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Twelfth Edition

Child Development

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Information Processing Chapter 7 Outline

The Information-Processing Approach

- The Information-Processing Approach to Development
- Cognitive Resources
  - Capacity and Speed of Processing Information
- Mechanisms of Change
- Concrete Operational Stage
- Comparisons with Piaget's Theory

Attention

- What is Attention?
- Infancy
- Childhood

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Information Processing Chapter 7 Outline (continued)

Memory

- What is Memory?
- Infancy
- Childhood

Thinking

- What is Thinking?
- Infancy
- Childhood

Metacognition

- What is Metacognition?
- The Child's Theory of Mind
- Metacognition in Childhood

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Chapter 7 Preview

What do children notice in the environment?
What do they remember?
How do they think about it?

These questions illustrate the Information-Processing Approach.

Using this approach, researchers usually do not describe children as being in one stage of cognitive development or another.

They do, however, describe and analyze how the speed of processing information, attention, memory, thinking, and metacognition change over time.

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The Information-Processing Approach

The Information-Processing Approach to Development

- focuses on how children process information about their world
- analyzes how children manipulate information, monitor it, and create strategies for handling it (Munkata, 2006; Siegler, 2006, 2007; Siegler & Alibali, 2005)
  - Effective information-processing involves attention, memory, and thinking.
  - The flow of information takes many routes, processes may overlap, and they do not always occur in the same direction.

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The Information-Processing Approach (cont.)

A Basic, Simplified Model of Information-Processing

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The Information-Processing Approach (cont.)

The Information-Processing Approach to Development (continued)

- A computer metaphor can illustrate how the information-processing approach can be applied to development:
  - A computer's information processing is *limited* by its hardware and software.
  - The hardware limitations include the amount of data the computer can process—its capacity—and speed.
  - The software limits the kind of data that can be used as input and the ways that data can be manipulated.

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The Information-Processing Approach (cont.)

Cognitive Resources

Capacity and Speed of Processing Information

- Developmental changes in information-processing are influenced by increases in capacity and speed of processing, or cognitive resources.
  - Increase in capacity improves processing of information.
  - Reaction-time tasks are used to assess processing speed.
  - Speed improves throughout childhood and adolescence.

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The Information-Processing Approach (cont.)

Mechanisms of Change

Robert Siegler (1998) described 3 mechanisms that work together to create changes in children's cognitive skills:

- **Encoding**
  - process by which information gets into memory
- **Automaticity**
  - ability to process information with little or no effort
- **Strategy construction**
  - creation of new procedures for processing information

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The Information-Processing Approach (cont.)

Mechanisms of Change (continued)

Children's information is characterized by *self-modification.*

- Children learn to use what they have learned in previous circumstances to adapt their responses to new situations.
- **Metacognition**
  - cognition about cognition, or "knowing about knowing"
- Siegler (2007)
  - Children play an active role in their cognitive development.

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The Information-Processing Approach (cont.)

Comparison with Piaget's Theory

information-processing psychologists:

- are constructivist and see children as directing their own cognitive development
- describe ways in which children do and do not understand important concepts at different points in life
- explain how more advanced understanding grows out of less advanced concepts
- emphasize the impact that existing understanding has on the ability to acquire new understanding

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The Information-Processing Approach (cont.)

Comparison with Piaget's Theory (continued)

Unlike Piaget, information-processing developmentalists:

- view development as a gradually increasing capacity for processing information, which allows children to acquire increasingly complex knowledge and skills, rather than knowledge occurring abruptly in distinct stages
- focus on more precise analysis of change and on the contributions of ongoing cognitive activity

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Attention

What Is Attention?

Attention

- focusing of mental resources
- improves cognitive processing for many tasks

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Attention (cont.)

What Is Attention? (continued)

Attention is allocated in different ways:

- **Sustained attention (vigilance)**
  - state of readiness to detect and respond to small changes occurring at random times in the environment
- **Selective attention**
  - focusing on a specific, relevant aspect of experience while ignoring experiences that are irrelevant
- **Divided attention**
  - concentrating on more than one activity at the same time

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Attention (cont.)

