

9.85 Cognition in Infancy and Early Childhood

Lecture 2: Theoretical perspectives in developmental psychology I: Piaget

Background

- From the beginning of Western philosophy: two competing traditions.
- **Rationalism** -- Some knowledge is innate. (Plato)
- **Empiricism** -- "Nothing is in the intellect which was not first in the senses." (Aristotle)

Background (Stanford Encyclopedia of Philosophy)

- **Maybe there are two types of knowledge:**
- All doctors that specialize on eyes are doctors.
- All ophthalmologists are doctors.
- All bachelors are unmarried.
- Some doctors that specialize on eyes are unmarried.
- Some ophthalmologists are unmarried.
- Many bachelors are ophthalmologists.

Background

- **Relations of ideas (Hume) or analytic truths (Kant) -- idea is contained in the concept itself.**
- **Matters of fact (Hume) or synthetic truths (Kant) -- idea goes beyond the concept itself.**

Background

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| <ul style="list-style-type: none">• Rationalism• We have knowledge about things we've never experienced (the infinite)• Evidence is too impoverished to explain our concepts.• Experience is fallible -- cannot provide certainty. | <ul style="list-style-type: none">• Empiricism• Things that are necessarily true are "trifling" (Locke). The idea is contained in itself.• What does knowing X mean if it doesn't mean that knowing that X is true of the world?• Knowledge does not need to be certain, only probable. |
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Background

- How do we get to the truth about the world? (How are synthetic a priori judgments possible?)
- Kant suggested an answer: the world we experience depends on two factors:
 - The world itself.
 - The way our minds are able to experience the world.
- Our ability to experience the world assumes that certain propositions (e.g., mathematical truths, causal laws?) are true.
- Kant was to be a great influence on Piaget

Background

- But although there was considerable disagreement about whether ideas were innate or learned in principle... in practice, almost everyone assumed babies knew little if anything.

Locke 1632-1704

- "Let us then suppose the mind to be . . . void of all characters, without any ideas; how comes it to be furnished? ... Whence has it all the materials of reason and knowledge? To this I answer, in one word, from experience; in all that our knowledge is founded, and from that it ultimately derives itself." (*An Essay Concerning Human Understanding*)

Rousseau, 1712-1788

- "We are born capable of learning, but knowing nothing, perceiving nothing. The mind, bound up within imperfect and half grown organs, is not even aware of its own existence. The movements and cries of the new-born child are purely reflex, without knowledge or will" (*Emile*)

Darwin, 1809-1882

- "At this time, though so early, it seemed clear to me that a warm soft hand applied to his face excited a wish to suck. This must be considered as a reflex or an instinctive action, for it is impossible to believe that experience and association ... could so soon have come into play." (*A Biographical Sketch of an Infant*)

James, 1842-1910

- "If my reader can succeed in abstracting from all conceptual interpretation and lapse back into his immediate sensible life at this very moment, he will find it to be what someone has called a big blooming buzzing confusion..." (*Percept and Concept*)

Freud, 1856-1939

- "We are bound to suppose that a unity comparable to the ego cannot exist ... from the start; the ego has to be developed." (*On Narcissism*)

Watson, 1878-1958

- “Give me a dozen healthy infants, well-formed and my own specified world to bring them up in and I’ll guarantee to take any one at random and train him to become any type of specialist I might select -- doctor, lawyer, artist, merchant-chief and yes, even beggerman and thief ...” (*Behaviorism*)

Behaviorism

- Brief recap ...
- Organisms respond adaptively to the environment.
- Thorndike’s Law of Effect: actions with positive consequences are likely to be repeated and actions with negative consequences, avoided.

Behaviorism: brief recap

- An animal presented with a conditioned stimulus (me waving a water bottle) and an unconditioned stimulus (like food being thrown) would learn to associate the two stimuli.
- When presented only with the conditioned stimulus, the animal would produce a response (e.g., reaching for the food) normally elicited by the unconditioned stimulus.

Piaget

- Child prodigy (albino sparrows -- age 10)
- Background in biology (mollusks)
- Early concern with whether categories were “out there” or in the mind. (“Vanity of nomenclature” -- age 16)
- Brief flirtation with poetry ...

Hymn to the Idea (1916)

“The Idea surges from the depths of our being. The Idea overthrows kings and priests, raises the masses, decides the outcome of battles, guides the whole of humanity. Everything is Idea, comes from the Idea, returns to the Idea. The Idea is an organism, is born, grows, and dies like organisms, renews itself ceaselessly ...”

Piaget

- Went to work with Binet on intelligence testing.
- Became more interested in patterns of errors than successes.

Piagetian revolution

- Wanted to bridge two different traditions:
- Rationalism and empiricism
- But also epistemology and biology.

