Interview with a kindergartner

- **Experimenter:** It’s 12 o’clock in the afternoon and the sun is shining really bright. You already ate something today, but you’re still very hungry, so you decide to eat pancakes with syrup, orange juice, cereal, and milk. Could that be lunch?
- **Kindergartner:** No. . . because lunch you have to have sandwiches and stuff like that.
Interview with a kindergartner

- **Exp**: Can you have cereal for lunch?
- **Kid**: No.
- **Exp**: Can you have pancakes for lunch?
- **Kid**: No... No.
- **Exp**: Well, how do you know if something is lunch or not?
- **Kid**: If the time says 12:00.
- **Exp**: This was 12:00.
- **Kid**: Well, I don’t think so.
Interview with a kindergartner

- **Exp**: (Repeats story.) Is that lunch?
- **Kid**: I know...that one is NOT lunch..you have to eat sandwiches at lunch.
- **Exp**: Can you have anything else?
- **Kid**: You can have drinks, but not breakfast.
Conceptual Development
What are concepts?

- Concepts are mental groupings of more-or-less interchangeable elements
  - Objects (dog, island)
  - Events (lunch, birthday)
  - Qualities (sweet, fast)
  - Abstractions (true, good)
Why Concepts Are Important

- **Concepts are basic elements of thinking**
  - **language**: most words symbolize concepts
    - E.g., “dog” and “chien” symbolize a mental grouping of dogs and all knowledge about dogs
  - **memory**: concepts link our past and future experiences with the present
    - E.g., If I recognize Lassie to be a dog, I can reasonably infer that Lassie has some of the same properties of the dogs I’ve met before and will meet in the future
  - **learning**: concepts allow us to generalize new experiences
    - E.g., If I know that Lassie and Fido are dogs, and I learn that Lassie and Fido have FRTG-23 in their cells, I can infer that other dogs might too.
How might concepts develop?

- Two ways concepts might change with age
  - its relation to other concepts (semantic network)
  - knowledge about the units of the concept (schemas)
Concept **Island**

- **Knowledge about islands**
  - Islands are bodies of land
  - Islands are totally surrounded by water
  - Islands have beaches
  - Sometimes the beaches are sandy, with sea shells
  - People travel to islands where there is warm weather and palm trees
  - Australia is the biggest island in the world
  - The combination of N. and S. America is not an island
Semantic Network for *Island*

- Objects
  - Nonliving
    - Dogs
    - Ferns
  - Natural
    - Tables
    - Houses
    - Gold
    - Rocks
    - Peninsulas
    - Continents
    - Islands
      - Hawai’i
      - Australia
Island schema

- **Island schema**
  - *Is a:* land mass
  - *Shape:* any closed figure
  - *Material:* stone, dirt, sand
  - *Function:* habitat, vacation spot
  - *Size:* ≈ 1 - 8,000,00 sq km
How do concepts change?

- Keil (1983) asked children two kinds of questions
  - +D/-C: On this piece of land, there are apartment buildings, snow, and no green things growing. This pieces of land is surrounded by water on all sides. Could that be an island?
  - +C/-D: There is this place that sticks out land like a finger. Coconut trees and palm trees grow there, and the girls sometimes wear flowers in their hair because it’s so warm all the time. There is water on all sides except one. Could that be an island?
How do concepts change?

- For the concept *island*, 5-year-olds most often categorized by characteristic features, whereas 9-year-olds most often categorized by defining features.
- This pattern was observed for many other concepts that have defining features.
How do concepts change?

- **Concept Uncle**
  - Exp (+D/-C): Suppose your mommy has all sorts of brothers, some very old and some very, very young. One of your mommy’s brothers is so young, he’s only 2 years old. Could that be an uncle?
  - Kid: No... because he’s little and 2 years old.
  - Exp: How old does an uncle have to be?
  - Kid: About 24 or 25.
  - Exp: If he’s 2 years old, can he be an uncle?
  - Kid: No... he can be a cousin.
Concept Uncle

Exp (-D/+C): This man your daddy’s age loves you and your parents and loves to visit and bring presents, but he’s not related to your parents at all. He’s not your mommy or daddy’s brother or sister or anything like that. Could that be an uncle?

Kid: Yes.

Exp: What is an uncle?

Kid: An uncle is that he brings you presents at Christmas.

Exp: What else?

Kid: An uncle is that he let you come over to his house?

Exp: Could I be your uncle?

Kid: No ... because I don’t know you.

Exp: If I got to know you and brought you presents, could I be your uncle?

Kid: Yes.
What’s going on?

