Intro. to Cognitive Science

Cognitive Development

Cognitive Development

Cognition – Mental processes by which knowledge is acquired, elaborated, stored, retrieved, and used to solve problems.

Cognitive Development – Refers to the changes that occur in children's mental skills and abilities over time.

Piaget's Theory of Cognitive Development

Piaget's Theory of Cognitive Development

Scheme – (Schema for singular, Schemata for plural)

An organized pattern of thought or action that one constructs to interpret some aspect of one's experience.

Represent the way that people organize and understand the things around them.

Piaget's Theory of Cognitive Development

Symbolic schemes – internal mental symbols that one uses to represent aspects of experience.

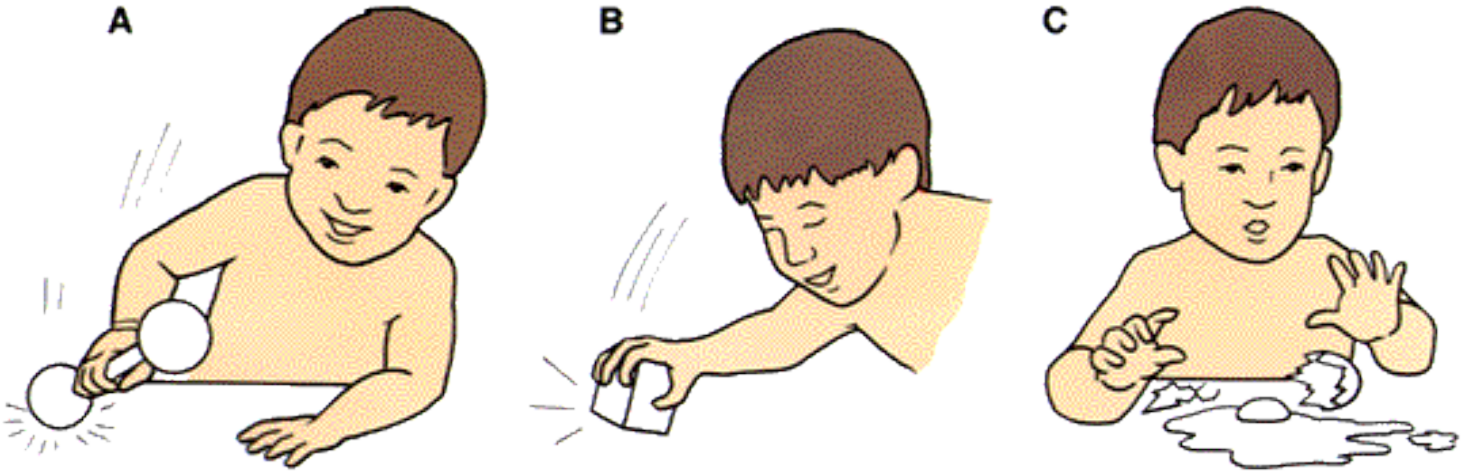
Cognitive operation – an internal mental activity that one performs on objects or thoughts.

Piaget's Theory of Cognitive Development

Assimilation – The process of interpreting new experiences by incorporating them into existing schemes.

Accommodation – The process of modifying existing schemes in order to incorporate or adapt to new experiences.