Infancy

- Newborns can detect a contour; older infants scan patterns more thoroughly.
- 4 month-old infants can selectively attend to an object and sustain their attention.
- Infants' attention is strongly governed by novelty and habituation.
  - **Habituation**
    - decreased responsiveness to a stimulus after repeated presentations
  - **Dishabituation**
    - recovery of a habituated response after a change in stimulation

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Attention (cont.)

Infancy (continued)

Joint Attention

- individuals focus on the same object or event
- Requires:
  - 1) an ability to track another's behavior, such as following the gaze of someone
  - 2) one person directing another's attention
  - 3) reciprocal interaction (Butterworth, 2004).
- Joint attention plays important roles in many aspects of infant development and considerably increases infants' ability to learn from other people (Flom & Pick, 2007; Mundy & Newell, 2007; Tomasello, Carpenter, & Liszkowski, 2007).

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Attention (cont.)

Gaze Following

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Attention (cont.)

Childhood

- Control over attention shows important changes during childhood (Posner & Rothbart, 2007).
- External stimuli are likely to determine the target of the preschooler's attention.
- Preschool children's ability to control and sustain their attention is related to school readiness (Posner & Rothbart, 2007).
- Attention problems in childhood are linked to information-processing difficulties in late adolescence (Friedman & others, 2007).

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Memory

What Is Memory?

Memory: retention of information over time

- Processes and Types of Memory
  - basic processes required for memory:
    - encoding
    - storage
    - retrieval
  - Short-term memory- has limited capacity for retaining information
  - Long-term memory- relatively permanent and unlimited type of memory

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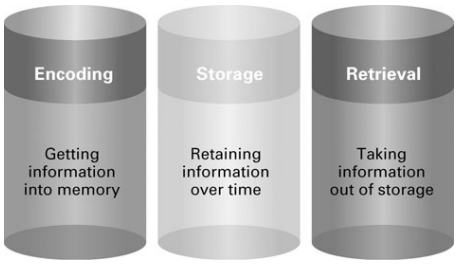
Memory (cont.)

Processing Information in Memory



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Memory (cont.)

Processes and Types of Memory (continued)

Working memory: mental "workbench" where information is manipulated and assembled

- Baddeley's model of working memory has 2 short-term stores:
  - 1 for speech
  - 1 for visual and spatial information
  - plus a central executive that monitors and controls the system

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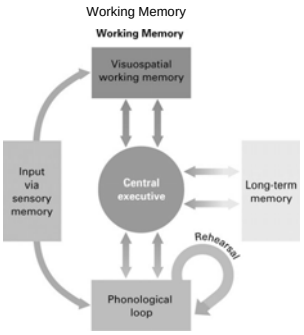
Memory (cont.)



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Memory (cont.)

Constructing Memories

Schema theory

- People mold memories to fit information that already exists in their minds.
- process is guided by **schemas:** mental frameworks that organize concepts and information

Fuzzy trace theory

- When individuals encode information they create a *verbatim memory trace* (precise detail) and a *fuzzy trace* or *gist* (the central idea).

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Memory (cont.)

Content Knowledge and Expertise

– Experts are better than novices at:

- detecting features and meaningful patterns of information
- accumulating more content knowledge and organizing it effectively
- retrieving important aspects of knowledge with little effort

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Memory (cont.)

Content Knowledge and Expertise (continued)

– Experts are also better than novices at:

- using **chunking:** grouping bits of information into a higher-order unit that is remembered as a whole
- having more elaborate networks of information
- Novices have to allocate considerable time to the task at hand, which restricts their time for comprehension.

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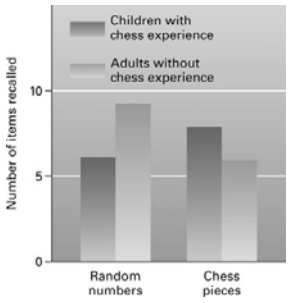
Memory (cont.)

