Lesson 2: Cognitive Psychology

Understanding Cognitive Processes in Speech and Language Therapy

Learning Outcomes

By the end of this lecture, students will be able to:

- Define cognitive psychology and its scope.
- Explain how information is processed by the human brain.
- Describe the components and functions of working memory.
- Discuss the role of executive functions in communication.
- Explain the cognitive processes involved in problem solving.
- Describe how the brain processes language.
- Recognize the importance of cognitive processes in speech and language therapy.

7.1 Introduction to Cognitive Psychology

Cognitive psychology is the scientific study of the mental processes that enable people to acquire, store, process, and use information. These processes include perception, attention, memory, thinking, language, reasoning, problem solving, and decision making.

Unlike behaviorism, which focuses only on observable behavior, cognitive psychology seeks to understand what happens inside the mind when people learn, communicate, and interact with their environment.

For speech and language therapists, cognitive psychology provides essential knowledge about how people understand language, produce speech, remember words, and solve communication problems. Cognitive impairments often accompany language disorders, neurological diseases, and developmental conditions, making an understanding of cognition fundamental to clinical practice.

7.2 Information Processing

One of the central ideas in cognitive psychology is the **Information Processing Model**, which compares the human mind to a computer. Information enters the brain, is processed, stored, and later retrieved when needed.

The information processing system consists of three main stages:

1. **Sensory Memory**
2. **Working (Short-Term) Memory**
3. **Long-Term Memory**

Sensory Memory

Sensory memory briefly stores information received through the senses.

Examples include:

- Visual information (iconic memory)
- Auditory information (echoic memory)
- Touch sensations

Most sensory information disappears within a few seconds unless attention is directed toward it.

Attention

Attention acts as a filter that determines which information moves from sensory memory into working memory.

There are several types of attention:

- Selective attention
- Sustained attention
- Divided attention
- Alternating attention

Children with attention difficulties often experience problems following conversations and classroom instructions.

Long-Term Memory

Information that is rehearsed and meaningfully encoded can be transferred into long-term memory, where it may remain for years or even a lifetime.

Long-term memory includes:

- Episodic memory (personal experiences)
- Semantic memory (facts and knowledge)
- Procedural memory (skills and habits)

7.3 Working Memory

Working memory is the mental system responsible for temporarily storing and manipulating information while performing cognitive tasks.

Unlike simple short-term memory, working memory allows individuals to actively process information.

For example, when solving a mathematics problem mentally, following spoken instructions, or understanding a long sentence, working memory is continuously active.

Baddeley and Hitch's Working Memory Model

According to Baddeley and Hitch (1974), working memory consists of four interacting components.

1. Central Executive

The central executive controls attention and coordinates the activities of the other components.

Functions include:

- Planning
- Decision making
- Dividing attention
- Inhibiting distractions

2. Phonological Loop

The phonological loop temporarily stores speech sounds and verbal information.

It is essential for:

- Vocabulary learning
- Sentence repetition
- Reading
- Language acquisition

3. Visuospatial Sketchpad

This system temporarily stores visual and spatial information.

Examples include:

- Remembering maps
- Recognizing faces
- Copying drawings
- Understanding spatial relationships

4. Episodic Buffer

The episodic buffer integrates information from working memory and long-term memory to create meaningful episodes.

It combines:

- Visual information
- Verbal information
- Previous knowledge

Importance of Working Memory in Speech and Language Therapy

Working memory plays an important role in:

- Following multi-step instructions
- Understanding complex sentences
- Learning new vocabulary
- Reading comprehension
- Producing organized speech

Children with language disorders frequently have reduced working memory capacity.

7.4 Executive Functions

Executive functions are high-level cognitive processes that regulate goal-directed behavior.

They enable individuals to plan, organize, monitor, and adapt their behavior to changing situations.

The main executive functions include:

- Inhibitory control
- Cognitive flexibility
- Working memory
- Planning
- Organization
- Self-monitoring

Inhibitory Control

Inhibitory control allows individuals to resist distractions and suppress inappropriate responses.

Example:

A child waits for another person to finish speaking before answering.

Cognitive Flexibility

Cognitive flexibility refers to the ability to shift between tasks or adapt to new situations.

Example:

Changing communication strategies when talking to different people.

Planning and Organization

Planning involves setting goals and determining the steps needed to achieve them.

Communication requires planning before speaking or writing.

Individuals with executive dysfunction may produce disorganized narratives or lose track of conversations.

Executive Functions and Communication

Executive functions are essential for:

- Conversational turn-taking
- Organizing stories
- Problem solving during communication
- Understanding social rules
- Self-correcting speech errors

Many neurological disorders affecting communication also impair executive functioning.