Piaget's Theory of Cognitive Development

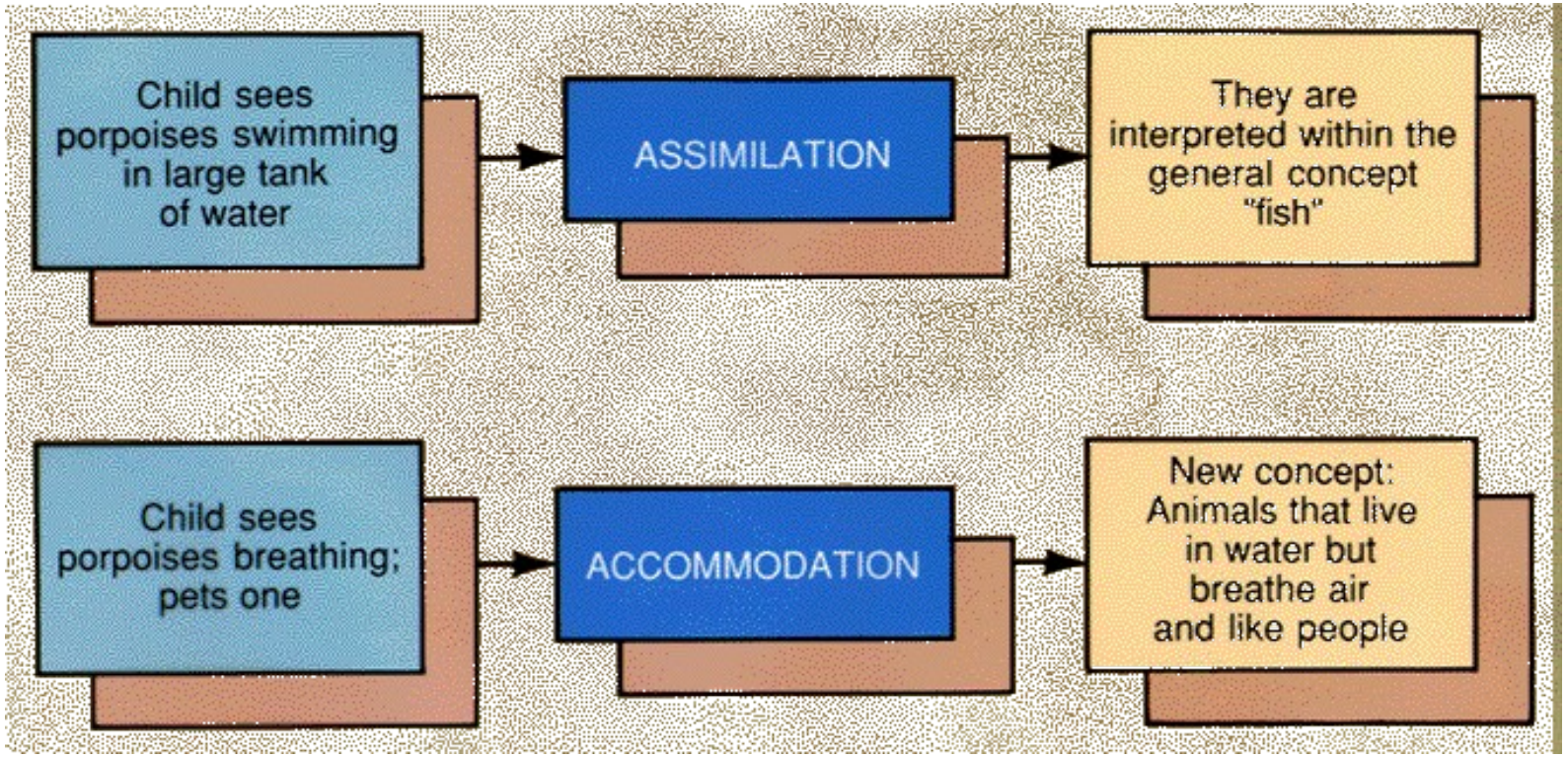


Banging is a favorite **scheme** used by babies to explore their world . . .

. . . And **assimilation** occurs when they incorporate new objects into the scheme.

Accomodation occurs when the new object doesn't fit the existing scheme.

Piaget's Theory of Cognitive Development



PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- Invariant developmental sequence
  - Sequencing is fixed
  - There are individual differences
    - When entering/emerging stages

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- The Sensorimotor Stage (Birth to 2 years)
  - Use senses and motor behaviors to construct knowledge
  - Coordinate sensory inputs and motor skills
  - Transition from being reflexive to reflective

What is accomplished during sensorimotor stage?

- Development of:
  - Problem-Solving Abilities
  - Imitation
  - Object concept

Piaget's Theory of Cognitive Development

Piaget's Stages of Cognitive Development

Stage 1: Sensorimotor Stage (Birth-2yrs)

Stage 2: Preoperational Stage (2-7yrs)

Stage 3: Concrete Operations (7-11yrs)

Stage 4: Formal Operations (11-on)

Invariant developmental sequence!

Piaget's Theory of Cognitive Development

6 substages to Sensorimotor Stage:

Stage 1 (0-1mo) – Reflexes

Stage 2 (1-4mos) – Primary Circular Reactions

Stage 3 (4-8mos) – Secondary Circular Reactions

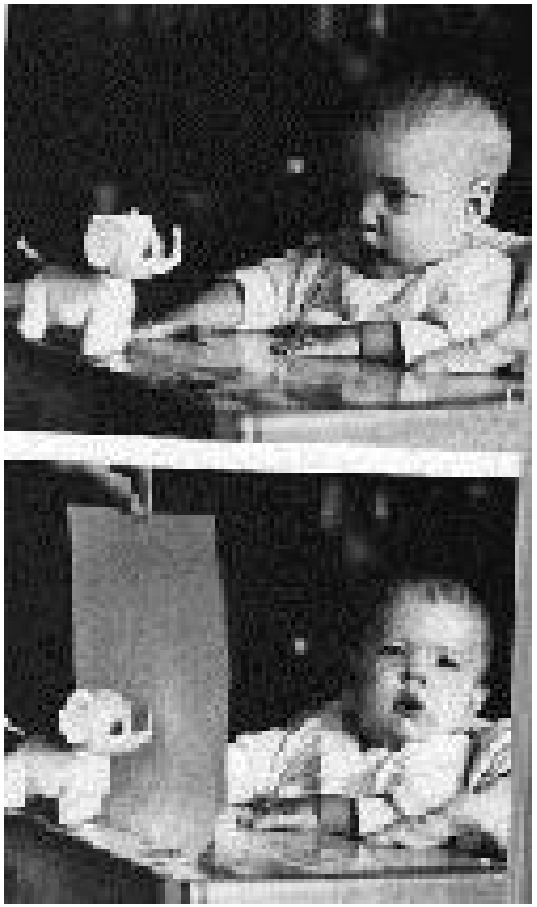
Stage 4 (8-12mos) – Purposeful coordination of secondary schemes

Stage 5 (12-18mos) – Tertiary Circular Reactions

Stage 6 (18-24mos) – Mental Solutions

Piaget's Theory of Cognitive Development

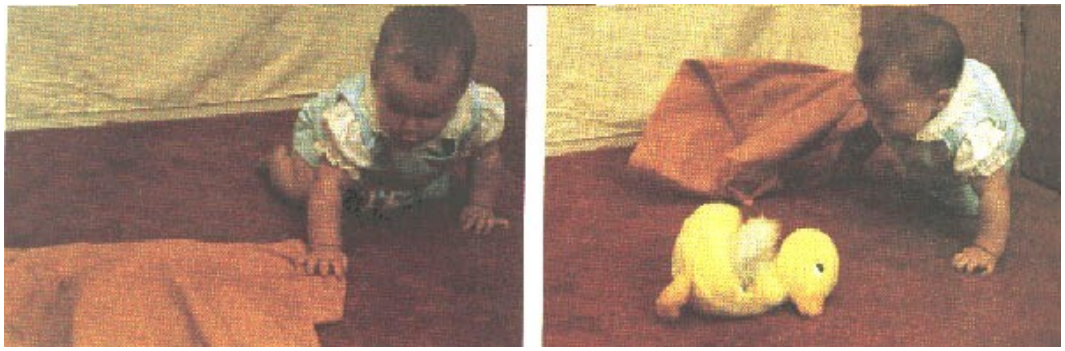
- Object Permanence: knowledge that an object continues to exist independent of our seeing, hearing, touching, tasting or smelling it!
- Stage 1 – Tracks, then ignores



Piaget's Theory of Cognitive Development

Object Permanence – knowledge that an object continues to exist independent of our seeing, hearing, touching, tasting or smelling it!

Stage 4 – Search for objects that disappear in last place found



Piaget's Theory of Cognitive Development

Object Permanence – knowledge that an object continues to exist independent of our seeing, hearing, touching, tasting or smelling it!

