

“ What distinguishes humans from all other animals is not really language, but the ability to imitate.”

Susan Blackmore

# IMITATION

COGS171

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## TYPES OF LEARNING

### Learning Type

### Defining Characteristic

Habituation

Loss of a response to a stimulus after repeated exposure

Imprinting

Learning that is irreversible and limited to a sensitive time period in an animal's life; often results in a strong bond between new offspring and parents

Association

Behavioral change resulting from a link between a behavior and a reward or punishment; trial-and-error learning

Imitation

Learning by observing and mimicking others

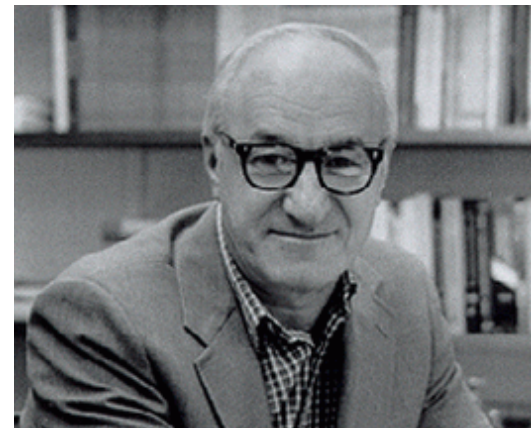
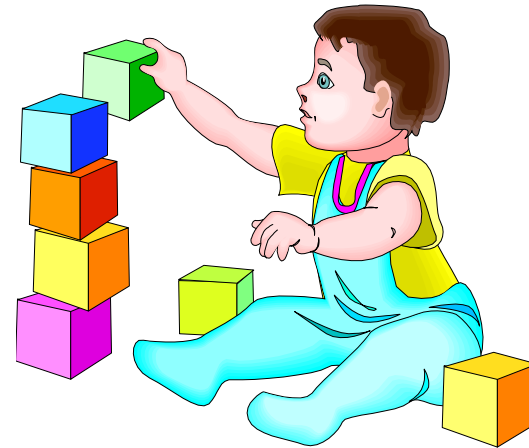
Problem solving

Inventive behavior that arises in response to a new situation

# The Characteristics of Bandura's (early) Theory with Emphasis on Learning

## Early version (Social Learning Theory)

- emphasized the means by which we acquire behavior: **Learning...**
  - Operant Conditioning
  - Classical (Pavlovian) Conditioning
  - But especially, **Imitation**



Albert Bandura

# Observational Learning

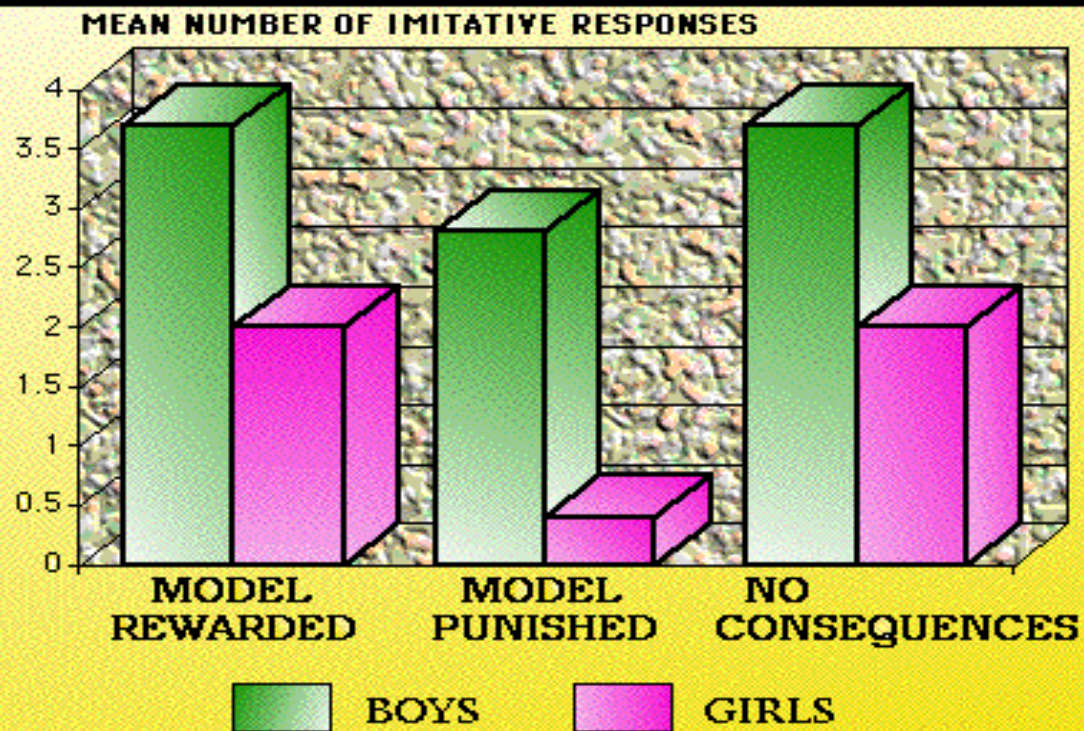
In a set of well-known experiments, called the "Bobo doll" studies, Bandura showed that children (ages 3 to 6) would change their behavior by simply watching others.