Memory for Numbers and Chess Pieces



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Memory (cont.)

Diversity in Children's Development

Culture and Children's Memory

- A culture sensitizes its members to certain objects, events, and strategies, which in turn can influence the nature of memory (Cole, 2006; Fivush, 2007; Greenfield, Suzuki, & Rothstein-Fisch, 2006).
- In schema theory, a child's background, which is encoded in schemas, is revealed in the way the child reconstructs a story.
- This effect of cultural background on memory is called the *cultural specificity hypothesis.*

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Memory (cont.)

Diversity in Children's Development (continued)

Culture and Children's Memory (continued)

- **Cultural specificity hypothesis**
  - cultural experiences determine what is relevant in a person's life and, thus, what the person is likely to remember
  - Cultures may vary in the strategies that children use to remember information, usually due to schooling (Cole, 2006).

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Memory (cont.)

Infancy

First Memories

- Rovee-Collier (1987)
  - Infants of 2- 6 months remember perceptual-motor information through ages 1-1/2 to 2.
- Mandler (2000)
  - Infants in Rovee-Collier's experiments display only implicit memory.
    - i.e.- memories of skills and routine procedures that are performed automatically without conscious recollection

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Memory (cont.)

Infancy (continued)

First Memories (continued)

- **Implicit memory**
  - memory without conscious recollection
  - memories of skills and routine procedures that are performed automatically, such as riding a bicycle
- **Explicit memory**
  - conscious memory of facts and experiences
  - does not occur until the 2nd half of the 1st year

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Memory (cont.)

The Technique Used in Rovee-Collier's Investigation of Infant Memory

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Memory (cont.)

Infancy (continued)

Infantile Amnesia

- Most adults can remember little, if anything, from the 1st 3 years of their life.
- This is called *infantile* or *childhood amnesia.*
- Elementary school children also do not remember much of their early child years (Lie & Newcombe, 1999).
- By the end of the 2nd year, long-term memory is more substantial and reliable (Bauer, 2006, 2007, 2008).

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Memory (cont.)

Childhood

- Children's memory improves considerably after infancy.
- Children can remember a great deal of information if they are given appropriate cues and prompts.
- One reason children remember less than adults is that they are far less expert in most areas.
- Other sources of improvement in children's memory include changes in memory span and their use of strategies.

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Memory (cont.)

Memory Span

- Short-term memory has a very limited capacity.
- Tasks suggest that short-term memory increases during childhood.
- Speed of processing increases.
- Rehearsal of information improves.

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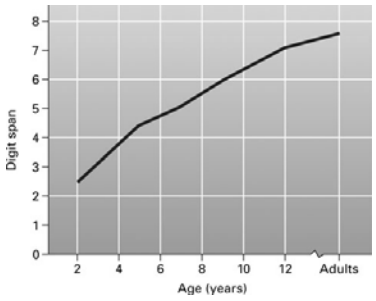
Memory (cont.)

Developmental Changes in Memory Span



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Memory (cont.)

Strategies

- use of mental activities to improve the processing of information
- Strategies that can improve long-term memory include:
  - **Organization**
    - more likely to be used by older children and adults
  - **Elaboration**
    - adolescents are more likely to use than children
  - **Imagery**
    - works better for older than younger children

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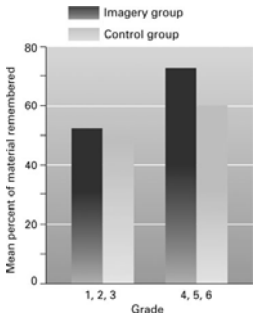
Memory (cont.)

Imagery and Memory of Verbal Information



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Memory (cont.)

Reconstructive Memory and Children as Eyewitnesses

- Children have schemas for all information.
  - Schemas affect how children encode, store, and retrieve memories.
- factors that can influence the accuracy of a young child's memory (Bruck & Ceci, 1999):
  - There are age differences in children's susceptibility to suggestion.
  - There are individual differences in susceptibility.
  - Interviewing techniques can produce substantial distortions in children's reports about highly salient events.