Stage 1 – Tracks, then ignores
Stage 2 – Looks where it disappeared
Stage 3 – Search for partially hidden
Stage 4 – Search for objects that disappear in last place found
Stage 5 – Follows series of visible displacements
Stage 6 – Fully developed

TABLE 6.2 Summary of Piaget's Account of Sensorimotor Development

Substage	Methods of Solving Problems or Producing Interesting Outcomes	Imitation	Object Concept
1. Reflex activity (0–1 month)	Exercising and accommodation of inborn reflexes.	Some reflexive imitation of motor responses.[1]	Tracks moving object but ignores its disappearance.
2. Primary circular reactions (1–4 months)	Repeating interesting acts that are centered on one's own body.	Repetition of own behavior that is mimicked by a companion.	Looks intently at the spot where an object disappeared.[2]
3. Secondary circular reactions (4–8 months)	Repeating interesting acts that are directed toward external objects.	Same as in Substage 2.	Searches for partly concealed object.
4. Coordination of secondary schemes (8–12 months)	Combining actions to solve simple problems (first evidence of intentionality).	Gradual imitation of novel responses; deferred imitation of very simple motor acts after a brief delay.	Clear signs of emerging object concept; searches for and finds concealed object that has not been visibly displaced.
5. Tertiary circular reactions (12–18 months)	Experimenting to find new ways to solve problems or reproduce interesting outcomes.	Systematic imitation of novel responses; deferred imitation of simple motor acts after a long delay.	Searches for and finds object that has been visibly displaced.
6. Invention of new means through mental combinations (18–24 months)	First evidence of insight as the child solves problems at an internal, symbolic level.	Deferred imitation of complex behavioral sequences.	Object concept is complete; searches for and finds objects that have been hidden through invisible displacements.

[1]Imitation of simple motor acts (such as tongue protrusions, head movements, and the opening and closing of one's lips or hands) is apparently an inborn, reflexlike ability that bears little relation to the voluntary imitation that appears later in the 1st year.

[2]Many researchers now believe that object permanence may be present very early and that Piaget's reliance on search procedures badly underestimated what young infants know about objects (see the discussion beginning on page 211).

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- Development of Problem-Solving Abilities
  - Sensory Motor Stage
    - Reflex activity (birth – 1 month)
    - Primary circular reactions (1–4 months)
      - first motor habits, repetitive
      - Focus on the body

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- Sensory Motor Stage (cont.)
  - Secondary circular reactions (4–8 months)
    - Repetitive actions with objects beyond the body
    - Can focus on the outside world

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- Sensory Motor Stage (cont.)
  - Coordination of secondary reactions

    (8–12 months)
    - Coordinate 2 or more actions to achieve a goal (intentional)

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- Sensory Motor Stage (cont.)
  - Tertiary circular reactions -12–18 months
    - Active experimentation, trial and error
  - Symbolic problem solving -18–24 months
    - Can engage in mental experimentation
    - trial and error is not always necessary

http://www.youtube.com/watch?v=T9mRBNM5Lwg

- http://www.youtube.com/watch?v=y4MCqFkbQXI

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- Development of Imitation
  - Novel responses by 8–12 months of age
  - Deferred imitation – 18–24 months
  - Research now shows 6-month-olds are capable of deferred imitation

http://www.youtube.com/watch?v=l0N6mlpoN3M

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- Development of Object Permanence
  - Objects continue to exist when they are no longer visible/detectable
  - Appears by 8–12 months of age
    - A-not-B error: search in the last place found, not where it was last seen
  - Complete by 18–24 months

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- Challenges to Piaget's Account
  - Neo-nativism
    - Infants are born with substantial innate knowledge
    - Require less time/experience to be demonstrated
    - Young children seem to possess some object permanence, memory
      - http://www.youtube.com/watch?v=RnOrttfv3nM
      - http://www.youtube.com/watch?v=ETFjzvtvOnk

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- Challenges to Piaget's Approach
  - Theory theories
    - Combination of neo-nativist and Piagetian perspective
      - Infants are prepared at birth to make sense of some information.
      - Beyond this, Piaget's constructivist approach is generally accurate.
      - http://www.youtube.com/watch?v=8hLubgpY2_w

Piaget's Preoperational Stage

Moon is following me!

How do they think and behave during preoperational stage

- Age range
  - 2 to 6-7 years of age, typically (varies)
- **Symbolic thought**
  - Mental representation of objects/events.
  - Elaboration of **the representational ability**
    - Ex: language (words symbolize objects, events, and feelings).
  - Dual representation – think about an object in two ways at one time (3 years)

Preoperational Stage (cont.)

- Pretend play
  - 12-13 months – familiar activities; i.e. feed themselves
  - 15-20 months – focus on others; i.e. feed doll
  - 30 months – others take active role; i.e. doll feeds itself
- Imaginary Friends
  - More common among first-born and only child

How Do We Characterize the Logic of the Preoperational Child?

- Lack of logical operations
  - No flexible or reversible mental operations
- Egocentrism
  - Only view the world through their own perspective
  - Three-mountain test

Figure 9.1 The Three-Mountains Test

How Do We Characterize the Logic of the Preoperational Child?

- Egocentrism (cont.)
- Ex: (phone conversation between dad, who is at work, and 4-year-old Mary, who is at home)

  Father: Mina, is Mommy there?

  Mina: (Silently nods)

  Father: Mina, may I speak to Mommy?

  Mina: (Nods again silently)

How Do We Characterize the Logic of the Preoperational Child?

- Causality
  - Influenced by egocentrism
    - Caused by will
  - Precausal thinking
    - Transductive reasoning
      - Mom picks up the lunch bag and goes to work, lunch bag causes mom to leave
    - Animism
      - A loud truck is upset
    - Artificialism
      - “Mountains ‘grow’ because stones have been manufactured and then planted; lakes have been hollowed out, cities are built before the lakes adjacent to them”

How Do We Characterize the Logic of the Preoperational Child?

- Confusion between mental and physical phenomena
  - Believe their thoughts reflect external reality
  - Believe dreams are true

Examples of Preoperational logic

How Do We Characterize the Logic of the Preoperational Child?