Piaget

- Critical questions:
 - How can the processes that support knowledge be both
 - flexible (allow learning from experience)
 - and accurate (converge on the truth about the world)?
 - How can abstract, logical structures emerge from biological processes?

Piaget

- Founded a field he called “genetic epistemology”
- Looking for biological processes that could support the growth of knowledge.

Piagetian mechanism of cognitive development

- Adaptation
 - Assimilation
 - Accommodation

Piagetian mechanisms

- Assimilation: Incorporate new knowledge into existing cognitive structures.
- Adaptation: change cognitive structures to accommodate new evidence.

Mechanism of cognitive development

- Adapting simple schemes to a structured world would result in structured representations.

Not simple empiricism

- Structure of existing knowledge shapes access to new knowledge.
- Disputed the idea that experience imposes itself “without the subject having to organize it”

Not simple empiricism

- “To explain these successive generalizations by the simple action of associations would explain nothing at all because the problem is precisely to know why these associations are formed and not others among the infinity of combinations possible”

Not simple empiricism

- Anti-prevailing behaviorist ideas.
- Between 1932 and 1950 not a single one of Piaget’s books was translated into English.

Not simple nativism either

- Cognitive development is
- A) universal and
- B) biologically constrained
- But:

Not simple nativism either

- Driven by adaptation not maturation.
- Cognitive structures are not inherited but develop through functioning on the environment.
- (Differed also from Kant in this respect)

Not simple nativism either

“That which is inevitable does not have to be innate.”
(in response to Chomsky and Fodor)

Continuity and change

- Distinguished
 - **Functional properties of knowledge** -- (mechanisms of cognitive development -- stable over development)
 - **Content of knowledge** (changed over development)
 - **Structural features of knowledge** (changed over development)

Cursory overview of Piagetian stages

- Ages may vary; stages are invariant -- knowledge is cumulative
- Sensorimotor development (birth-2)
- Preoperational thought (ages 2-7)
- Concrete operational thought (ages 7-11)
- Formal operational thought (adolescence)

Sensorimotor thought

- “Schema” as the sensorimotor version of a concept.
- Intelligence in action
- Objects identified through their affordances (bottles are for sucking, rings for grasping).

Sensorimotor thought

- First produce interesting results by accident
- Then produce them deliberately
- Intentional action emerges when means and ends are differentiated.
- Culminating in representational and symbolic thought.
- Piaget believed that true representational thought only emerged towards the end of infancy.

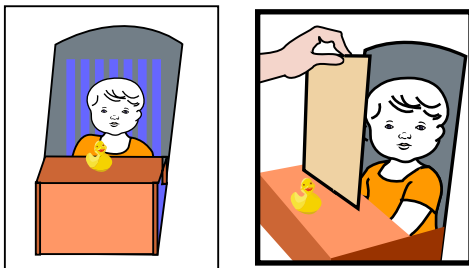


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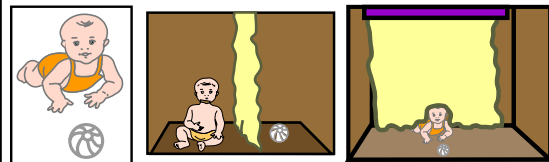


Illustration courtesy of MIT OCW.

A not B error

- Our very own guest lecturing baby ...
- Ruth Rosenholtz and Sara

Object concept

- Why is it a big deal?
- Because it suggests representational thought.
- Responding to concepts not percepts.
- Differentiating world in itself from actions-on-the-world.

Challenges to Piaget

- Young infants seem to represent non-visible objects (we'll discuss these at length)
- Meta-analyses (Wellman, et al., 1986; Markovitsch and Zelazo, 1999) suggest that children's tendency to make the A not B error is influenced by:
 - Repetitions of reaches to A
 - Number and distinctness of locations
 - Postural perseveration
- Alternative accounts invoke ancillary rather than conceptual deficits (Diamond, Thelen, Smith)

Preoperational thought

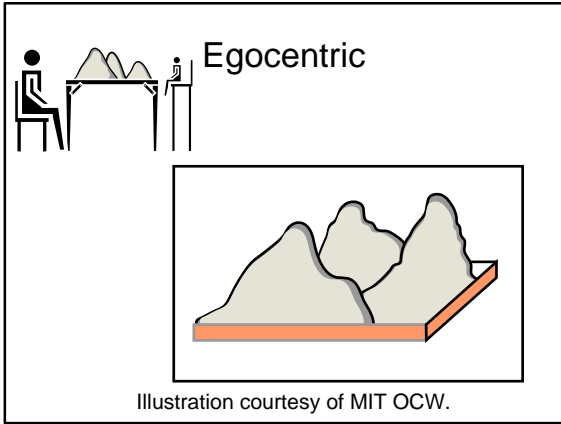
- Symbolic and representational thought emerge (imitation, language, pretend play).
- But no "operations"

Preoperational thought

- What's an operation?
- A representational act that respects logical transformations.
- Perspective taking, class inclusion, conservation, arithmetic manipulations, spatial, temporal, and causal relations.



