Cognition

Cognition:
- The mental processes involved in gaining and comprehending knowledge including thinking, knowing, remembering, judging, and problem solving.

Over the next three chapters we will study the facets of cognition in children
- In Chapter 6 we will look at the description of cognitive accomplishments as children grow older.
- In Chapter 7 we will study the cognitive processes that children engage in to move cognition forward.
- In Chapter 8 we will look at the individual differences in children’s cognition as measured by the IQ test.

Jean Piaget’s Theory of Intelligence

Influences:
- A precocious child. Probably genius level IQ. Did this affect his conception of intelligence?
- Early interest in interest in biology, and philosophy.
- Started out in a psychological clinic where he learned clinical method while interviewing patients, but soon grew disinterested in treatment.
- Left thinking that testing movement focused on individual differences to the detriment of understanding how children come to “know” their world.

Piaget’s Methodology – Clinical Method

- Resurrected clinical method to pursue how children think. Presented child with the concept and then asked questions to determine how they understood it.
- Because the questioning was not standardized, other scientists considered his methodology to be weak and he was really not recognized until the late 50s and early 60s.

Piaget’s Assumptions

- Piaget is a constructivist.
- There is not a pre-determined reality. “Reality” is determined by how the individual construct their cognitive schemes.
- Cognitive schemes show adaptation which means change.
  - Experience provides challenges to the individual’s development of mental schemes in understanding or “knowing” a reality. Intelligence is in the ability to adapt to the challenges of knowing by creating a better understanding. Adaptation toward a better understanding is a function of two processes:
    - Assimilation - the interpretation of reality consistent with current cognitive scheme.
    - Accommodation – the adjustment of current cognitive schemes to account for new experiences.

Assimilation and Accommodation

Taylor comes to know the family’s pet by calling it “doggie.” The scheme might be that the familiar, playful, furry creature that licks its face.
Taylor meets the next door neighbors pet which is larger, has longer fur, and is calmer. It is different by yet there are similarities. Learns to call it “doggie” despite differences. Expands understanding of “doggie” scheme through assimilation.
Taylor meets aunt Mabel’s cat, which acts and sounds different but yet there are similarities to the “doggie” mental scheme. Mable tells her not a “doggie” but a “kitty.” Taylor accommodates to the differences and creates mental scheme for “kitty.” The organization of the knowledge into two separate schemes for cats and dogs creates a better understanding of them for Taylor.

What motivates the child to learn

Equilibration
- Equilibrium - A balance between assimilation and accommodation and there is no need to change mental structures.
- Disequilibrium – When new knowledge occurs that cannot be assimilated by current cognitive structure accommodation in the scheme occurs. Development is a series of disequilibrin as the child grows older.

Moderate Novelty Principle.
- Children are most motivated to understand experiences that test their current mental schemes through accommodation.
Stages of Sensorimotor Thought

<table>
<thead>
<tr>
<th>Reflexive Schemes</th>
<th>Stage 1</th>
<th>Birth –1 month</th>
<th>Infant observes objects when in view</th>
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</thead>
<tbody>
<tr>
<td>Primary Circular</td>
<td>Stage 2</td>
<td>1 – 4 months</td>
<td>Newborn reflexes</td>
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<tr>
<td>Reactions</td>
<td></td>
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<tr>
<td>Secondary Circular</td>
<td>Stage 3</td>
<td>4 – 8 months</td>
<td>Simple motor habits centered around own body</td>
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<tr>
<td>Reactions</td>
<td></td>
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<tr>
<td>Coordination of</td>
<td>Stage 4</td>
<td>8 – 12 months</td>
<td>Repeat interesting effects in that occur by accident in the environment</td>
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<tr>
<td>Secondary Circular</td>
<td></td>
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<tr>
<td>Reactions</td>
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<tr>
<td>Tertiary Circular</td>
<td>Stage 5</td>
<td>12 – 18 months</td>
<td>Explore properties of objects through novel actions</td>
</tr>
<tr>
<td>Reactions</td>
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<tr>
<td>Mental Representations</td>
<td>Stage 6</td>
<td>18 months – 2 years</td>
<td>Internal mental representations of objects or events; deferred imitation</td>
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Object Concept Stages