- Lack of ability to logically conserve
  - Conservation
    - properties such as weight and mass remain the same (are conserved) when superficial characteristics such as their shape or arrangement are changed
- They fail to conserve due to
  - Centration
    - focusing on one dimension of a situation while ignoring others
  - Irreversibility
    - lack of recognition that actions can be reversed

Figure 9.2 Conservation

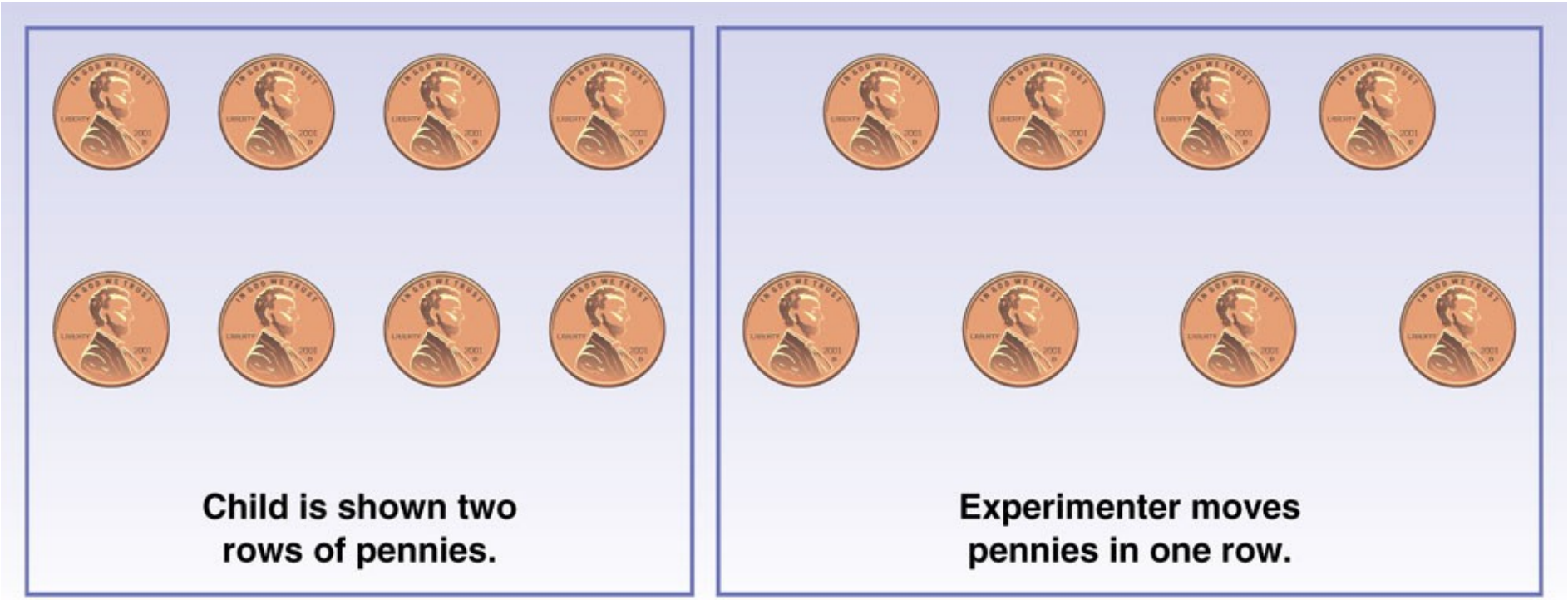


Figure 9.3 Conservation of Number

How Do We Characterize the Logic of the Preoperational Child?

- They are unable to demonstrate understanding of class inclusion
  - class inclusion
    - Including new objects/categories in broader mental classes
      - Requires child focus on more than one aspect of situation at once