## **He observed three different groups of children:**

- One group of children saw the child praised for aggressive behavior (rewarded)
- A second group saw the child told to go sit down in a corner and was not allowed to play with the toys (punished)
- A third group saw a film with the child simply walking out of the room (no consequence)

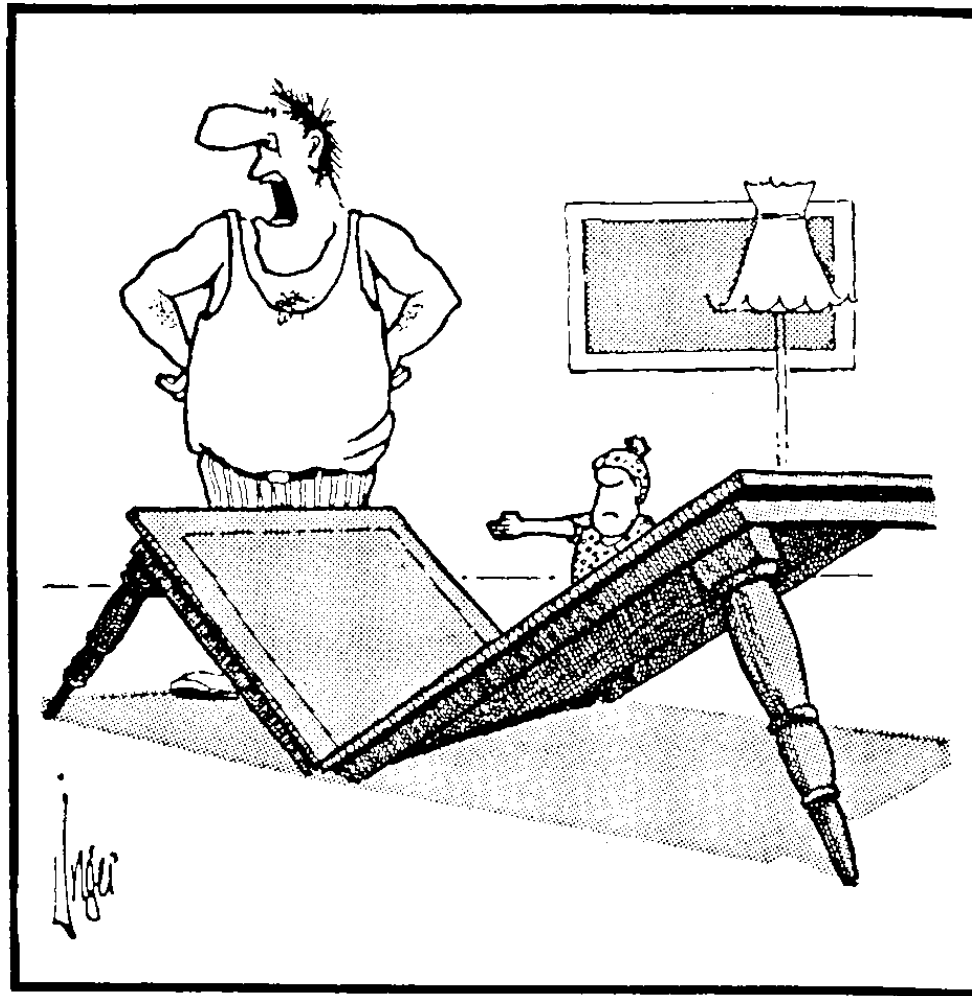
# Observational Learning

## EFFECT OF OBSERVED CONSEQUENCE ON IMITATIVE BEHAVIOR



SOURCE: Bandura, A. (1965)

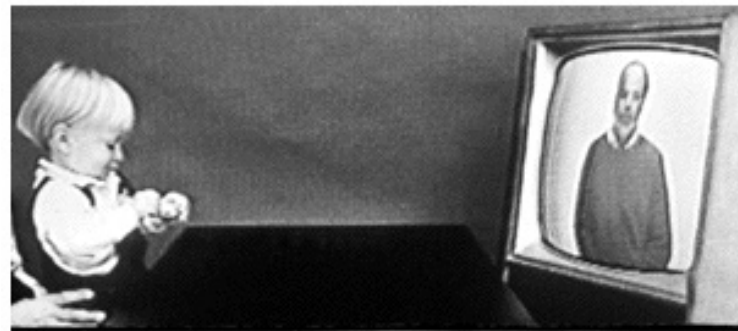
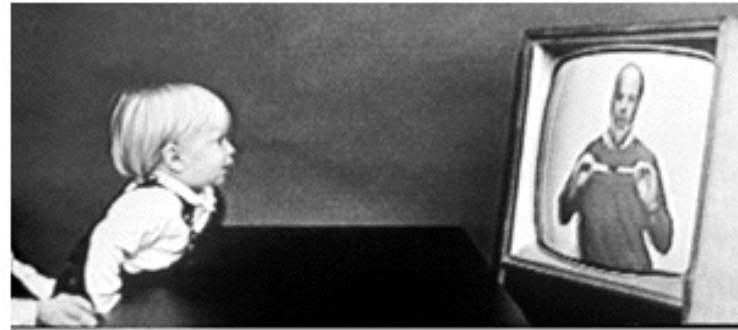
# Imitation May Not Always Be Desirable



"Okay that's it that's the last time he watches  
'Kung Fu."