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Memory (cont.)

Research in Child Development

Age Differences in Suggestibility

- Whether a young child's eyewitness testimony is accurate or not may depend on:
  - type, number, and intensity of the suggestive techniques the child has experienced (Bruck, Ceci, & Principe, 2006; Pipe, 2007)
- It appears that the reliability of young children's reports has as much or more to do with the skills and motivation of the interviewer as with any natural limitations on young children's memory.

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Memory (cont.)

Research in Child Development (continued)

Age Differences in Suggestibility (continued)

- research indicates that changes need to be implemented (Bruck, Ceci, & Principe, 2006):
  1) Interviewers should be required to electronically preserve their interviews with children.
  2) A research-validated interview schedule with children needs to be developed.
  3) Programs need to be created to teach interviewers how to use interviewing protocols.

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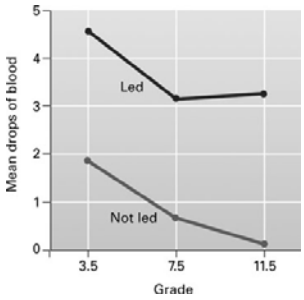
Memory (cont.)

Suggestibility of Children at Different Grade Levels



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Thinking

What is Thinking?

Thinking: manipulating and transforming information in memory

- In Baddeley's model of working memory, thinking is the job of the central executive (see figure # 7.4).

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Thinking (cont.)

Infancy

Concepts

- categories that group objects, events, and characteristics on the basis of common properties

– **Infants form concepts early in their development**
  - as young as 3 months

– **Jean Mandler (2004)**
  - argues that early categorizations are best described as *perceptual categorizations*,
    – based on similar perceptual features of objects, such as:
      - size
      - color
      - movement
    – also based on parts of objects, such as:
      - legs for animals

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Thinking (cont.)

Infancy (continued)

Jean Mandler (2004) (continued)

- concludes that at about 7-9 months of age, infants form *conceptual categories*
- Further advances in categorization occur in the 2nd year of life (Booth, 2006).
- The infant's advances in processing information—through attention, memory, imitation, and concept formation—is much richer, more gradual and less stage-like, and occurs earlier than was envisioned by earlier theorists, such as Piaget.

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Thinking (cont.)

Childhood

3 types of thinking receive considerable interest among psychologists and educators in critical thinking (Halpern, 2007; Sternberg, Roediger, & Halpern, 2007):

- critical thinking
- scientific thinking
- problem-solving

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Thinking (cont.)

Childhood (continued)

Critical thinking

- If you think critically, you:
  - ask not only what happened, but how and why
  - examine supposed "facts" to determine whether there is evidence to support them
  - argue in a reasoned way rather than through emotions
  - recognize that there is sometimes more than one good answer or explanation

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Thinking (cont.)

Childhood (continued)

Critical thinking (continued)

- If you think critically, you also:
  - compare various answers and judge which is the best
  - evaluate what other people say rather than immediately accept it as the truth
  - ask questions and speculate beyond what is known to create new ideas and new information

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Thinking (cont.)

Childhood (continued)

Critical thinking (continued)

- involves thinking reflectively, productively, and evaluating evidence
- Jacqueline and Martin Brooks (1993, 2001)
  - few schools teach students to think critically; instead they push for a single correct answer and have students recite, define, describe, state, and list
- One way to encourage students to think critically is to present them with controversial topics or both sides of an issue to discuss.

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Thinking (cont.)

Childhood (continued)

Critical thinking (continued)

- Brown and Campione's "Fostering a Community of Learners" (FCL) program
  - encourages reflection and discussion including:
    - online consultation
    - **reciprocal teaching:** students take turns leading small-group discussions
    - using adults as role models
- "Fostering a Community of Learners" represents an attempt to apply what is known about children's cognitive development to improving their education (Lehrer & Schauble, 2006).

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Thinking (cont.)