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Birth –1 month</th>
<th>Infant observes objects when in view</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 2</td>
<td>1 – 4 months</td>
<td>Infant’s glance lingers at point of disappearance</td>
</tr>
<tr>
<td>Stage 3</td>
<td>4 – 8 months</td>
<td>Searches for half hidden objects, or if playing with object that falls from view</td>
</tr>
<tr>
<td>Stage 4</td>
<td>8 – 12 months</td>
<td>Infant actively searches for object that is hidden from view, but fails visible displacement (A not B search error)</td>
</tr>
<tr>
<td>Stage 5</td>
<td>12 – 18 months</td>
<td>Infant solves visible displacement but not invisible</td>
</tr>
<tr>
<td>Stage 6</td>
<td>18 months – 2 years</td>
<td>Mental representation—Infant can imagine an object’s movements although unseen</td>
</tr>
</tbody>
</table>

Testing for Object Permanence at 4 mos.

Baillargeon’s Rotating screen. For child to be surprised by this they have to know that objects are solid and can not be compressed.

- Violation of expectancy-infants increase attention when their expectancies are violated.

Baillargeon, 4 month infants, Object Permanence
Testing Understanding of Object Permanence

Core Knowledge Approach

Piaget viewed intelligence as a single learning system that learns to comprehend the world through a diversity of experience, but experience is key.

Core Knowledge (modular approach):
- Argues that the comprehension of our environment is so essential to our survival that we are born with specialized hard wired core knowledge domains to aid our understanding (innate knowledge).

Core Knowledge

Infants start life with innate, special-purpose core domains of knowledge (modules) that prepare the child to rapidly develop key aspects of cognition. Although this gives the child a “legup” the child begins as a naïve theorist that uses experience to test his/her theories about the world
  - Numerosity
    - may be critical if we need to keep track of how food is distributed over a territory
  - Behavior of physical objects
    - such as the properties of solidity, continuity, and causality.

Rene B.
Critique of Sensorimotor Thought

Critique:
- The child may know more than Piaget had originally thought, or at least know it earlier. Some variation in age can be explained by Piaget’s theory, but not all.
- Different ways of testing infants find more advanced abilities.
- Some cognitive schemes may develop by looking and listening. Piaget expected the sensori-motor infants would only develop these abilities if they actually acted upon the environment.
- Did Piaget underestimate the congenital organization of the brain. Recent research suggests presence of innate knowledge or predispositions to learn that Piaget didn’t consider.

Evaluation of Core Knowledge

What does Violation of expectancy mean? What does it mean when they say infants "know", and what is it that they know?

Interpreting Infant Data

Do Infants understand number
- An infant is habituated to pictures of random items.
  - Apple and glass
  - Car and telephone
  - etc.
- Shapes, sizes and colors and positions in visual scene change. Number is the only thing that remains the same.
- Child is then shown three objects and now looks at the display longer. What does this mean.

Child habituated to puppet that jumps three times, with speed and duration of jumps varying. When shown puppet that jumps two times, dishabituates. What does this mean.

Preoperational Thought 2-6 years

In SM stage child used physical actions to represent knowledge of the world, in PO Child now capable of symbolic representation.

Thought becomes faster and more mobile
- Symbolic thought makes language possible
  - Thought becomes public and communicated
  - Thought can be corrected
- Make believe play becomes prevalent. Can use object as a symbol of something else. Pretending.
- Deferred imitation becomes possible
  - The ability to mentally represent the actions of another and reproduce in your own behavior at a later time. Meltzoff found it at about 14 months with a 1 week interval. A little earlier than what Piaget expected.
Representational Thought

Young pre-op children have difficulty with dual representation

De Loache’s Study of search behavior in 2 ½ and 3 year old children using models

- Used model of a larger room and showed children where an object was hidden. Children then looked in larger room, and later in model.
- 3 year olds successful in larger room and model, but 2 ½ year olds could not find it in larger room although they remembered where it was in model. Memory not a problem.
- 2 ½ olds can use a photo to find object but that is direct representation, not a symbolic representation.