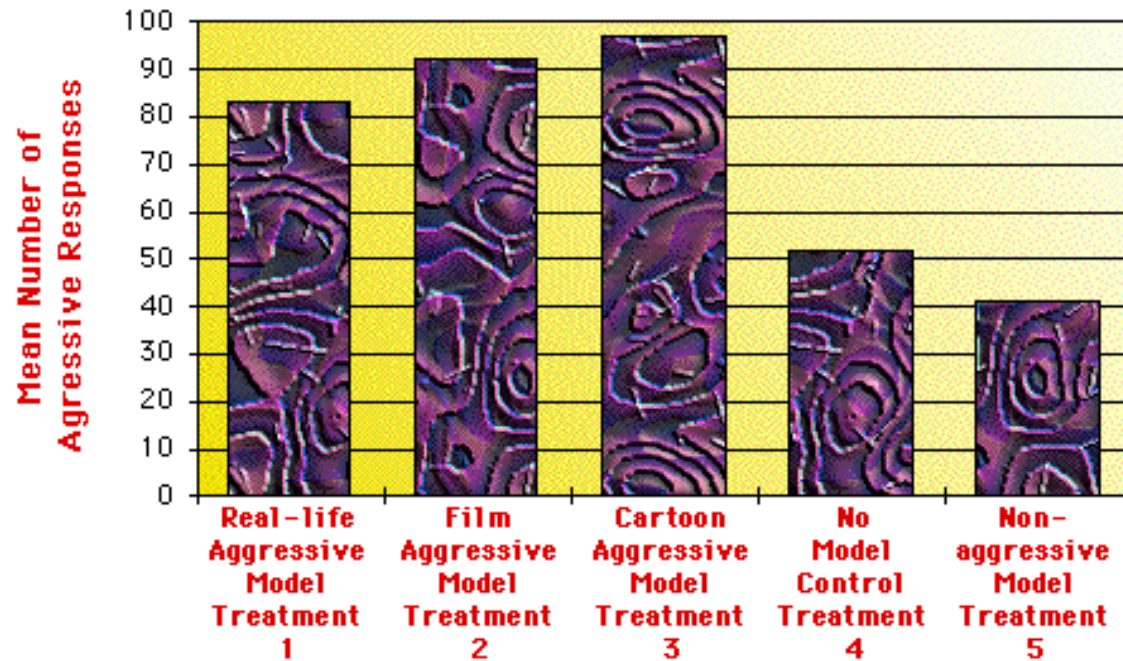
# Observational Learning via Television

- This 14-month-old boy is imitating behavior he has seen on TV



