental capabilities**
- **With maturation and experience:**
  - **Information-processing skills improve**
  - **Attention spans increase**
  - **Memory storage capacity improves**

Slide 49) Linkages: Development and Memory

- **Most children remember autobiographical memories from age 5 or 6**
- **Few children remember anything from before age of 3**
- **Why do children experience "infantile amnesia"?**
  - **Young children lack necessary processes for memory encoding and storage?**
  - **Children have yet to develop a sense of self?**

Slide 50) Linkages: Development and Memory (cont.)

- **Other possible explanations:**
  - **Early memories are implicit, not explicit.**
  - **Early memories are lost due to the lack of language skills to talk about, and solidify, those memories.**
  - **Specific events may be difficult to remember because of "generalized event representations."**

Explicit memories are consciously recalled/retrieved. Implicit memories exist but the circumstances, situations, and/or details cannot be consciously recalled.

Slide 51) Review and Discuss

- **Describe the major functions of the sensory, working, and long-term memories.**
  - **How can you as a teacher use this information to further your students' intellectual development?**
- **How can information regarding top-down and bottom-up processing help students to better solve problems?**

Slide 52) Brain and education

Slide 53) Brain-Mind Learning Principles

1. **All learning is physiological.**
2. **The Brain-Mind is social.**
3. **The search for meaning is innate.**
4. **The search for meaning occurs through patterning.**
5. **Emotions are critical to patterning.**
6. **The Brain-Mind processes parts and wholes simultaneously.**
7. **Learning involves both focused attention and peripheral perception.**
8. **Learning always involves conscious and unconscious processes.**
9. **There are at least two approaches to memory: archiving individual facts or skills or making sense of experience.**
10. **Learning is developmental.**
11. **Complex learning is enhanced by challenge and inhibited by threat associated with helplessness.**
12. **Each brain is uniquely organized**

Slide 54) Insights From The Brain About Education

- **Brains are not passive receptors of information.**
- **Brains are doing things even when they don't seem to be.**
- **Behavior can be "released", rather than only "caused."**
- **Acting ("output") changes experience ("input").**
- **The same input can result in different experiences.**
- **Effective systems can be distributed rather than hierarchical.**

Slide 55) Insights From The Brain About Education (cont.)

- **Such systems depend on effective communication, both talking and listening.**
- **Expect changes to take time/persistence.**
- **Knowledge is NOT dangerous, but it does not guarantee security and is always incomplete.**
- **What one sees is not necessarily what's out there.**
- **Reality is a hypothesis; the brain is designed to continually check and revise it by looking at things from additional perspectives.**

The brain is organized to learn by observing changes in inputs which result from outputs. Teachers who attempt to get students to learn by simply giving them inputs ("passive learning") will not only be less effective at producing learning (changes in the brain), but will also contribute to a lack of appreciation of

students for "consequences" (the reality of outputs as an important determinant of inputs, to oneself and others). "Active learning" may, but does not necessarily, require "hands on" activities. It can go on if students are allowed/encouraged to constantly be themselves questioning what they are hearing. For this to occur, it is essential that the teacher regard his or herself not as a definitive authority but rather as also in part a student. This posture is desirable as well to encourage students to recognize that sharing of different perspectives is an essential component of any understanding of either "truth" or "reality", and that they themselves are important contributors of the needed perspectives.

Slide 56) Enriched Environments for Academic Success

- **Enrich the cortex**
  - **Provide steady source of positive emotional support - love, encouragement, warmth and caring.**
  - **Our old rats live longer with tender loving care.**
- **Provide a nutritious diet with enough protein, vitamins, minerals and calories.**
  - **Low protein diets during development diminish the capability of branches on the nerve cells in the cortex to respond to enriched conditions.**
- **Stimulate all the senses, but not necessarily all at once.**

Multisensory enrichment develops the entire cortex; whereas, an input from a single task stimulates the growth of only a precise area of the brain.

Slide 57) Enriched Environments for Academic Success (cont.)

- **Provide an atmosphere free of undue pressure and stress but suffused with a degree of pleasurable intensity.**
- **Present a series of novel challenges that are neither too easy nor too difficult for the child at his or her stage of development**
- **Allow for social interaction for a significant percentage of activities.**
- **Promote the development of a broad range of skills and interests that are mental, physical, aesthetic, social and emotional**

Slide 58) Enriched Environments for Academic Success (cont.)

- **Give the child an opportunity to choose many activities.**
  - **Allow each unique brain to choose.**
- **Give the child a chance to assess the results of efforts and to modify them.**
- **Promote exploration and the fun of learning.**
  - **Rats living in enriched environments are more exploratory than those living in impoverishment.**
- **Allow the child to be an active participant rather than a passive observer**

As he builds sand castles on the beach and admires his construction before a wave destroys them and he need to earn to start over and resculpt.

