Cognitive Development

Piaget was intrigued by the errors in thinking children made. To investigate how these errors and how thinking changes as we grow older, Jean Piaget carefully observed his children’s thinking as they grew. He observed four qualitatively different stages in thinking.

He called these stages:

- **Sensorimotor**: The state of development from about birth to 2 years where the infant explores the environment and acquires knowledge through sensing and manipulating objects.
- **Preoperational**: The stage of development that begins about 2 years and ends at about 7 years, characterized by increasing use of symbols and prelogical thought processes.
- **Concrete operational**: The stage of development that begins at about 7 years and ends at about 11 years characterized by the ability to think logically about concrete objects and situations.
- **Formal operational**: The stage of development that begins around the age of 11 and lasts through adulthood characterized by the ability to think logically about abstract principles and hypothetical situations.

Image source (right) Schacter, Gilbert and Wegner
Although stages suggest that each stage is distinct from the other, the boundaries between the stages are “fuzzy”. Like the changes of the seasons, cognitive development is a continuous gradual process.
Sensorimotor Stage (page 337)

Definition: The state of development from about birth to 2 years where the infant explores the environment and acquires knowledge through sensing and manipulating objects.

Image source: Hockenbury and Hockenbury (2005)
Image source: Lefton
Sensorimotor

What kind of behaviors is typical of a child in the sensorimotor stage of cognitive development (approximate age range is birth to 2 years old)?

- During this stage, infants acquire information and experience about the world through direct manipulation of objects using their motor skills and sensory experiences.
  - For example, they learn about rattles by grasping, shaking, and sucking it.
- They explore the cause-and-effect relationship. They begin to notice that their behavior can affect their world such as knocking a pile of blocks makes them crash or pulling the dogs tail makes it run away.
- These activities (direct interaction and establishing cause and effect helps infants develop schemas or theories of how the world works.
At the beginning of the sensorimotor stage, infants lack an understanding of object permanence. They don’t understand that an object continues to exist even when it is not seen. “Out of sight, out of mind”

At the end of sensorimotor stage, children start to develop a mental representation of the world around them. Children understand the concept of object permanence. They understand that an object continues to exist even when it can no longer be seen.
Preoperational Stage (page 338)

Definition: The stage of development that begins about 2 years and ends at about 7 years, characterized by increasing use of symbols and prelogical thought processes.

When Piaget uses the word “operational”, “operations”, etc., he refers to logical, mental activities.

What kind of behaviors is typical of a child in the preoperational stage of cognitive development (approximate age range is 2 to 7 years old)?

- Symbolic thinking emerges. They start to use words, images, and symbols to represent their world. Such behaviors are characterized by
  - The use of language (the word “fly” represents an annoying, buzzing creature).
  - Using language (a symbolic system) to ask for a drink of water instead of walking to the sink and pointing to it.
  - The use of fantasy and imagination (remember when you built a fort out of the couch cushions?).
  - Using a doll to represent a real baby

- Children often display:
  - An inability to conserve quantities
    - Inability to conserve is explained by
- centration and the
- inability to reverse processes
  - egocentrism
- They do not understand basic mental operations or rules.
- They are still trying to figure out the relationship between symbols and the actual objects (like maps).
Unable to Conserve

Preoperational children lack the ability to understand the principle of conservation. The principle of conservation states that two equal quantities remain equal even though the form or appearance is rearranged, as long as nothing is added and subtracted.
Unable to Conserve

They are the same

This is more.

Image Source: Kalat, ()
Unable to Conserve

A four-year old (who hates carrots) gets upset when a mother cuts the carrots into smaller pieces because the child thinks they have to eat more carrots.
**Centration**

The lack of understanding of conservation can be reflected in centration and irreversibility.

Preoperational children display centration. Centration is the tendency to focus or center on one aspect of the situation and ignore other important aspects of the situation.

In this particular case with the clay balls, when determining which one has more, the child “centers” on surface area and ignores height.

*Image source: Kalat,* ()
Centration

In the case of the graduated cylinder, they “center” on height and not on surface area.

Image Source: Hockenbury and Hockenbury, 2008, Psychology
Egocentrism: The tendency for preoperational children to have difficulty in viewing the world from someone else’s perspective or point of view. Psychologists are NOT using egocentrism to mean selfishness or conceit as social psychologists use the word.

In response to the question “What does the doll see?”, an egocentric child picks the bottom set of triangles.
Concrete Operational Stage (page 339)

Definition: The stage of development that begins at about 7 years and ends at about 11 years characterized by the ability to think logically about concrete objects and situations.