# Learning Aggressiveness

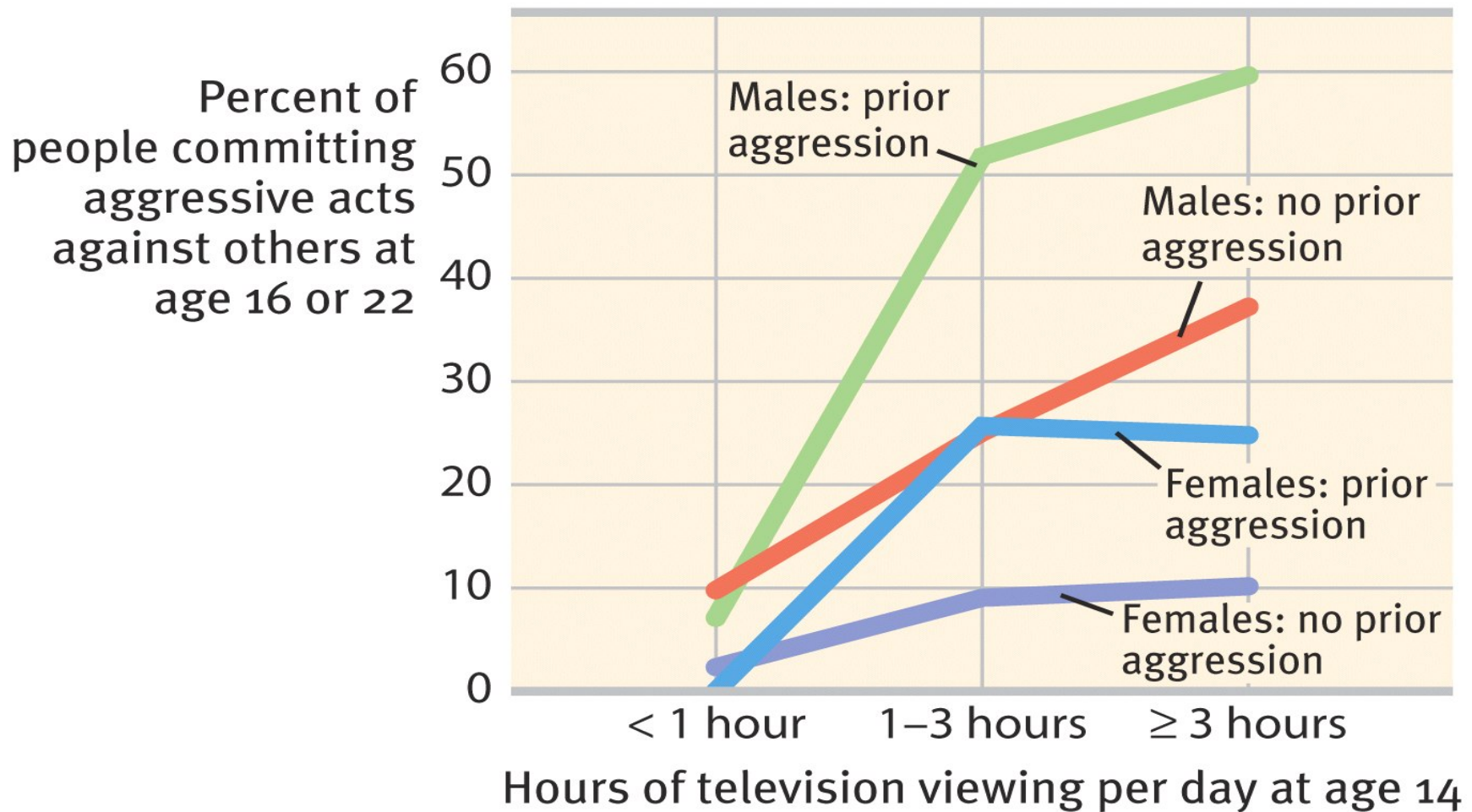
**Frequency of Aggressive Responses by Control Children and by Children Exposed to Aggressive and Inhibited Models**