Shortcomings of Preoperational Thought

Although capable of mental representations PO child very much affected by real world appearances and often make faulty Intuitive conclusions based on them.

- Mueller-Lyer illusion
- Identity constancy, a cat named “Maynard”

Meet Maynard the cat, or maybe dog.

Shortcomings (cont.)

PO children also show a problem with Centered Thought, in which attention is over focused on single attributes, which distorts thought. Have difficulty in Decentering.

Lack of reversible operations

- Conservation problems
Taking another’s perspective

Shortcomings of Preoperational thought

Egocentrism
- Tendency to see things from their own perspective and difficulty in taking other’s perspectives. The preoperational child believes that what is in his/her mind is in the mind of others.

Are children as egocentric as Piaget proposed?
- Depends on how it is tested
- However, the child’s understanding of the person’s mind and how it differs from others, is limited.

Theory of Mind

Piaget's discovery of preoperational Egocentrism is a part of what became known later as the Theory of Mind.
This refers to the theory we develop about what is in our minds and the minds of others.

Desires and The Child’s Theory of Mind

Theory of Mind (TOM) begins during Pre-Op
- First step in the child’s creation of a Theory of the Mind is the understanding of a connection between a person’s desires and their actions
- This appears to occur as early as the first year of life.
  - Infant watches an adult who makes a fuss over one of two stuffed kittens “Oooh, look at the kitty” at later point adult chooses to pick up that kitty or the other one. Infant looks longer when adult chooses other (Spelke, 2002).
  - By 2 a child understands that other children may choose other toys to play with because they like them even though he or she does not.

At two years of age the child understands there is a relationship between a person’s desires and the actions they choose to engage in.

Beliefs and Theory of Mind

Theory of Mind
A more difficult problem for children is understanding the relationship between beliefs and actions.
Do people have differ in their beliefs and can that cause them to act differently.

Theory of Mind
Performance on the “False Belief Problem” improves quickly from 14% at 3 to 85% at 5.
Very robust finding that has been replicated in over many cultures.
The dramatic change suggests the maturation of a unidentified brain mechanism
- Aligned with this explanation is the finding that autistic children have a very difficult time solving the falsebelief problem, even more so than developmentally delayed. One study found that fewer than half between 6-14 years of age could solve problem.
Experiences that foster theory of mind

Children who are more advanced in language development better on false-beliefs (Jenkins & Astington, 1996).
- Does language aid the reflection on thoughts of self or are the children more cognitively advanced?

Children who engage in extensive fantasy play show better understanding of false beliefs.
- Children pretend to have different beliefs or feelings so gains practice in how they affect behavior.

Social interactions with others who believe and desire differently are probably related.
- More interactions with peers and having several older siblings helps.

Concrete Operations 6-11

With the advent of concrete operations the child becomes capable of using logic to help correct their mistaken impressions that come from the appearance of objects or their faulty intuitions. We see this change in how preoperational and concrete operational handle the following problems differently:
- Hierarchical Classification
- Seriation
- Transitive Inference
- Conservation

Hierarchical Classification

The logic of classifying objects into superordinate and subordinate categories.

Class Inclusion Problem: “Are there more red flowers or flowers?”

Concrete Operations-Seriation

Concrete Operations-Seriation

(a) Incomplete (b) Extension (c) Seriation

Preoperational orderings Concrete-operational ordering

Concrete Operations-Relational Logic

Relational Logic
- Seriation: of objects of different length based on their unique place
- Transitivity

A < B
B < C
Therefore: A < > = C?