- **Why do children’s concepts change over time?**
  - Piaget’s theory:
    - Children begin to think taxonomically
  - **Information-processing approach**
    - Children’s knowledge is heavily influenced by ‘cue validity’
  - **Core Knowledge approach**
    - Children acquire new causal beliefs or a new application of old causal beliefs
Piaget’s Theory

- Piaget’s theory:
  - Concepts are equivalent to defining features
    - Uncle = Mother’s brother or Aunt’s husband
  - Preoperational children fail on tasks like Keil’s because they do not yet represent taxonomic relations among concepts, but base their judgments on thematic relations
Piaget’s theory: Support

- **Piaget’s theory:**
  - Based view on children’s object sorting, “Put together what goes together”
  - *Preschoolers*: put dogs and cars together because dogs like to ride in cars, and cats and chairs together because cats like to curl up in chairs
  - *Older children*: put dogs and cats together because they’re animals, and put cars and chairs together because they’re artifacts.
Piaget’s theory: Criticism

- **Criticism of Piaget’s theory:**
  - Children might represent taxonomic relations, but find thematic ones more interesting.
  - Bauer and Mandler (1989) showed 1-year-olds:
    - "See this one?"
    - "Can you find another one just like it?"
    - 1-year-olds chose the bear on 85% of trials.
Piaget’s theory: Criticism

- **Piaget’s theory:**
  - Even on Keil’s task, kindergartners sometimes use defining features, especially for moral terms
    - robber
    - lie
Piaget’s theory: Criticism

- **Concept lie**
  - -D/+C: This girl hated a boy in her class because he was so mean and did really nasty things to her. She wanted to get him into trouble, so she told the teacher all the nasty things the boy had really done. Could that be a lie?
  - +D/-C: This little boy always got good grades in school and prizes for being so smart. The other children were jealous of him because of it, and he didn’t want to make them feel bad and wanted them to be friends. So, one time, when he really got a good mark on a test, he told them that he got a bad mark so they’d be his friends. Could that be a lie?
Piaget’s theory: Criticism

- For moral concepts, 5-year-olds and 9-year-olds most often categorize by defining features.
Information-Processing Approach

- **Concepts are more than just defining features**
  - Even for adults, many concepts are difficult to define very precisely (e.g., *game*)
  - Precise definitions for some terms are not very useful
    - Dog: A quadruped of the genus *Canis*, of which wild species or forms are found in various parts of the world, and numerous races or breeds, varying greatly in size, shape, and colour, occur in a domesticated or semi-domesticated state in almost all countries. These are referred by zoologists to a species *C. familiaris*; but whether they have a common origin is a disputed question.
Rosch & Mervis (1975): Instead of defining features, concepts may be represented in terms of probabilistic features.

- Brother of father or mother, OR Husband of Aunt
- About as old as one’s parents
- Nice $p=1$
- Handsome $p=.7$
- Handsome $p=.5$
Evidence in favor of this view is built around three ideas:
- Cue validity
- Basic level categories
- Prototypes
Information-Processing Approach: Support

- **Cue Validities:**
  - Children might decide whether objects are examples of one concept or another by comparing **cue validities**
  - The cue validity of a feature is the degree to which the frequency of a feature accompanies a category member and the infrequency with which it accompanies non-category members
  - For example, because most (though not all) birds can fly, and because most (though not all) nonbirds cannot fly, flight is a highly valid cue for
Information-Processing Approach: Support

Cue Validities:
- Cue validity helps to explain
  - why adults are so much faster to identify robins as birds than ostriches, and
  - why children are more likely to say that an ostrich is not a bird than to say that a robin is not a bird.
Information-Processing Approach: Support

- **Cue Validities:**
  - Infants in the first few months are already sensitive to cue validity.
  - This seems to allow them to form basic concepts such as *cat* on the basis of perceptual information.
Quinn & Eimas (1996)
- Showed 3- to 4-month-olds pairs of cat pictures
- From trial to trial, infants looked equally long at new cats, but a very long time at a new dog
- This finding suggests that they treated clearly different cats as alike, whereas they saw a different dog as not alike
The IP Approach also helps to explain the development of object concept hierarchies.