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Source: A. Bandura, "The Role of Imitation in Personality Development," Reprinted by permission from *Journal of Nursery Education*, Vol. 18, no 3 (April, 1963): pp. 207-215. Copyright ©1963. National Association for the Education of Young Children. 1834 Connecticut Ave., N.W., Washington D.C. 20009.

# TV, Observational Learning, and Prior Experience



## What is the basis for this social learning?

- Selective attention
- **Mirror neurons**
- Motor primitives
- Classification-based learning system



# What Is The Role of Mirror Neurons In Imitation?

Lyons, “The Rational Continuum of Human Imitation”

- Their intriguing mapping of perception to action suggests a potential role in imitation
- But, if MN were simply responsible for imitation then monkeys would be good imitators
- Unfortunately, they are not

“Therefore, mirror neurons are not simply a dedicated imitation circuit”

# If Not Imitation Then What?

## Hypothesis

- Initially evolved as a mechanism for inferring other agent's intentions (which monkeys do well)
- Later recruited (adapted) to support imitation in primate evolution, especially the unique imitative capacity in humans
  - Mirror system “recognizes and segments” observed actions “into strings of discrete elements (a vocabulary of motor actions), each of which is a motor act in the observer's repertoire”
  - Imitation then is a matter of “replaying a sequence of familiar motoric subcomponents after they have been automatically extracted from visual input”

\*\*\*Note the similarity to what we do with language and remember that MNS is embedded in Broca's area\*\*\*

# What Is Imitation Really?

## Problems

- it oversimplifies what imitation is.
- It assumes imitation is a low-level process.
  - “the encoding of observed actions to an automatic ‘resonance’ process”
  - A matter of plugging an input perception stream directly into an output motor stream without the need for interpretation or transformation
- It occurs without much cognitive mediation

Although effortless and automatic, imitation is a highly interpretive process that involves significant amounts of inference making and cognitively-mediated representation. Therefore, a full and complete theory of MNS involvement in imitation must take this complexity into account.

# Deconstructing Imitation

Furthermore, a complete theory must account for two aspects of imitation that seem to be contradictory

- **Selective (rational) imitation**
  - Children (as young as 12mos) use subtle social and contextual clues to infer which aspects of an observed behavior merit careful reproduction and which can be ignored
- **Overimitation (irrational) imitation**
  - Children persistently copy actions that are obviously irrelevant or counterproductive

# Selective Imitation

- The “novel” lightbox (Gergely et al., 2002)
  - Infants (14-mos) observe an adult cause the box to light up by pushing on its transparent plastic top
  - Instead of using hands, the adult leans over and pushes panel with his forehead
  - Infants are brought back a week later and allowed to manipulate the lightbox
    - ~67% attempt to illuminate it with forehead (faithfully imitating or copying the adult model)
    - Authors noticed that in this condition adult model had his hands visibly free and therefore appeared to deliberately choose the forehead instead of hands – perhaps infants were sensitive to this rationalization.

