Social learning, traditions, teaching

Ádám Miklósi
Department of Ethology
Eötvös University, Budapest
Defintion

Obtaining new behavioural skills by being exposed (observing, listening) to other skilled individual

Japanese macaque
Kawamura, Itani, Kawai: potato washing

Importance of experiments
„Biological approach“

Species typical behaviour: (Zentall 2004)

High reliability, low flexibility

Individual Learning:

High flexibility, negative consequences

Social Learning:

High flexibility, few negative consequences

Stable environment:
Species typical behaviour
Variable environment:

Slow changes
Social learning
Rapid changes
Individual learning
Is social learning an adaptation?

- Is there an advantage of being able to learn socially?
- Is social learning an adaptation to special environmental challenges?

Does social learning offer an advantage over individual learning?

Are social species better in "social learning" than solitary ones?

- e.g. lions versus cheetah

Heyes (2012) asocial and social learning is not different (only in input)
Social learning „strategies“  
(Laland 2004)  

„Producers” and „scroungers”  
population equilibrium at equal fitness  

Producers/scrounger individuals  
or  
Producing/scrounger tactics in all individual  

Animals must be selective in using social learning  

WHEN?  
WHO?
Producers/scrounger individuals

Giraldeau and Lefebvre (1986): Opportunity to scrounge may reduce performance

Group I (N=8): observation only – learning to open the tube
Group II (N=8): observation+ scrounging – little learning
Public and private information

Training: using the „rich feeder” (private information)

Test after 2 parallel demonstrations

Stickleback

Social learning strategies

when established behaviour is unproductive
when asocial learning is costly
when uncertain

the majority
if rare
successful individuals
if better
if dissatisfied
good social learners
kin
„friends“
older individuals

Laland 2004
Social “misinformation” in fish?

Training of founders

Transmission chain:
Replacement of founders with naive fish (followers)

90% of followers prefers the “long route”
Other adaptive constrains, trade offs...

They prefer to swim with the school because it is safer

Laland and Williams 2002 Behav. Ecol.
Social „misinformation“ in chimpanzees?

Ant-dipping in chimpanzees
(Goodall, 1963, McGrew, 1974)

Variation among populations
(Whiten et al. 1999)

Differences in techniques
1. „Pull through“ (Gombe)
2. „mouthing“ (Tai)

„Pull through“ is more efficient

Undetected environmental variation can explain „suboptimal“ behaviour

Chimpanzees are fishing for different ant species
Differences in inflicting pain

Actually, a possible test would be to try ant dipping with naive humans
Social learning mechanisms

A-sample → A’ copy

What type of information is the observer extracting when it watches demonstrators solving a problem?

Tennie et al 2006

Demonstration of learning!

No learning:

Mimikri: genetic basis, broken wing display (Plover)

Social facilitation:
Increase in frequency of an established behaviour
  barking (dog)
  watching an eating conspecifics (chick)
  yawning (human)
A taxonomy of imitative and emulative learning processes of solving problems by observations

- **Imitation**
  - copying the form of an action

- **Object Movement**
  - re-enactment
  - copying the form of a caused object movement

- **End-State Emulation**
  - copying only the end or outcome of an action sequence

---

**Affordance Learning**
- learning about operating characteristics of objects or environment

---

**Social Learning**
- copying what another individual does

---

**Imitative vs. Emulative**
- shape
- sequential structure
- hierarchical structure
- causal links
- intentional links

**Result Emulation**
- goal emulation

---

**Other Forms of Social Learning**

---

Whiten A et al. Phil. Trans. R. Soc. B 2009;364:2417-2428
Methodological problems in the study of social learning

Control for "learning"
Excluding contagious behaviour
  e.g. facilitation of feeding in puppies
Introduce delay between observation and performance

Control for "observation"
Control group – no demonstrator
Experimental group – demonstration

Control for social facilitation ("presence")
Control group – no demonstrator
Social facilitation – demonstrator
Experimental group – demonstration
Social learning mechanisms

Local and stimulus enhancement
Increased likelihood of visiting a place (local) or contacting a type of stimulus by virtue of observing others doing it.