Childhood (continued)

Scientific Thinking

- aimed at identifying causal relations
  - Children's understanding of *how* events are caused carries more weight in their causal inferences than *whether the cause happened immediately before the event*.
  - Unlike scientists, children are more influenced by happenstance than overall patterns, and they maintain old theories regardless of the evidence.
  - Children also have difficulty designing experiments that distinguish among alternative causes.

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Thinking (cont.)

Childhood (continued)

Scientific Thinking (continued)

- often the skills scientists use are not routinely taught in schools
- Effective science teaching helps children distinguish between fruitful errors and misconceptions, and to detect plainly wrong ideas that need to be replaced by more accurate conceptions (Bybee, Powell, & Trowbridge, 2007).
- Students need to learn inquiry skills *and* science content (Gallagher, 2007).

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Thinking (cont.)

Childhood (continued)

Solving Problems

- **Problem-solving:** involves:
  - finding an appropriate way to attain a goal
  - using rules to solve problems
  - using analogies to solve problems
    - **Analogies:** involve correspondence in some respects between things that are dissimilar
  - using strategies to solve problems
    - Teachers should model strategies, verbalize the steps, and guide the children to practice the strategy.

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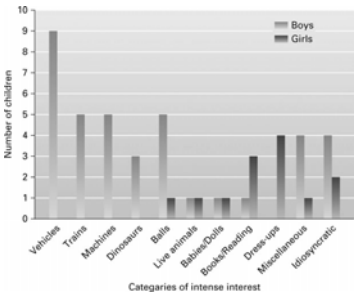
Thinking (cont.)

The Type of Balance Scale Used by Siegler (1976)



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Thinking (cont.)

Childhood (continued)

Caring for Children

- Helping Children Learn Strategies
  - strategies for long-term memory and have them practice extensively
  - encourage children to monitor effectiveness of new strategy by comparing their performance on tests and other assessments
  - motivate children to learn and to use the strategies

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Thinking (cont.)

Childhood (continued)

Caring for Children (continued)

- Helping Children Learn Strategies (continued)
  - Pressley and his colleagues (Pressley & Harris, 2006; Pressley & Hilden, 2006; Pressley & others, 2001, 2003, 2004; 2007a,b):
    - teachers' use of strategy instruction is far less complete and intense than what is needed for students to learn how to use strategies effectively
    - education needs to be restructured so that students are provided with more opportunities to become competent strategic learners

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Metacognition

What Is Metacognition?

Metacognition

- cognition about cognition, or "knowing about knowing"
- helps children perform many cognitive tasks more effectively (Doherty, 2007; Flavell, 2004)
- includes knowledge about when and where to use particular strategies for learning or for solving problems

Metamemory

- individuals' knowledge about memory
- includes general knowledge about memory and knowledge about one's own memory

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Metacognition (cont.)

The Child's Theory of Mind

Theory of mind

- awareness of one's own mental processes and the mental processes of others

Developmental Changes

- 18 months- 3 years of age
  - Children begin to understand three mental states:
    - perceptions
    - emotions
    - desires

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Metacognition (cont.)

The Child's Theory of Mind (continued)

Developmental Changes (continued)

- 18 months - 3 years of age (continued)
  - Perceptions
    - By 2 years of age
      - children recognize that another person will see what's in front of her own eyes instead of what's in front of the child's eyes (Lempers, Flavell, & Flavell, 1977)
    - By 3 years of age
      - they realize that looking leads to knowing what's inside a container (Pratt & Bryant, 1990)

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Metacognition (cont.)

The Child's Theory of Mind (continued)

Developmental Changes (continued)

- 18 months - 3 years of age (continued)
  - Emotions
    - can distinguish between positive (happy) and negative (sad) emotions
  - Desires
    - 2-3 year-olds understand the way desires are related to actions and to simple emotions
    - Children also refer to desires earlier and more frequently than they refer to cognitive states such as thinking and knowing (Bartsch & Wellman, 1995).

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Metacognition (cont.)