What kind of behaviors is typical of a child in the concrete operational stage of cognitive development (approximate age range is 7 to 11 years old)?

- They are less egocentric in their thinking.
- They can reverse mental operations.
- They can focus on two aspects of a problem.
- Thinking and the use of logic tends to be limited to concrete concepts (concepts and events that are tangible and can be related to their own experience and actual events).
- They can classify and organize concrete objects (eg. oaks as trees), but not abstract ideas.
- Explanations tend to be very concrete and tangible.
  - “friendship is when someone plays with me”.
  - When asked “What can be done to end world hunger?”, children at concrete operations tend to responses such as “drop food from parachutes” or “grow more food”
Formal operational stage (page 339)

Definition: The stage of development that begins around the age of 11 and lasts through adulthood characterized by the ability to think logically about abstract principles and hypothetical situations.

- When solving problems, the person is much more systematic and logical than the concrete operational child.
  - For example, when determining what factors influence the period of a pendulum, concrete operations children will change multiple factors (length of the string and weight), while the formal operational child will change one at a time.
  - If a child was asked to determine which factors influence the speed of a car:
    - engine size* (large vs. small),
    - wheel size* (large versus small),
    - muffler* (present/absent),
    - color, or
    - tail fins (present/absent),

  concrete operational children changed more than one variable at time, where formal operational children will change one at a time.
Formal Operations

A formal operational thinker is able to think logically even when dealing with abstract concepts or hypothetical situations.

- Explanations tend to be more global and abstract.
  - When explaining friendship, a formal operations thinker will explain it in terms of:
    - mutual trust,
    - empathy,
    - loyalty,
    - consistency and shared beliefs
  compared to a concrete operations thinker who explains it as “friendship is when someone plays with me”.

- Thinking abstractly continues through adulthood and varies individually.
  - Abstract thinking tends to be limited to one’s area of expertise or special interest.
  - The more diverse knowledge you have, it increases the likelihood you will think abstractly in different domains.
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<thead>
<tr>
<th>Piaget Stages of Cognitive Development</th>
<th>Monopoly Game</th>
<th>Guidelines for Parents</th>
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<tbody>
<tr>
<td><strong>Sensorimotor Stage:</strong> The stage which sensory input and motor responses become coordinated.</td>
<td>The child puts houses, hotels, and dice in her mouth and plays with “Chance” cards.</td>
<td>Active play with a child is most effective at this stage. Encouraging explorations in touching, smelling, and manipulating objects. Peekaboo is a good way to establish the permanence of objects.</td>
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<td><strong>Preoperational Stage:</strong> The period of cognitive development when children begin to use language and think symbolically, yet remain intuitive and egocentric.</td>
<td>The child plays Monopoly, but makes up her own rules and cannot understand instructions.</td>
<td>Specific examples and touching or seeing things continue to be more useful than verbal explanations. Learning the concept of conservation may be aided by demonstrations with liquids, beads, clay and other substances.</td>
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<td><strong>Concrete operational Stage:</strong> The period of cognitive development during which children begin to use concepts of time, space, volume, and number, but in ways that remain simplified and concrete.</td>
<td>The child understands basic instructions and will play by the rules but is not capable of hypothetical transactions dealing with mortgages, loans, and special pacts with other players.</td>
<td>Children are beginning to use generalizations, but they still require specific examples to grasp many ideas. Expect a degree of inconsistency in the child’s ability to apply concepts of time, space, quantity and volume to new situations.</td>
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<td><strong>Formal operational Stage:</strong> The period of intellectual development marked by a capacity for abstract, theoretical, and hypothetical thinking.</td>
<td>The child no longer plays the game mechanically; complex and hypothetical transactions unique to each game are possible now.</td>
<td>It is now more effective to explain things verbally or symbolically and to help children master general rules and principles. Encourage the child to create hypotheses and to imagine how things could be.</td>
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What are Some of the Major Criticisms of Piaget’s Theory of Cognitive Development?

Although the scientific research generally supports Piaget’s fundamental ideas of different cognitive abilities, subsequent research has criticized part of his findings.

- Piaget underestimated the cognitive abilities of infants and children. Children acquire object permanence at a much earlier age than Piaget suggests.
- Piaget’s stages are not as universal as he believed. Abstract thinking is context dependent. “Abstract problems” are easier to solve if you have experience with them. English majors tend to think concretely about physics problems, rather than abstractly like physicists.
- Piaget underestimated the social and cultural factors that affect cognitive development. Social interactions by family members affect cognitive development (also see chapter 2: Pumping neurons into your brain).

What are the educational implications of Piaget?
- When teaching new material, make it concrete, not abstract