Transmission of food preference

Eichenbaum 2000
Social learning mechanisms

**Observational learning** ("conditioning" associative processes): Associating a cue or object with an affective state or behaviour(s) by virtue of observing demonstrators respond to it (learning about positive or negative value)

Box opening (pierce paper) by pigeons (Palameta and Lefebvre, 1985)

<table>
<thead>
<tr>
<th>No model</th>
<th>Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening + No eat</td>
<td>NO</td>
</tr>
<tr>
<td>Opening + eat</td>
<td>YES</td>
</tr>
<tr>
<td>No open + eat</td>
<td>Gradually</td>
</tr>
</tbody>
</table>
Social learning mechanisms

Observational learning

Curio 1986
Social learning mechanisms

**Emulation:** Learning about possible goals, affordances ("what can be done with objects or parts of the environment")

Mitchell (1987) “the organism is not bound to reproduce the model, but reorganizes the relationship between model and copy to its own ends

Object movement re-enactment
Definitions of imitation

Descriptive definitions

Thorpe (1956) „true“ imitation
...copying of a novel action without natural predisposition or in the case of which we have no simpler explanation...

Whiten and Ham (1992)
...the observer copies some aspect of the behaviour of the demonstrator ....

Heyes (1992)
... the observer acts in a way that is topographically similar to the action of the demonstrator...
Definitions of imitation

Imitation:
Copying the form of the action (shape, sequential structure, hierarchical structure)

“Cognitive imitation”

Whiten and Byrne (1991)
Ability to take the other’s perspective
Representation and re-representation

Call and Tomasello (1995)
Recognition of the goal, achieving the goal by imitation

“Non-cognitive imitation”

Tomasello and mts 1993: aping (mimicking)
Byrne 1998: response facilitation
Imitation: Problems

Measuring behaviour
correspondence between demonstrator and observer

Novelty
relative
previous learning

Level of complexity
motor behaviour, novel behaviour?
arbitrary (non-species specific) behaviour
Two-action task

“Non-cognitive imitation”
Response facilitation
Preferred action type

(Zentall, Sutton, & Sherburne, 1996).
Imitation of a motor skill

The movement of head position in space at 1/25 sec intervals

Marmoset (*Callithrix jacchus*)

Voelkl and Huber 2000
Imitation: Do as I do!

„Do as I do” method with human demonstrator:

Performing a „matching” action on the basis of observing the demonstrator

COMMAND: DO IT! (CSINÁLD!)
1. Training of 3 actions
2. Training of further 6 actions

Transfer testing:
1. Novel demonstrator
2. Control for the demonstrated action
3. „Novel” demonstrations


Philip, the dog for disabled Belgian shepherd, 4 years old
Levels of imitation

Byrne and Russon (1998)

**Action level imitation:** copying of individual units

**Program level imitation:** copying the structure of behaviour

**Copying action sequences** (Whiten 2000)
Hierarchical imitation

The role of imitation in feeding

Processing of food:

Mountain gorilla (Byrne 1995)

Stinging hairs!

nettle (Laportea alatipes)
Eating neetle
(after Byrne)

- Top down
- Left-right hands
- Dotted line bimanual coordination
- Deltoid: decision points
- Brackets: possible choices
Neural basis of social learning?

Mirror neurons
Representation of elementary actions (grasping, holding, tearing)
“UTILISING” the behaviour of the other

Observation has an **some influence** on the behaviour of the observer
Observer **modifies** its motor behaviour

The output is the resultant of the interaction between

- representations of the observed behaviour
- and
- representations of the existing behaviour

Social learning situation can be used to investigate the individual’s ability to “understand/represent” the action of the other.
The concept of efficiency

The observer assigns a goal (target) to an action by evaluating its efficiency as an optimal means of obtaining the same target within the specific constrains of the situation (Brass et al 2007)
Selective (rational) imitation

Gergely et al 2005

Subjects (12 month old children) choose the imitative action only if there "seems" to be reason for it
⇒ overimitation
⇒ "pedagogy"
## Aquisition of behavioural skills.....

<table>
<thead>
<tr>
<th>Method</th>
<th>(inflexible?)</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited</td>
<td></td>
<td>spider’s web, rat-killing</td>
</tr>
<tr>
<td>Trial and error</td>
<td>(slow?)</td>
<td>crow’s tool use</td>
</tr>
<tr>
<td>Social learning</td>
<td>(slow?)</td>
<td>potato washing in monkeys</td>
</tr>
</tbody>
</table>

**WHY TEACHING....?**
A functional definition of teaching

Actor A can be said to teach if (1) it modifies its behaviour only in the presence of a naïve observer, B, at some (2) cost or at least without obtaining an immediate benefit for itself. A behaviour thereby encourages B, punishes B, provides experience for B, sets an example for B.