Why it is called “Concrete” Operations

CO logic is demonstrated in concrete settings where child can see all the aspects of the problem needed for solution and manipulate them. Hence, the name. But if the problem is given abstractly then there is a problem.
Jane is taller than Kathie, but Camille is taller Jane. Who is the shortest?
Concrete Operations Conservation

Conservation

Horizontal Decalage
Different levels of understanding that seem to require same mental operations

Concrete Operations 6-11

CO logic is demonstrated in concrete settings where child can see all the aspects of the problem needed for solution and manipulate them. Hence, the name.

Problems:
- The use of this logic is terribly dependent on the context in which the problem is posed. Even though the child is capable of logic in some circumstances they can not transfer this logic to all situations. This limitation known as the horizontal decalage

Cognitive Development and Humor

Relationship of cognitive understanding to humor
- "Why did the old man tiptoe past the medicine cabinet?" "He didn’t want to wake the sleeping pills." Classification
- "Fat Ethyl walked into a restaurant and ordered a whole cake to eat. When the waiter asked if she wanted to cut it into 4 or 8 pieces, she replied: "Four, I’m on a diet." Conservation
- "In a graveyard in Spain they have found a skull which they believe to be that of Christopher Columbus when he was a small boy." Propositional Logic

Formal Operations-Conservation of Volume

In Formal Operations mental schemes are based on formal abstract reasoning which the child can use to solve problems. Concrete operational child limited to the concrete situation that they can observe, thus they are lost when they have to generate the solution that is not evident, that is hypothetical.
Formal Operations-Conservation of Volume

Formal Operations 11- adult
The ability to use logic at a concrete level moves to the development of abstract formal logic that can be formed with language.
- "I am very glad I do not like onions, for if I liked them I would eat them, and I hate eating unpleasant things."
- Propositional logic: "If a is true, then b is false."

Formal Operations-Propositional Logic
The Nelsons have gone out for the evening, leaving their four children with a new babysitter, Nancy Wiggins. Among the many instructions the Nelsons gave Nancy before they left was that three of their children were consistent liars and only one of them consistently told the truth, and they told her which one. But in the course of receiving so much other information, Nancy forgot which child was the truth-teller. As she was preparing dinner for the children, one of them broke a vase in the next room. Nancy rushed in and asked who broke the vase. These were the children's statements:
- Betty: Steve broke the vase.
- Steve: John broke it.
- Laura: I didn't break it.
- John: Steve lied when he said I broke it.

Piaget’s Pendulum Problem
At the formal operational level children are capable of hypothetical/deductive thought.

Solving Formal Operations
Hypothetical/Deductive reasoning
- Variables
  - length
  - weight
  - Arc
  - Push

Formal Operations
Does everyone make it to FO?
- Only about 30-40% of adolescents and adults succeed. Did Piaget overestimate their ability to develop formal operations?
- Cultural dependence, western democracies
- Puluwat of South Pacific, formal operational navigators
- If child develops formal logic it should be immune to familiarity and context effects but it isn’t
- Physics, Political Science and English majors
Piaget’s Theory

Critique:
- Does development take place in stages based on wholistic structures.
- Problem of horizontal decalage.
- Is there a hierarchical organization to development?
- Does he explain development or describe it.

Piaget’s View of an Intelligent Child

Piaget saw the child as incredibly curious that largely educated him/herself in seeking out knowledge to solve the disequilibria that experience brought forward. Piaget liked telling an anecdote of adolescents in a park who were planning a “snowball fight.” He saw them as motivated by their exercise of formal operations as they would be by the snowball fight.

Does this image match our image of the child? Very bright young children seem to verify Piaget’s ideal of the child.

How would teachers react to Piaget’s conception of the child?

Lev Vygotsky’s Sociocultural Theory

Vygotsky was a contemporary of Piaget, who also studied children’s thinking
- Similar to Piaget in seeing the child as an active participant in his/her cognitive development
- However, believed children’s cognitive growth develop out of social interactions, and beliefs, values, what is learned and the tools used to produce learning depend on the culture.
- Piaget interested more in universal course of cognition, Vygotsky more interested cultural influences, which works again universal cognitive abilities.