Preoperational thought

- Egocentric
- Precausal
 - Animistic (river flows because it wants to)
 - Artificialistic (river flows because of boats)
- Bound by appearances
- Unable to relate parts to wholes



Challenges to Piaget

- Piaget believed children couldn't "decenter" from their own perspective.
- Flavell (3-year-old children)






Illustrations courtesy of MIT OCW.

Challenges to Piaget


- Young children know very well *that* someone else will see things differently
- But they may not be able to specify *what it is* they will see. (Flavell, 1989)


Bound by appearances

ROW A 

ROW B 

Does Row A or Row B have more? Do they have the same?



ROW A 

ROW B 



Does Row A or Row B have more? Do they have the same?

Figures courtesy of MIT OCW.

Bound by appearances

A  B 

Does A have more clay than B, or does B have more clay than A? Or do they both have the same amount?

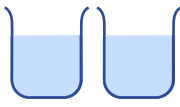
A  B 

Does A have more clay than B, or does B have more clay than A? Or do they both have the same amount?

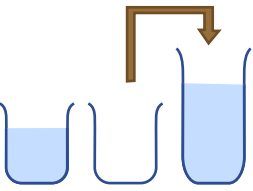
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Bound by appearances

Does A have more than B, or does B have more than A? Or do they both have the same amount?



Does A have more than B, or does B have more than A? Or do they both have the same amount?



Figures courtesy of MIT OCW.

Failures of conservation

- Failures of reversibility (operations can be undone)
- Failures of compensation (changes in one dimension compensate for changes in another)
- Failures of identity (it's the same stuff)

Decalage

- Horizontal decalage -- discontinuities of conceptual development within a stage
 - conservation of number before conservation of liquid
- Vertical decalage -- discontinuities of conceptual development between stages
 - Have a concept (like perspective-taking) in action before you have it in symbolic representation.

Challenges to Piaget

- Claim is that preoperational children confuse appearance and reality -- and are captured by appearances.
- Preoperational children are "phenomenalists"

Challenges to Piaget

- But if you show children a sponge that looks like a rock and ask:
 - "What is this really and truly? Is it really and truly X or is it really and truly Y?"
 - "When you look at this with your eyes right now, does it look like X or does it look like Y?"
- Four-year-olds pass
- And three-year-olds are as likely to make errors of realism (answer "rock" to both) as errors of phenomenalism (answer "sponge" to both).

Challenges to Piaget

- Suggests children's difficulty may be with holding onto multiple representations at once.
- Rather than with distinguishing appearance and reality.

Unable to relate parts to wholes



Illustration courtesy of MIT OCW.

Challenges to Piaget

- Who would have more pets? Jane who owns the pigs or Sally who owns the baby pigs? -- Kids fail.
- Who would have more pets? Jane who owns the pigs or Sally who owns the pig family? -- Kids pass.

Challenges to Piaget

- Suggests problem is not with class inclusion pre se.
- Rather, difficulty is with having 2 labels for one object.
- X is a pig and X is a baby pig -- is hard to understand.
- Hierarchical labels aren't -- X is a pig and X is **part of** a pig family. (Markman, 1973)

Later developments

- Concrete operations: identity, addition, negation, reversibility, etc.
 - But concrete operations operate on what is known or believed to be true.
- Formal operations act on what could, in principle, be true.
 - Hypothetico-deductive reasoning, propositional thinking

Summary: Challenges to Piaget

- Questioning of experimental methodologies
- Discovery of early competencies
 - Flavell: visual perspective-taking, appearance reality
 - Baillargeon: object representation
 - Diamond, Thelen, Smith: A not B error
 - Markman: class inclusion
 - Meltzoff: early imitation
- Difficulties with stage theory
- Frustration with adaptation and disequilibrium as a learning mechanism.

However:

- Piaget has had an enormous impact.
- Children actively construct knowledge by applying their current conceptual understanding to evidence.
- Shaped the scope of the field: children's understanding of space, time, number, probability, morality, intentional action, causality, etc.

Wednesday: theoretical approaches

- **Core knowledge/modularity (Leslie, Spelke, Carey)**
- **Theory theory (Carey, Gelman, Gopnik, Meltzoff, Wellman)**
- Connectionism (Bates, Elman, Karmiloff-Smith, Johnson)
- Information processing (Case, Klahr, Siegler)
- Dynamic systems (Thelen, Smith)
- Biological maturation (Diamond, Neville)