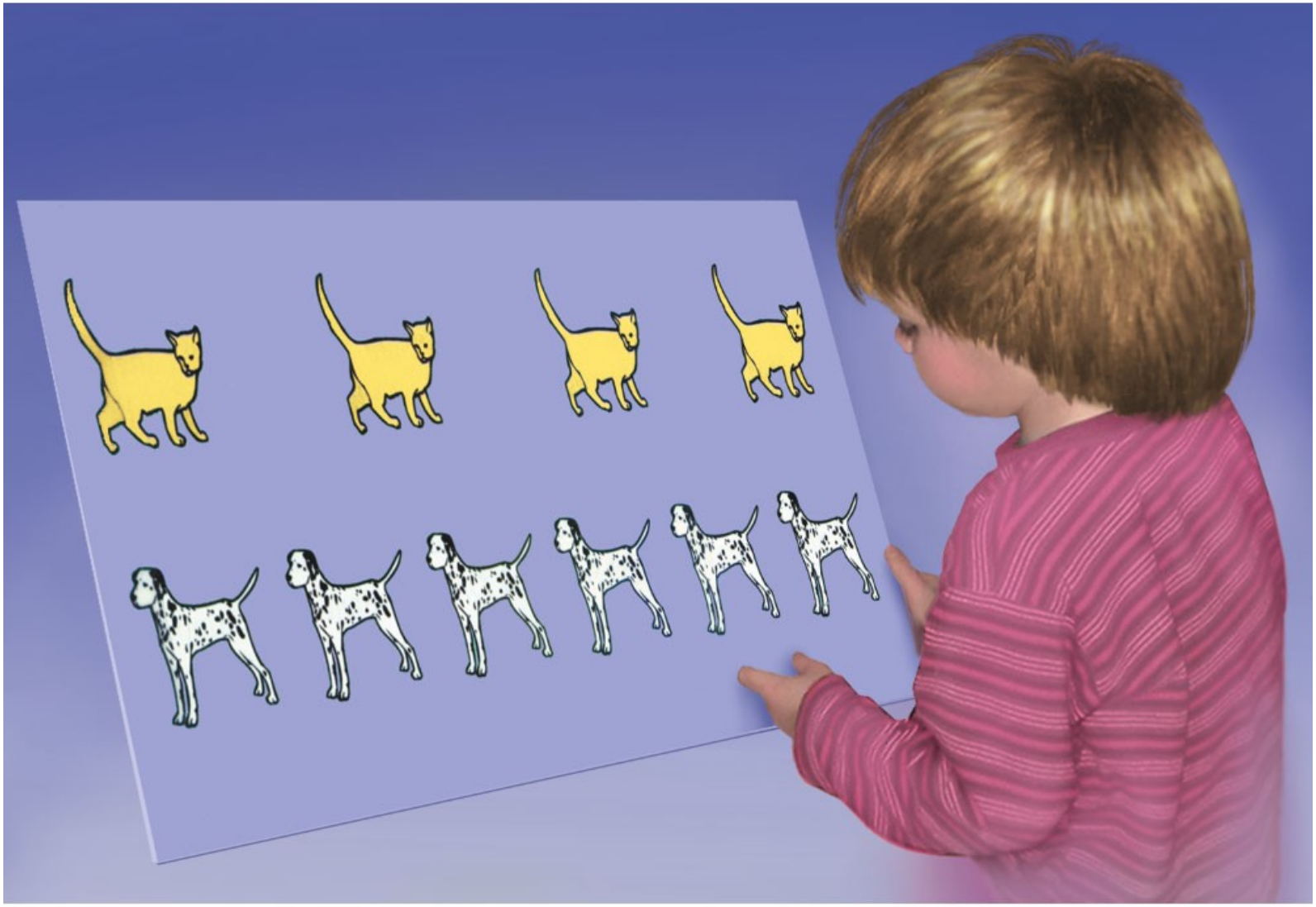


Figure 9.4 Class Inclusion

Evaluation of Piaget

- Piaget's theory underestimates child abilities,
  - Three-mountain test
    - Errors attributed to demands on child and language development
  - Causality
    - Logical understanding appears more sophisticated
  - Conservation
    - Approach may mislead child

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

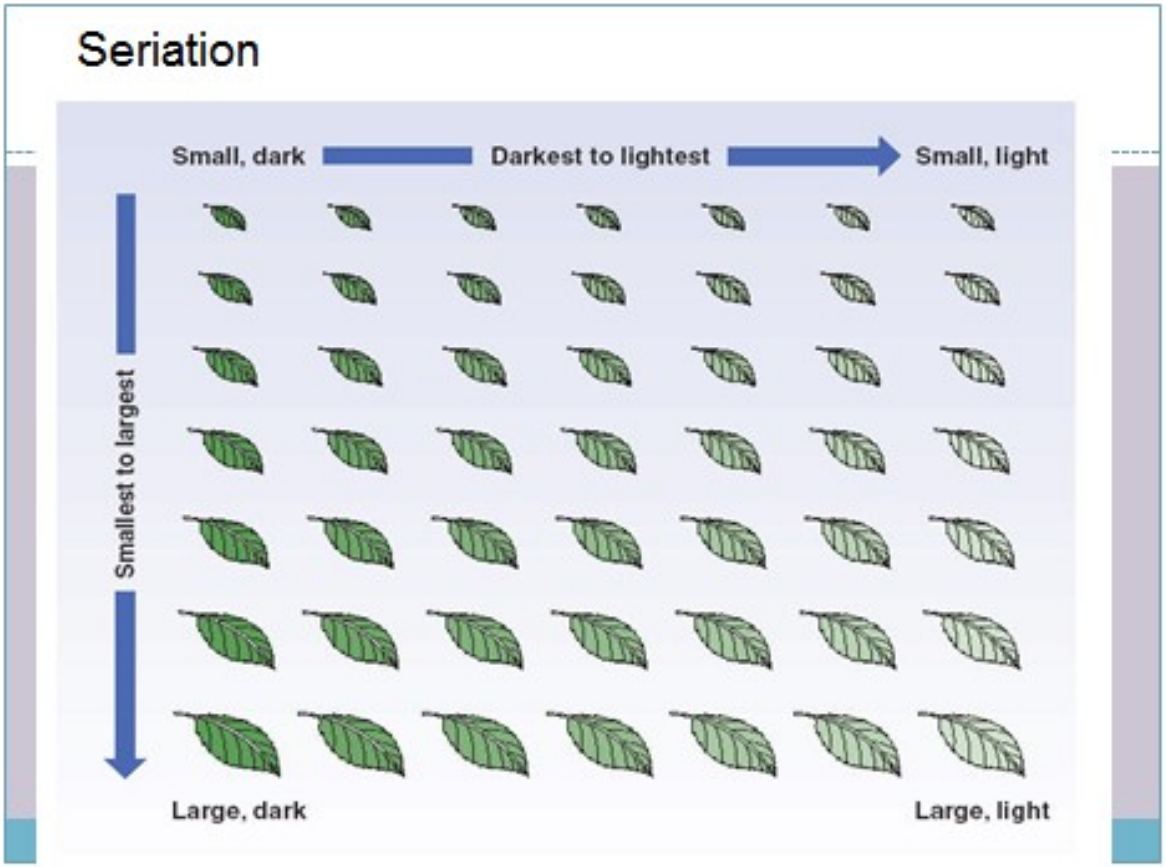
- The Concrete Operational Stage (7–11 years)
  - Cognitive operations
    - Internal mental activity to modify symbols to reach a logical conclusion
      - Conservation – capable of
        - Decentering
        - Reversibility