<table>
<thead>
<tr>
<th>Level</th>
<th>Type of Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most General</td>
<td>Inanimate Objects</td>
</tr>
<tr>
<td>General</td>
<td>Furniture, Vehicles</td>
</tr>
<tr>
<td>Medium</td>
<td>Chairs, Tables</td>
</tr>
<tr>
<td>Specific</td>
<td>La-Z-Boys, Armchairs</td>
</tr>
<tr>
<td></td>
<td>People</td>
</tr>
<tr>
<td></td>
<td>Europeans, Asians</td>
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<tr>
<td></td>
<td>Spaniards, Finns</td>
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<td></td>
<td>Picasso, Cervantes</td>
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<tr>
<td></td>
<td>Living Things</td>
</tr>
<tr>
<td></td>
<td>Animals, Plants</td>
</tr>
<tr>
<td></td>
<td>Cats, Dogs</td>
</tr>
<tr>
<td></td>
<td>Lions, Lynxes</td>
</tr>
</tbody>
</table>
Information-Processing Approach: Support

- Within a given hierarchy, there will always be a basic level category, where cue validities are maximized.
- For example, in furniture/chair/kitchen chair
  - Chair is a basic-level category because its features have the highest cue validities
  - Legs, a back, and a seat are associated with most chairs (but not beanbag chairs), whereas few other objects have these
Anglin (1977) showed that children typically form basic-level categories before superordinate and subordinate-level categories.

<table>
<thead>
<tr>
<th>Superordinate</th>
<th>Basic</th>
<th>Subordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Transportation</td>
<td>1. Cars</td>
<td>2. Volkswagens</td>
</tr>
<tr>
<td>2. Plant</td>
<td>1. Flower</td>
<td>3. Rose</td>
</tr>
</tbody>
</table>
Information-Processing Approach: Support

- Prototypes are the most representative instances of concepts because they have the highest cue validities.
  - Lassie is a prototypical dog because she had qualities (e.g., size, shape, bark) representative of dogs in general.
- Adults and children are quickest and most accurate in judging the category-membership of prototypes.
Information-Processing Approach: Support

- Research also indicates that infants as young as 3 months abstract prototypes from sets of objects (Bomba & Siqueland, 1983; de Haan et al., 2001).
Face Prototypes

Four Familiarization Faces

Example of Test Pair 1

Example of Test Pair 2
Fig. 2. One-month-olds' \((n = 12; \text{left bars})\) and 3-month-olds' \((n = 12; \text{right bars})\) mean proportion of looking to each face in the Average versus Familiar Individual Face test trial (top) and in the Novel versus Familiar Individual Face test trial (bottom) in Experiment 1. The horizontal line at 0.5 shows the level of looking to each face expected by chance.
Information-Processing Approach: Criticism

- **Which features matter and which don’t?**
  - For example, when a child encounters a novel object how does she know what features to pay attention to?

- **Features are not unrelated**
  - It’s not simply that birds build nests in trees and fly and have wings and have bird DNA
  - Rather, birds build nests in trees because they can fly, and they can fly because they have wings, and they have wings because they have bird DNA.
  - Features are **causally related** and causal features are most important (and sometimes most difficult) features for children to grasp
Core Knowledge Approach

- Core knowledge approach
  - children’s concepts reflect their understanding of cause-effect relations
Core Knowledge Approach

uncle
is
Father’s or Mother’s
Brother OR Aunt’s
Husband

Therefore
About Same Age
as Parents

Therefore
Loves Mommy
or Daddy

Therefore
Loves Me
Core Knowledge Approach: Support

- **Krascum & Andrews (1998)**
  - Two groups of children were given identical descriptions of “Wugs” and “Gillies”
  - Exp group was also told *why* wugs and gillies had the properties they did
  - Exp > Control, categorizing and remembering the categories
Core Knowledge Approach

- CK Approach emphasizes children’s use of causal relations in reasoning
  - According to Piaget and Rosch, concepts are formed when different items share many more visual features than they do not share
  - But many adult concepts involve ignoring visual similarity
  - The CK Approach argues that children can ignore visual similarity in their reasoning much earlier than Piaget or Rosch supposed
Development of Early Biological Concepts

- Findings indicating that children go beyond similarity:
  - Conservation of identity over metamorphosis (Rosengren et al., 1991)

What will it look like when it grows up?
Development of Early Biological Concepts

- Findings indicating that children go beyond similarity:
  - 2. Essentialism (Gelman & Wellman, 1991)

Which of these looks most like the pig?
Which of these has the same kinds of insides as the pig?
Findings indicating that children go beyond similarity:

3. Category-based inference (Gelman & Markman, 1986)
Development of Early Biological Concepts

Findings indicating that children go beyond similarity:

4. Inheritance-based categorization (Opfer & Bulloch, 2007)
Interim Summary

- How children’s **object concepts** change
  1. Shift from categorizing objects (e.g., *island*) by **characteristic** features to categorizing by **defining** features
  2. Development of **superordinate** and **subordinate** categories (e.g., that a flower is also a **plant** and a **rose**)
  3. Development of **long-term memory for new categories** by learning how features are causally related to one another