The Child's Theory of Mind (continued)

Developmental Changes (continued)

- 3 - 5 years of age
  - understand that the mind can represent objects and events accurately or inaccurately
  - realize that people can have *false beliefs (*beliefs that are not true)
    - develops in a majority of children by the time they are 5 years old (Wellman, Cross, & Watson, 2001)

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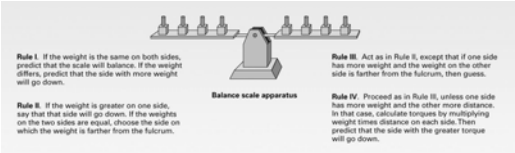
Metacognition (cont.)

Developmental Changes in False-Belief Performance



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Metacognition (cont.)

The Child's Theory of Mind (continued)

Developmental Changes (continued)

– 5 - 7 years of age

- deepening appreciation of the mind itself rather than just an understanding of mental states
- 5-6 year-olds understand that human sources may have different experiences, but they still think there is an objective truth (Kuhn & others, 2000).
- By 7, children are able to recognize that reality is not directly knowable, that knowledge is subjective, and that people may have different interpretations of the same event due to differing interpretive processes (Mills, 2007).

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Metacognition (cont.)

The Child's Theory of Mind (continued)

Developmental Changes (continued)

– 7 years and beyond

- begin to understand that people can have ambivalent feelings (Flavell & Miller, 1998; Whitesell & Harter, 1989)
- start to recognize that the same person can feel both happy and sad about the same event
- engage in more **recursive thinking**: thinking about what other people are thinking about

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Metacognition (cont.)

The Child's Theory of Mind (continued)

Developmental Changes (continued)

- Individual Differences
  - There are individual differences in when children reach certain milestones in their theory of mind.
  - **Executive function:** describes several functions (such as inhibition and planning) that are important for flexible, future-oriented behavior
    - may be connected to theory of mind development

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Metacognition (cont.)

The Child's Theory of Mind (continued)

Developmental Changes (continued)

- Theory of Mind and Autism
  - Another individual difference in understanding the mind involves autism.
  - Approximately 2 to 6 out 1,000 children are estimated to have some sort of autism spectrum disorder (National Institute of Mental Health, 2007).
  - Autism can usually be diagnosed by the age of 3 years, sometimes earlier.

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Metacognition (cont.)

The Child's Theory of Mind (continued)

Developmental Changes (continued)

- Theory of Mind and Autism (continued)
  - Children with autism show a number of behaviors different from children their age
    - deficits in social interaction
    - deficits in communication
    - repetitive behaviors or interests
    - often show indifference toward other others
      - prefer to be alone
      - show more interest in objects than people
  - It now is accepted that autism is linked to genetic and brain abnormalities (Lacoboni & Dapretto, 2006).

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Metacognition (cont.)

The Child's Theory of Mind (continued)

Developmental Changes (continued)

- Theory of Mind and Autism (continued)
  - Children and adults with autism have difficulty in social interactions.
  - Autistic children have difficulty in understanding others' beliefs and emotions (Harris, 2006).
  - It may be that in autism a number of different but related deficits lead to the social cognitive deficits (Rajendran & Mitchell, 2007).

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Metacognition (cont.)

The Child's Theory of Mind (continued)

Developmental Changes (continued)

- **Metacognition in Childhood**
  - By 5 or 6 years of age
    - know that familiar items are easier to learn than unfamiliar ones
    - metamemory is limited
    - inflated opinion of their memory abilities
    - little appreciation for the importance of cues to memory

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Metacognition (cont.)

The Child's Theory of Mind (continued)

Developmental Changes (continued)

- Metacognition in Childhood (continued)
  - By 5 or 6 years of age (continued)
    - Children's understanding of their memory abilities and their skill in evaluating their performance on memory tasks is relatively poor at the beginning of the elementary school years but improves considerably by 11-12 years of age (Bjorklund & Rosenbaum, 2000).

E-LEARNING TOOLS

To help you master the material in this chapter, visit the Online Learning Center for Child Development, twelfth edition at:

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