## Test of “Rational” Imitation

- Gergely et al. replicated study with two conditions and a slight twist – the adult model now had a blanket wrapped around her shoulders
  - Hands-free: adult used her forehead while hands rested flat on the table, appearing to “choose” to use her forehead
  - Hands-occupied: adult used her forehead while using her hands to keep blanket tightly wrapped around her, appearing to have no option but to use her forehead
- Results
  - Hands-free: 69% of children used their forehead
  - Hands-occupied: only 21% used forehead (they emulated the goal not the specific action)

# Overimitation

- Horner and Whiten (2005) compared imitative tendencies in 3- and 4-year olds and similarly aged chimps.
  - What effect would the availability of causal information have on imitation strategy?
- Both groups observed an adult extract a reward from inside a novel object, composed of an upper and lower compartment.
- The reward was located in the lower compartment and could be easily obtained through a door in the front
- However, the participants watched the adult retrieve the reward in an awkward or less efficient manner – uncovering the top of the box, tapping a wand inside the empty top compartment, and then reaching in the front door to retrieve the reward

## Overimitation (cont)

- The two groups saw the experimenter do this in two conditions
  - One version of the box had opaque walls making it difficult to tell how necessary or superfluous the actions of the experimenter were
  - In a second condition, the box had transparent walls and observers could readily tell if the experimenter's movements were necessary for achieving the goal
- Results
  - A rational imitation model would predict that in the opaque condition, in which no causal information is available, children should imitate the behaviors but in the transparent condition they should emulate the goal

## Results

- Monkeys behaved as predicted – rationally
  - 60% imitated in the opaque condition
  - ~100% emulated in the transparent condition
- Surprisingly, children’s responses were the same for both conditions – they overimitated!
  - Most tended to imitate in the opaque condition
  - But, they also tended to imitate in the transparent condition (doing all the unnecessary steps as well)

\*\*\* All studies in which children overimitate appear to involve actions on novel tools and artifacts \*\*\*

# Theories of Overimitation

- Imitation appears to have at least two slightly different motivations:
  - A means of learning about the world (a desire to learn)
    - A way to extract new knowledge from the behaviors of others
  - A form of social interaction (a desire to relate)
    - Centers on the ‘similarity relation that is established between the imitator and the model’ and less on the actions *per se*
- Young infants and children copy behaviors primarily to learn about the world. By their second birthday, they copy primarily for social reasons
  - Overimitation is seen as a byproduct of the desire to “promote a shared experience with others” (social game theory of overimitation)

## But, How Different are They?

- Assumption: behavior has a fundamental hierarchical organization (i.e., superordinate behaviors constructed from a finite vocabulary of simpler ones)
- Computationally, selective imitation assumes the imitator switches from imitation to emulation at some critical point
  - This switch point is the result of some rational process that determines that the goal is what is important not how the action is made
  - This leads to efficiency, ease of performance, ease of learning, conservation of attentional resources, etc

Problem: imitators are unlikely to know with certainty which details of the modeled behavior are functionally important and which are not.

## How Do Children Know When to Switch

- One answer is pedagogy: They receive assistance from adult models
  - Adults offer cues to help direct children's attention
- Another answer is that children “attempt to compute the significance of the information that is lost if that goal was accomplished emulatively rather than imitatively.”
  - How that's done isn't clear. But, it seems that the intentionality of the actor is taken into account

# Are Tools Special?

- Most new and novel tools are causally opaque – i.e., we can't know how to use them simply by inspecting the physical device
- Because of that selective imitation would be difficult to do and therefore actions that appear unnecessary may have a significance that is hidden to us
- We privilege the actor's implied knowledge over our own incomplete knowledge
- Why is this not true for monkeys, who are able to use some simple tools?
  - Do they understand tools as tools?
    - They only used for immediate needs; they don't save them or reuse (simple teleology)

# Human Tool Use

- Evolved from simple teleology to inverse teleology to recursive teleology
  - I.T = thinking about the goal that a particular object could facilitate
  - R.T = ability to conceptualize objects as tools for making other tools (key difference)
- Creates a challenge for observational learning because the goal state is not easily identifiable (e.g. tool developed for future use rather than immediate use) and the rewards are not clearly linked to reinforcers
- The human capacity for IT and RT means that the informational significance of tool action is difficult to estimate accurately