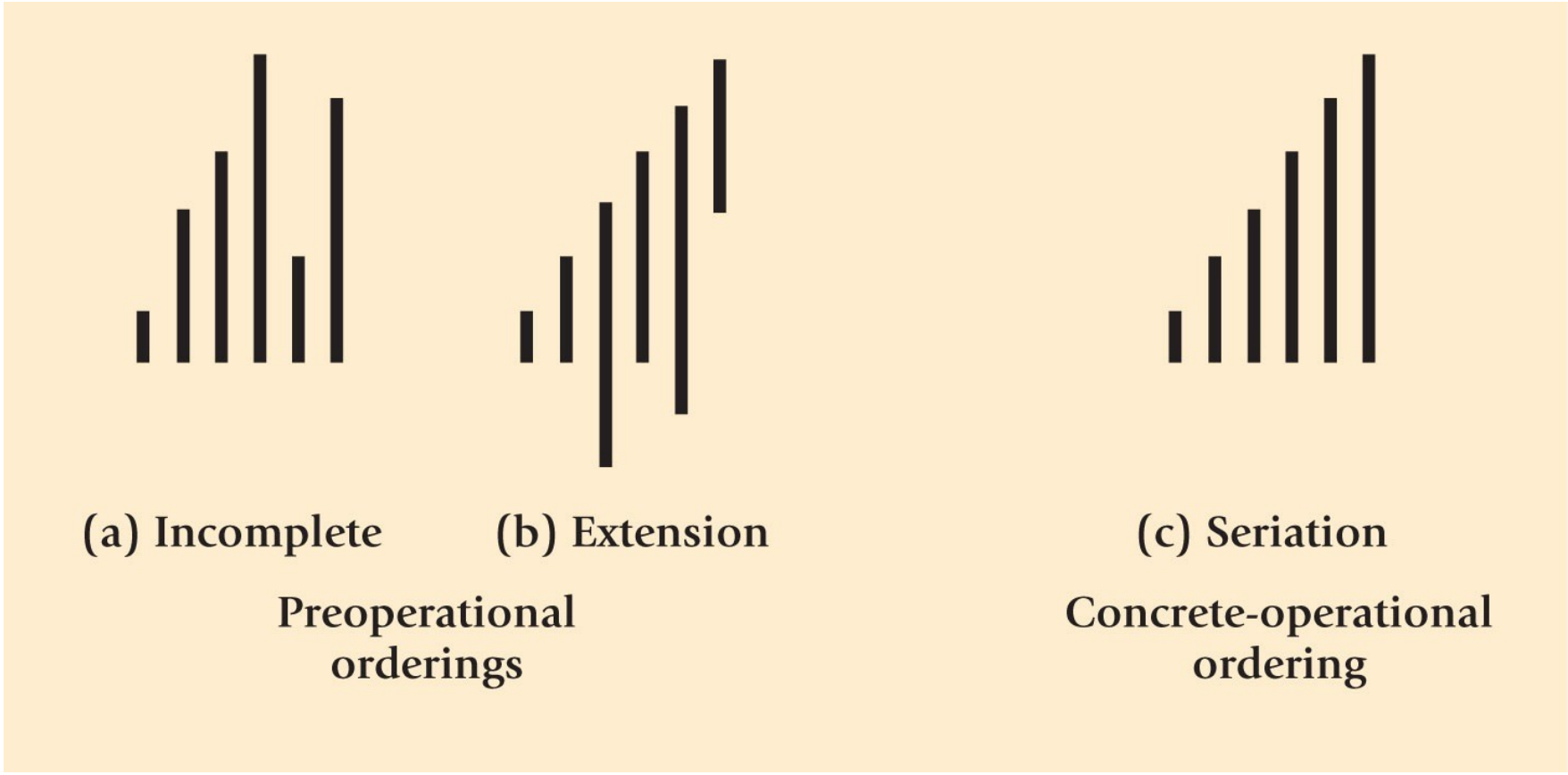
TABLE 6.3 A Comparison of Preoperational and Concrete-Operational Thought

Concept	Preoperational Thought	Concrete-Operational Thought
Egocentrism	Children typically assume that others share their point of view.	Children may respond egocentrically at times but are now much more aware of others' divergent perspectives.
Animism	Children are likely to assume that unfamiliar objects that move on their own have lifelike qualities.	Children are more aware of the biological bases for life and do not attribute lifelike qualities to inanimates.
Causality	Limited awareness of causality. Children occasionally display transductive reasoning, assuming that one of two correlated events must have caused the other.	Children have a much better appreciation of causal principles (although this knowledge of causality continues to develop into adolescence and beyond).
Perception-bound thought/centration	Children make judgments based on perceptual appearances and focus on a single aspect of a situation when seeking answers to a problem.	Children can ignore misleading appearances and focus on more than one aspect of a situation when seeking answers to a problem (decentration).
Irreversibility/reversibility	Children cannot mentally undo an action they have witnessed. They cannot think back to the way an object or situation was before the object or situation changed.	Children can mentally negate changes they have witnessed to make before/after comparisons and consider how changes have altered the situation.
Performance on Piagetian tests of logical reasoning	Their egocentrism and their perception-bound, centered reasoning means that children often fail conservation tasks, have difficulty grouping objects into hierarchies of classes and subclasses, and display little ability to order objects mentally along such quantitative dimensions as height or length.	Their declining egocentrism and acquisition of reversible cognitive operations permit concrete-cooperational children to conserve, correctly classify objects on several dimensions, and mentally order objects on quantitative dimensions. Conclusions are now based on logic (the way things must necessarily be) rather than on the way they appear to be.

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- Relational logic – capable of
  - Mental seriation
  - Transitivity
- Horizontal décalage – different levels of understanding that seem to require same mental operations
  - Based on complexity
- Limited to real or tangible aspects of experience


Seriation
Small, dark
Darkest to lightest
Small, light
Smallest to largest
Large, dark
Large, light



- Figure 6.5 Children's performance on a simple seriation task. If asked to arrange a series of sticks from shortest to longest, preoperational children often line up one end of the sticks and create an incomplete ordering (a) or order them so the top of each successive stick extends higher than the preceding stick (b). Concrete operators, by contrast, can use the inverse cognitive operations greater than (>) and less than (<) to quickly make successive comparisons and create a correct serial ordering (c).

