THE DEVELOPMENTAL PROBLEM OF INDUCTION:
How Do Children Know?

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Some examples of induction

- What comes next: 2 4 8 16 32 __ ?
- What does “spore” mean?
  - ragweed ____; mold ____; anthrax ____...
- You have just completed a masterful tower of blocks, when Chris walks by and knocks it over.
  Q: Did Chris do it on purpose?

We are constantly making projections based on limited evidence. The problem of induction is how, based on a few examples, we can infer general principles or patterns?
What’s the problem?  
*(after Nelson Goodman)*

➤ Which prediction do you prefer?  
1. “Any crow I see will be black”  
2. “Any crow I see will be black (before 2010) or bright orange (after 2010)”

➤ Why is (1) more compelling?  
– Consistent with past instances, but so is (2)  
– Fits background knowledge (negative evidence)  
  • Animals don’t change color on Jan. 1st

※ Problem: What if you lack background knowledge?
The dev prob of induction: Two examples

Learning: What’s new? (almost) the same old (primate) brain?
1. Shared attention: roots of teaching and learning
   - What is it?
   - Where does it come from?
   - Evolution of “The Apprentice”: Baby, you’re built for culture!
2. Where language comes from:
   - What a word means…
Knowledge in complex organisms: The old and the new

- Primate learning abilities
  - memory of places, things, and features
  - generalization; probability estimation
  - reinforcement learning

Specialized (?) human learning abilities
- symbolization & predication
- mentalism; intentional stance
- imitative learning
- theorizing
- autobiographical self-concept
- conceptual flexibility
- metaphor

continuum of abilities... interactions...

- habituation
- "proto-symbolization": secondary association
discrimination & perceptual learning
The emergence of Attention Sharing

Emerges between 9 and 18 months...
- Product of inductive learning
- Facilitates inductive learning

First signs: Do you see what I see?

Is it a special human social skill?
- No, but what we do with it is!
- Teaching + Imitation = CULTURAL LEARNING!
Gaze following at 12 mth: Do you see…?
(Deák, Flom & Pick, 2000)

Why is this important?
- Using another person’s mind to find important information in the environment
Merv points…

(photo by David Leavens)
Imitation: Using inferences to learn skilled actions

1-year-old infants imitate actions performed for them, and seem to represent the model’s intentions:
- 14-month-olds: imitate specific action, even if there is a simpler way to achieve goal
- 18-month-olds imitate and go beyond: complete a “frustrated” incomplete action

These seem to be species specific…but not innate!
- nut-cracking & termite-fishing: harder than you think!
One problem in language learning: Words and their meanings

- Why are words hard?
- One use for shared attention: What are you talking about?
- Using language to learn language: Semantic bootstrapping of word meanings
Word learning: Using shared attention to infer meanings

- When an adult utters a novel word, how could the child induce its meaning?

- Baldwin: 18-month-olds* monitor adults’ attention; make inferences about what they are referring to

- Tomasello & Barton: Toddlers map verbs onto intended actions, not accidental ones
Using language to learn language:
Semantic bootstrapping

Semantics cues provide critical information about word meanings:

• “snoxen!”
• “...the snoxen”
• “The dog chased the scared snoxen”
  - but inherently variable and unpredictable...
  ...how do children deal with this?
Flexibly using semantic cues to learn word meanings…

“…is a tulla”

“…is made of snorb”

“…has a framm”
Current directions: Solving the developmental problem of induction

1. What are the regular sources of information in the child’s world?
   – How do infants/children learn to predict these?
2. We must investigate:
   – What kinds of regularities children notice;
   – How this depends on their activity;
   – What sorts of brain mechanisms allow them to learn these!