Slide 59) Non-enriched Environments = Lack of Academic Success

- **A vacillating or negative emotional climate.**

- **A diet low in protein, vitamins, and minerals, and too high or too low in calories.**
- **Sensory deprivation.**
- **High levels of stress and pressure.**
- **Unchanging conditions lacking in novelty.**

Slide 60) Non-enriched Environments = Lack of Academic Success (cont.)

- **Long periods of isolation from caregivers and/or peers.**
- **A heavy, dull atmosphere lacking in fun or in a sense of exploration and the joy of learning.**
- **A passive, rather than active involvement in some or all activities.**
- **Little personal choice of activities.**
- **Little chance to evaluate results or effects and change to different activities.**
- **Development in a narrow, not panoramic, range of interests.**

Slide 61) Tactics For Improving The Educational System

- **Listen more to other teachers, plan using their experience**
- **Educate/involve parents more**
- **Create sense of parent/teacher partnership in dealing with problems no one knows exactly how to solve**
- **Provide more prenatal education to parents**
- **Provide new education for teachers**
- **Provide teachers with current information about, usable resources for dealing with various forms of "learning disabilities"**

Slide 62) Language development

Slide 63) Language

- **Definition**
- **Language contains**
    - **Phonemes**
    - **Morphemes**
    - **Grammar**
        - **Syntax**
        - **Semantics**

Language is a system for communication that utilizes sounds and symbols; rules govern how to combine sounds and symbols

Phonemes—are the smallest unit of sound in a language (b sound in baby, th sound in that)

Morphemes—are the smallest unit of meaning in a language, created by combining phonemes; include prefixes, suffixes, and root words

Grammar—contains the rules for combining morphemes for effective communication

Syntax provides rules for word order (noun followed by verb)

Semantics is a system to create meaning; The family has set aside a nest egg for retirement. Compared with… The mother bird sat on her eggs in the nest.

Slide 64) Language Development

- **Prelinguistic stage**
  - **Crying**
  - **Cooing**
  - **Babbling**
- **Linguistic stage**
  - **Single utterances**
  - **Telegraphic speech**
  - **Learning rules of grammar**

Prelinguistic stage

- Crying—at first reflexive, then becomes purposeful to indicate needs
- Cooing—vowel sounds (ooooo, aaaa)
- Babbling—consonant sounds added to vowel sounds (bababa)

Linguistic stage

- Single utterances—single words; sometimes overextension of words (e.g., call all men "Daddy" or furry animals with four legs "cat" or "dog" whichever reflects their experiences)
- Telegraphic speech—connecting two or three words, omitting words that are not essential to the meaning; "I want", "Mama juice", "I go bye-bye"
- Learning rules of grammar—vocabulary increases as does learning rules for grammar; learn many rules by imitation (e.g., add –ed to indicate past tense); rules can be overgeneralized such that irregular words are not properly utilized (e.g., I goed to the store.)

Slide 65) Language Development

- **Nature or nurture or both?**
  - **Is language reinforced behaviors or do humans have a special capacity for language learning?**
- **Influences of heredity and environment**

Humans may have what Chomsky called a language acquisition device, whereby humans have built in biases or rules that guide language pattern recognition. Children seem to look for patterns in language that they hear and then generalize the pattern.

There is a sensitive period for language development. Children need to hear and be exposed to language early on.

Additionally, children are rewarded by parents and teachers for using language. Parents and teachers serve as models for appropriate language use and reinforce language.

By the age of 5-6 years old, children have mastered their native language.

Slide 66) Language Development: The School Years

- **Pronunciation**
- **Syntax**
- **Vocabulary and meaning**
- **Comprehension**
- **Metalinguistic awareness**
- **Pragmatics**

During the school years, the following are taught to further language development

Pronunciation—proper sounds are taught and reinforced; most sounds are mastered by first grade

Syntax –although children master basic word order early on, they begin to learn how to use extra clauses and the passive voice

Vocabulary and meaning—vocabulary grows exponentially during the school years; children love to play word games and learn new words; however, they understand the words' literal meanings or try to grasp the meaning based on context, they cannot yet grasp abstract meanings

Comprehension—children focus on understanding what they hear and read

Metalinguistic awareness—over time children learn how to explicitly use language and understand how it works; study and extend language rules that they already know

Pragmatics—social conventions for appropriate use of language, "how to talk to whom"

Slide 67) Review and Discuss

- **Describe how language develops.**
- **Describe the different components of language.**
- **How can you as a teacher foster language development in your classroom?**
- **Is the ability to use language unique to human beings? Explain your response.**
    - **If chimpanzees have been taught to use sign language much like hearing impaired humans, are they both in fact using language? Explain your response.**

Slide 68) The End.