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- The Formal Operational Stage (11–12 +)
  - Hypothetico-deductive reasoning
    - Ability to generate hypotheses and use deductive reasoning (general to specific)
      - Allows for hypothetical thinking
    - Inductive reasoning
      - Going from specific observations to generalizations
    - Thought is rational, systematic, and abstract

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- Personal and Social Implications of Formal Thought
  - Thinking about what is possible in life
  - Forming a stable identity
  - Understanding of other's perspectives
  - Can weigh alternatives
  - Questioning others
  - Thinking of how the world "ought to be"

PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

- Does Everyone Reach Formal Operations?
  - Early Piaget – Yes, at least some signs by 15–18
  - Other researchers – No; lack of education
  - Later Piaget – Yes, but only on problems that are either interesting or important
  - Today:
    - Performance is likely to be inconsistent across domains
    - Requires interest in and experience with subject matter

AN EVALUATION OF PIAGET'S THEORY

- Piaget's Contributions
  - Founded cognitive development
  - Stated children construct their knowledge
  - First attempt to explain development
  - Reasonably accurate overview of how children of different ages think
  - Major influence in social and emotional development, and education
  - Influenced future research

AN EVALUATION OF PIAGET'S THEORY

- Challenges to Piaget
  - Piaget failed to distinguish competence from performance
  - Does cognitive development really occur in stages?
    - Little evidence of broad stages
  - Does Piaget "explain" cognitive development? – more of an description
  - Little attention to social/cultural influences

FOCUS ON RESEARCH: EVALUATING PIAGET THROUGH A CROSS-CULTURAL LENS

- Cross-cultural research demonstrates
  - No differences in order of attaining the different stages of cognitive development
  - Minor differences in ages of milestones
  - Differences in whether formal operational abilities were achieved by adolescents or adults
    - Domain is vital

Factors in Cognitive Development

Theory of Mind

What Is A Mind?

How Does It Work?

Theory of Mind: What Are Children's Ideas About How the Mind Works?

- Theory of Mind
  - Understanding of how the mind works
    - Allows for the ability to explain and predict behavior
  - Belief-desire reasoning
    - Understand behavior is based on:
      - What an individual knows or believes
      - What they want or desire

Theory of Mind: What Are Children's Ideas About How the Mind Works?

- Preschool-aged children
  - Predict and explain behavior and emotion by mental states
  - Beginning to understand source of knowledge
  - Elementary ability to distinguish appearance from reality

Do Children Understand Where Their Knowledge Comes From?

- Ability to separate beliefs from another who has false knowledge of a situation.
- Ability to deceive
- Evident by age 4, sometimes even at age 3
  - False-belief task – desire, not belief
    - Based on lack of cognitive inhibition
    - Improves with interaction with siblings

Figure 9.5 False Beliefs

False belief task

- https://www.youtube.com/watch?v=8hLubgpY2_w

Is Seeing Believing? What Do Preoperational Children Have To Say About That?

- Appearance-reality distinction
  - Understanding difference between real and mental events
  - May appear in children as young as three
- Limitations
  - Event or object may take more than one form in mind
  - Understanding changes in mental states
  - Understanding of relationship between model and represented object

What Is The Relationship Between Language and Cognition

- Interactionist view most likely
- Lev Vygotsky
  - During first year vocalizations and thoughts are separate
  - During second year thought and language combine
    - Children discover objects have labels
    - Learning labels becomes more self-directed
- Inner speech
  - Initially children's thought are spoken aloud
  - Eventually language becomes internalized
  - Language functions as self-regulative

Piaget's Theory of Cognitive Development

Piaget's Stages of Cognitive Development

Stage 1: Sensorimotor Stage (Birth-2yrs)

Stage 2: Preoperational Stage (2-7yrs)

Stage 3: Concrete Operations (7-11yrs)

Stage 4: Formal Operations (11-on)

Piaget's Theory of Cognitive Development

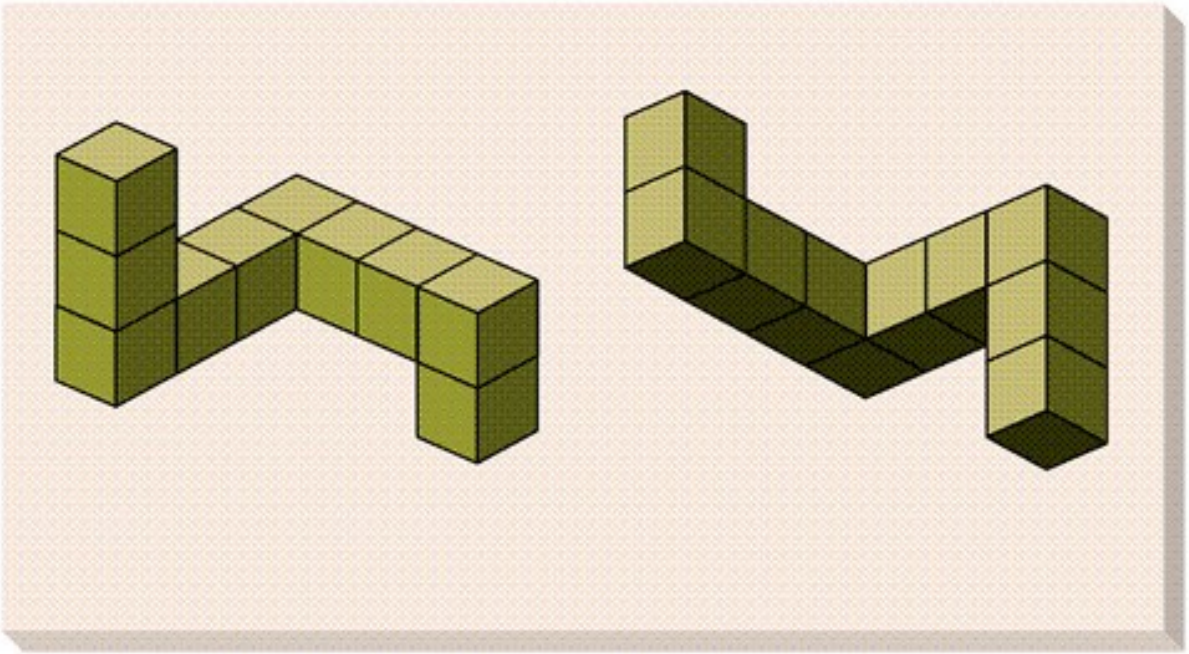
Stage 3: Concrete Operations (7-11yrs)

