Information Processing Theories

Metaphor: Computation System

- Underlying many information-processing theories is the metaphor of the child as a computation system.
- Cognitive development arises from children's gradually surmounting their processing limitations through:
  - Increasing efficient execution of basic processes
  - Expanding memory capacity
  - Acquisition of new strategies and knowledge

Piaget's Stages of Cognitive Development

<table>
<thead>
<tr>
<th>Stage</th>
<th>Approximate Age</th>
<th>New Ways of Knowing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensorimotor</td>
<td>Birth to 2 years</td>
<td>Infants know the world through their senses and through their actions. For example, they learn what dogs look like and what petting them feels like. Toddlers and young children acquire the ability to internally represent the world through language and mental imagery. They also begin to be able to see the world from other people's perspectives, not just from their own.</td>
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<tr>
<td>Preoperational</td>
<td>2-7 years</td>
<td>Toddlers and young children acquire the ability to internally represent the world through language and mental imagery. They also begin to be able to see the world from other people's perspectives, not just from their own.</td>
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<tr>
<td>Concrete operational</td>
<td>7-12 years</td>
<td>Children become able to think logically, not just instinctively. They now can classify objects into coherent categories and understand that events are often influenced by multiple factors, not just one. Adolescents can think systematically and reason about what might be as well as what is. This allows them to understand politics, ethics, and science fiction, as well as to engage in scientific reasoning.</td>
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<td>Formal operational</td>
<td>12 years onward</td>
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Continuous Cognitive Change

- Information-processing theorists view children as undergoing continuous cognitive change.
- The term continuous applies in two senses:
  - Important changes are viewed as constantly occurring, rather than being restricted to special transition periods between stages.
  - Cognitive growth is viewed as typically occurring in small increments rather than abruptly.

Distinctive Features

- Precise specification of the processes involved in children’s thinking.
  - Helps information-processing researchers understand and predict children’s behavior.

Information-Processing Theories: Development of Problem Solving

- Planning contributes to successful problem-solving.
  - Children begin to form simple plans by their first birthday.
  - With age, they make a greater variety of plans, which help them solve a broader range of problems.

Distinctive Features

- Precise specification of the processes involved in children’s thinking.
  - Task analysis helps information-processing researchers understand and predict children’s behavior.

- Emphasis on thinking as a process that occurs over time.
  - Emphasis on and
Memory System Components

- **Sensory memory**: Refers to sights, sounds, and other sensations that are just entering the cognitive system.

- **Working memory**: A workspace in which information from the environment and relevant knowledge are brought together, attended to, and actively processed.

- **Long-term memory**: Refers to information retained on an enduring basis.

These systems differ with regard to how much information they can store, the length of time for which they can retain information, the neural mechanisms through which they operate, and their course of development.

Information-Processing Theories: Explanations of Memory Development

- **Basic processes are the simplest and most frequently used mental activities**
  - Recalling facts and procedures
  - Generalizing from one instance to another
  - Events with one another
  - Objects as familiar

- **Basic processes: Encoding**
  - People encode information that draws their attention or that they consider important.
  - Children do not encode all of the important information in the environment.
  - Sometimes we see but do not encode.
Information-Processing Theories: Explanations of Memory Development

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Information-Processing Theories: The Development of Memory

- **Executive functioning involves control of cognition.**
  - Inhibiting tempting, counterproductive actions
  - Enhancing working memory through use of strategies
  - Being cognitively flexible

- **Executive functioning increases during preschool and early elementary years.**

Memory Is Located Throughout the Brain

All of the major areas of the cortex shown here continue maturing after birth.
Sources of Learning and Memory Development

- **Processing Speed**
- **Mental Strategies**
- **Content Knowledge**

**Processing Speed**

- The speed of basic processes increases greatly over the course of childhood
- Biological maturation and experience contribute to increased processing speed
  - Two biological processes that contribute to faster processing are **myelination** and **increased connectivity** among brain regions