7.5 Problem Solving

Problem solving is the cognitive process of identifying a problem, generating possible solutions, selecting the best option, and evaluating the outcome.

Problem solving generally involves five stages:

1. Identifying the problem
2. Defining the goal
3. Generating possible solutions
4. Choosing the most effective solution
5. Evaluating the result

Types of Problem Solving

Algorithmic Problem Solving

Uses systematic, step-by-step procedures that guarantee a correct solution.

Example:

Solving mathematical equations.

Heuristic Problem Solving

Uses practical strategies based on experience.

Although faster, heuristics do not always produce the correct answer.

Example:

Guessing the meaning of an unfamiliar word from context.

Problem Solving in Speech and Language Therapy

Speech-language therapists frequently help clients solve communication problems such as:

- Finding alternative words
- Using gestures
- Repairing conversational breakdowns
- Developing compensatory communication strategies

7.6 Language Processing

Language processing refers to the mental operations involved in understanding and producing language.

It is one of the most complex cognitive functions performed by the human brain.

Language processing involves several sequential stages.

Speech Perception

The listener detects and recognizes speech sounds through the auditory system.

Lexical Access

The brain identifies words stored in the mental lexicon.

Syntactic Processing

The brain determines the grammatical structure of sentences.

Example:

Understanding who performed an action in a sentence.

Semantic Processing

Semantic processing involves understanding the meanings of words and sentences.

Pragmatic Processing

Pragmatics concerns understanding language within its social context.

It includes:

- Humor
- Sarcasm
- Figurative language
- Conversational rules

Speech Production

Producing speech involves several cognitive stages:

1. Formulating an idea
2. Selecting appropriate words
3. Organizing grammar
4. Planning speech movements
5. Producing spoken language

7.7 Brain Regions Involved in Language Processing

Several areas of the brain work together during language processing.

Broca's Area

Located in the left frontal lobe.

Functions:

- Speech production
- Grammar
- Speech planning

Damage may result in **Broca's aphasia**, characterized by slow, effortful speech.

Wernicke's Area

Located in the left temporal lobe.

Functions:

- Language comprehension
- Understanding spoken language

Damage may result in **Wernicke's aphasia**, characterized by fluent but meaningless speech and impaired comprehension.

Angular Gyrus

The angular gyrus contributes to:

- Reading
- Writing
- Semantic processing
- Integrating visual and auditory information

Arcuate Fasciculus

This bundle of nerve fibers connects Broca's area and Wernicke's area, allowing coordination between language comprehension and speech production.

7.8 Clinical Applications in Speech and Language Therapy

Knowledge of cognitive psychology helps speech-language therapists:

- Assess cognitive-linguistic abilities.
- Identify cognitive factors contributing to communication disorders.
- Design individualized intervention programs.
- Improve attention, memory, and executive functioning during therapy.
- Support individuals with aphasia, traumatic brain injury, autism spectrum disorder, developmental language disorder, and dementia.

Key Points

- Cognitive psychology studies the mental processes underlying learning, thinking, memory, and language.
- Information processing involves sensory memory, attention, working memory, and long-term memory.
- Working memory temporarily stores and manipulates information necessary for communication.
- Executive functions regulate planning, attention, inhibition, and cognitive flexibility.
- Problem solving enables individuals to overcome communication challenges.
- Language processing requires coordinated activity across multiple cognitive systems and brain regions.
- Cognitive psychology provides the theoretical foundation for understanding many communication disorders encountered in speech and language therapy.

Review Questions

1. What is cognitive psychology, and why is it important in speech and language therapy?
2. Describe the stages of the information processing model.

3. Explain the four components of Baddeley and Hitch's working memory model.
4. What are executive functions, and how do they support communication?
5. Differentiate between algorithmic and heuristic problem solving.
6. Describe the stages involved in language processing.
7. Compare the functions of Broca's area and Wernicke's area.
8. How can cognitive impairments affect language and communication?

Suggested Reading

- Baddeley, A. D. (2020). *Working Memory: Theories, Models, and Controversies*. Annual Review of Psychology.
- Goldstein, E. B. (2023). *Cognitive Psychology: Connecting Mind, Research, and Everyday Experience* (6th ed.). Cengage.
- Sternberg, R. J., & Sternberg, K. (2024). *Cognitive Psychology* (8th ed.). Cengage.
- American Speech-Language-Hearing Association (ASHA). *Cognitive-Communication Disorders* (www.asha.org). This lecture is appropriate for first-year undergraduate students in **Speech and Language Therapy (Orthophonia)** and provides the cognitive foundations needed for later courses in neuropsychology, psycholinguistics, and communication disorders.