A. Accomplishments

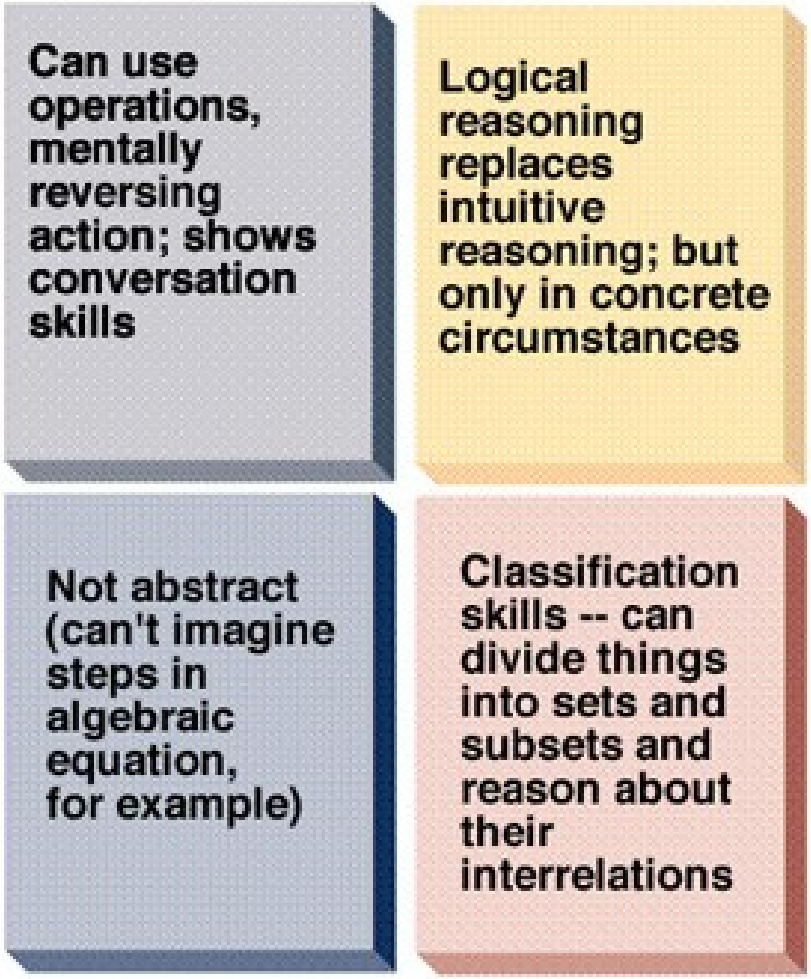
1. Logical Reasoning
2. Reversibility
3. Seriation
4. Transitivity

Piaget's Theory of Cognitive Development

Cubes Used to Study Mental Rotation Abilities



Characteristics of Concrete Operational Thought



Piaget's Theory of Cognitive Development

Piaget's Stages of Cognitive Development

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Piaget's Theory of Cognitive Development

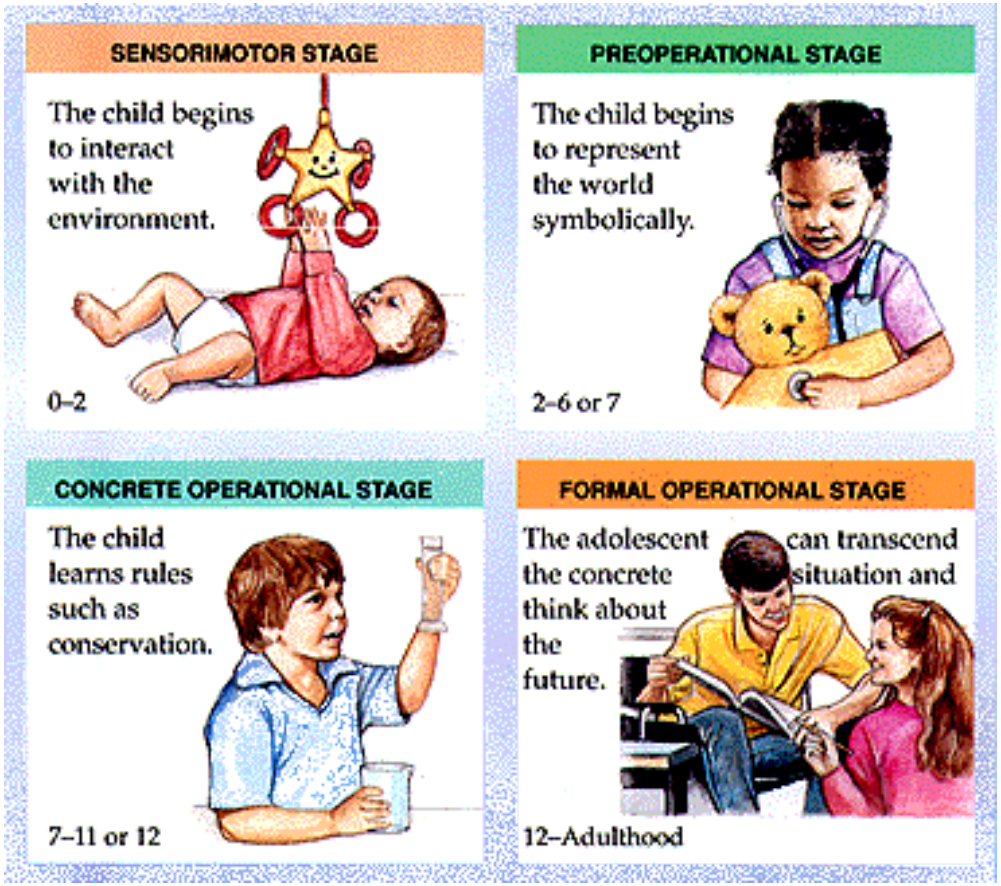
Stage 4: Formal Operations (11-on)

- Mental actions performed on ideas and propositions.
- Can reason logically about hypothetical processes and events that may have no basis in reality.

Characteristics of Formal Operational Thought

Abstract	Idealistic	Logical
Adolescents think more abstractly than children. Formal operational thinkers can solve abstract algebraic equations, for example.	Adolescents often think about what is possible. They think about ideal characteristics of themselves, others, and the world.	Adolescents begin to think more like scientists, devising plans to solve problems and systematically testing solutions. Piaget called this type of logical thinking hypothetical-deductive reasoning.

Piaget's Theory of Cognitive Development



Evaluating Piaget

- Underestimated abilities
- Competence/performance
- Stages
- How do they progress?
- Ignored social & cultural influences

Evaluating Piaget