As a result B acquires (new) knowledge or learns a skill (3) earlier in life or more rapidly or efficiently than it might otherwise do, or that it would not learn at all.

Caro and Hauser 1992
Teaching in cheetah: *Providing experience*

The mother brings dead/live prey to the den

<table>
<thead>
<tr>
<th>Age of cubs</th>
<th>Release of prey (%)</th>
<th>Action of the mother</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 months</td>
<td>less than 5%</td>
<td>80% kill</td>
</tr>
<tr>
<td>3.0 months</td>
<td>20%</td>
<td>80% kill</td>
</tr>
<tr>
<td>4.5 months</td>
<td><strong>70%</strong></td>
<td>80% kill</td>
</tr>
<tr>
<td>8.0 months</td>
<td>30%</td>
<td>50% kill</td>
</tr>
<tr>
<td>12 months</td>
<td>20%</td>
<td>20% kill</td>
</tr>
</tbody>
</table>

Cost: prey escapes
Facilitation of prey catching??

Caro, 1980
Teaching in vervet monkeys: Encouragement and punishment

Vervet monkeys: alarm calling in infants

Correct calls (n=26): 50% encouragement, reinforcing effect?

Incorrect calls (n=5): after flight physical attack on caller

Modification of incorrect behaviour...?
Teaching in apes: Intervention

Nut cracking chimpanzee’ mothers (n=2)
  (in nature: Boesch 1991)

Chimpanzee Washoe modifies signing behavior of Loulis (n=1)
  (in captivity: Fouts et al. 1982)

Gorilla Alberta forces her dauther to accept her own baby (n=1)
  (in captivity: Nakamichi 2003)
Teaching in humans

Spontaneous interaction between British and Nigerian parents and their infants *(Whiten and Milner, 1984)*

<table>
<thead>
<tr>
<th>AGE OF INFANT</th>
<th>British</th>
<th>Nigerian</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Provide stable base</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Support manipulation</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Assist</td>
<td>88</td>
<td>100</td>
<td>75</td>
</tr>
<tr>
<td>Reveal object properties</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Create discovery</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Demonstrate</td>
<td>72</td>
<td>100</td>
<td>13</td>
</tr>
<tr>
<td>Teach</td>
<td>43</td>
<td>88</td>
<td>0</td>
</tr>
</tbody>
</table>

*Parents say they are „just playing“.....*
Teaching in gorillas: A human parallel?

Mother-infant interactions during acquisition of motor behaviours: crawling, climbing, walking (Whiten 1999)

<table>
<thead>
<tr>
<th>Provide stable base</th>
<th>physical support of climbing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support manipulation</td>
<td>physical support of climbing</td>
</tr>
<tr>
<td>Assist</td>
<td>support infant’s head during crawling</td>
</tr>
<tr>
<td>Reveal object properties</td>
<td>“dangling over the cliff”</td>
</tr>
<tr>
<td>Create discovery</td>
<td>holding against horizontal logs</td>
</tr>
<tr>
<td>Demonstrate</td>
<td>-</td>
</tr>
<tr>
<td>Teach</td>
<td>-</td>
</tr>
</tbody>
</table>
Is this teaching?

**YES!**
Adjusted to the competency of the infant
   Toward a level not yet manifested
   Differential levels of motor ability
   During performance

**No!**
Very rare cases observed (in captivity)
Restricted to certain individuals
Side-effects of interactions (play, boredom)

Apes are good information “acquirers” but bad donors!
Why is there no more teaching in „animals“?

1. too high cost for the parent
2. too simple skills (one trial-learning)
3. favoured in species with special skills (e.g. killing different prey, high cost of mistakes)

Caro and Hauser 1992
Human infants have innate cognitive mechanisms that enable them to learn from infant-directed teaching. They are sensitive to ostensive cues indicating teaching contexts, interpret actions occurring in these contexts as referential, expect the "teacher" to provide relevant knowledge about referents, fast-map such information to the referred object.

Early social cognition: proto-conversations, gaze following, pointing, social referencing, imitative learning.

Gergely and Csibra, 2004
Evolution toward ‘pedagogy’ in humans

1. **Changes in social behaviour**
   monogamy: more time for teaching activity
   both parents can teach different/same things
   ➔ generalisable knowledge

2. **The institution of „nurseries“**
   multiple relations between „teachers“ and „pupils“
   calling upon the subject (e.g. „name“)
   information about teaching act
   ➔ ostensive cues

3. **Complex skills with multiple orders of freedom (easy to miss out)**
   ➔ referential information
   ➔ fast mapping