Vygotsky’s Sociocultural Perspective

Path of Intellectual Adaptation
- Vygotsky believed that all children born with elementary mental functions (attention, memory) but the culture transforms these into higher mental functions based on cultural values. Examples:
  - Children in Western cultures often taught strategies in school to learn lists of things, and in which they clearly show superiority
  - However, aboriginal Australians clearly better in locating objects in their natural settings
  - And finally, African children are better at remembering things that are presented orally (Shaffer & Kipp).
Piaget and Vygotsky

Early on involved in a public disagreement over the Role of Language in Cognition.

- Piaget -- Early language egocentric. Child is unable to take another’s perspective, as evidenced in collective monologues. Serves no cognitive function. More rare than he thought, 5%.
- Vygotsky -- Early language is really private speech for the self and helps child to plan, regulate and direct behavior. Facilitates cognition and problem solving.
- Vygotsky believed that private speech moved from its overt form in directing thought, to covert speech in which it played an inner directed role.

Who was right?

Recent research supports Vygotsky

Berk’s math study. Examined if and under what conditions children used private speech

Results:

- 1st grade, more audible private speech, the better the performance
- 3rd grade more internalized private speech the better the performance

Relationship of private speech to task difficulty among 5- and 6-year olds

Teachers and Directed Speech

Teachers played and active and direct Role in forming child’s private speech.

- Teacher’s verbal communication while instructing, provides model for child of effective problem solving
- Young children adopt teacher’s Verbal instruction and by repeating it to herself out loud
- With age Children learn to instruct themselves quietly, internalizing the cognitive model teacher provides

Vygotsky and Learning

Vygotsky also found that children learned better in social interactions than when alone

- Zone of Proximal Development
  - The Range of tasks child can handle alone, and what a child can accomplish with the help of adults or more skilled peers. Compare with Piaget’s moderate novelty.

Social interactions are more effective because they provide through:

- Scaffolded and Guided Participation
  - The more accomplished partner adjust the level of help in line with the child’s performance in accomplishing a goal
  - The social support helps the child to extend current skills to a higher level of competence

Cooperative Learning

- Interactions with peers and older siblings is thought to encourage activity within the zone of proximal development and that children engage in more symbolic play so this has encouraged more experimenting with cooperative education but it is early to make a judgment on how and where this should be used. Many studies show positive effects but some have shown that collaborative problem solving can undermine individual performance
**Vygotsky in Perspective: Evaluation**

Not yet received intense scrutiny

- More of a perspective, not a theory with testable hypotheses

How accurate is the picture of learning in social contexts?

- Proponents idealize the social/cultural interaction. Experts are not always willing or patient in giving information and being supportive, and novices not always willing to learn from someone who knows more. These interactions take place but difficult to know how frequent or how important they are in development.

**Implications for Education**

Would Piaget and Vygotsky agree or disagree?

- Readiness to learn. Children learn best when they cognitively prepared to understand the concepts.
  - Piaget's moderate novelty principle, Vygotsky's zone of proximal development.
- Physical materials are important for learning especially for young children.
  - Both agree but Piaget emphasizes it a bit more
- The role of the teacher.
  - Vygotsky sees the teacher as more involved in arranging and modeling cognitive behavior and providing scaffolding and Guided Participation.
  - Piaget saw the teacher as important in setting conditions that would challenge their mental structures, but after that the child’s learning would be more self-directed involved in independent discovery type of activities.

**Implications for Education**

Would Piaget and Vygotsky agree or disagree?

- The role of the peer group.
  - Vygotsky stressed collaborative learning with peers. Believed children are more motivated when working together in a social context, in which they learn to use higher-quality cognitive strategies from smarter, older children.
  - Piaget also felt peer interactions highly important but in a much different way. Peers disrupt children’s egocentric cognitive reasoning because they require them to explain their perspective and demanded that children rely on their logical abilities to be persuasive.