**Increase in Speed of Processing with Age**

**Mental Strategies**

- Strategies are another major source of learning and memory development
- A number of strategies emerge between ages 5-8
  - **Rehearsal**: The process of repeating information over and over to aid memory
  - **Selective attention**: The process of intentionally focusing on information that is most relevant to the current goal
Problem-Solving

- Children are active problem solvers
- According to *overlapping-waves theory*, children use a variety of approaches to solve problems
  - At any given time, children possess several different strategies for solving a given problem
  - With age and experience, the strategies that produce more successful performance become more prevalent

The Overlapping-Waves Model

Other Information-Processing Theories

Connectionist Theories/Neural Network Approach

- The simultaneous activity of neurons, interconnected processing units
- Sequential and parallel processing

Core-Knowledge Theories

View of Children’s Nature

Central Developmental Issues
Core-Knowledge Theories of Cognitive Development

- Principles of core-knowledge theories
  - Focus on areas (such as understanding people) that have been important throughout human history.
  - Children are much more advanced in their thinking than Piaget suggested.

Core-Knowledge Theories

- Domain specificity: Children’s innate understanding allows them to distinguish between animate beings and inanimate objects.

  - Children’s informal theories:
    - understanding organized into informal theories of domains like other people, plants and animals, and objects.
    - Psychology
    - Biology
    - Physics
    - Language

Perception of Objects as Distinct, Bounded Wholes

Piaget: infants do not have object permanence until 8-12 months

Liz Spelke: 3- to 5-month-olds in the moving rod study.

Methods

- Kellman & Speke (1983)
  - Habituate
  - Unitary Object Test
  - Two Object Test
Core-Knowledge Theories

- Domain specificity: Children’s innate understanding and specialized learning mechanisms
  - Allows rapid learning in certain areas
- What is learning? Refinement of core principles

Example: Baillargeon and support experiment
Familiarity vs. Novelty

Can 8-month-old infants compute statistics?

Sociocultural Theories
View of Children's Nature
Central Developmental Issues

Xu and Garcia (2008)
Sociocultural Theories of Cognitive Development

- Cognitive development occurs in an interpersonal contact, through interaction with parents, siblings, teachers, and playmates.
- Guided participation, in which knowledgeable individuals guide child learning, is an important sociocultural process.

Lev Semyonovich Vygotsky

- Parent of the sociocultural approach to child development
- His theory presents children as social beings, intertwined with other people who are eager to help them gain skills and understanding
  - It sees development as continuous, with change as quantitative rather than qualitative
  - Humans are seen as unique because of their inclination to teach each other and to learn from each other

Sociocultural Principles of Cognitive Development

- Children are social beings shaped by their cultural contexts.
- Children are both learners and teachers.
- Children are products of their culture.
- Cognitive change originates in social interaction.
Sociocultural Theories: Children as Products of Their Culture

Sociocultural theorists believe that many of the processes that produce development are the same in all societies. However, the content that children learn vary greatly from culture to culture. Children's memories of their own experiences also reflect their culture.

As illustrated by this photo of an East Asian father teaching his children to use an abacus, the tools available in a culture shape the learning of children within that culture.

Sociocultural Theories: How Does Cognitive Change Occur?

- Joint attention: Infants and social partners focus on common referent.
- Social referencing: Children look to social partners for guidance about how to respond to unfamiliar events.
- Social scaffolding: More competent people provide temporary frameworks that lead children to higher-order thinking.
  - Level of support matches need of learner
    - Children succeed where they would have failed without help
- Zone of proximal development: The range between what children can do unsupported and what they can do with optimal social support.
Sociocultural Theories: How Does Cognitive Change Occur?

Children’s Private Speech
Why do 5-year-olds talk aloud to themselves during activity?
Piaget (1923): egocentric speech: can’t imagine other’s perspective
Potentially the foundation for higher-order cognition.

As tasks get easier, talk is internalized
Research supports Vygotsky: use it when tasks are difficult.
Now called private speech.

Educational Implications

- Implies that one way to improve education is to change the culture of schools
  - The culture should be one in which instruction is aimed at deep understanding, in which learning is a cooperative activity, and in which learning a little makes children want to learn more
  - Ann Brown’s community-of-learner program is one impressive effort to meet these goals