Socially Biased Learning

Culture and Socially Biased Learning

Social learning as an adaptation

Darwin, Wallace, Romanes...

When is it advantageous to learn with conspecifics?

Things have to be learned fast (ex: predator avoidance)

Things that are costly to learn (ex: poisonous food)

Things that are too variable for genetic assimilation...

...but **not TOO variable**: adults are individuals who acquired behavioral patterns that allowed them to survive in the environment where current juveniles live (or...)

"Socially Biased Learning" X "Social learning"

Fragaszy & Visalberghi 2001:

"Social Learning" x "Individual Learning"?

ALL learning is "individual"…

... but sometimes, individual learning is "channeled, constrained, facilitated, or otherwise tweaked by social interactions".

Occurrence of Socially Biased Learning Ontogeny and Phylogeny

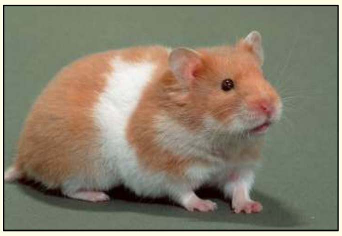
SBL is restricted to "social" species?

Social influences do not necessarily depend on **direct social interaction** (x consequences or remains of others' behaviour).

Birds & mammals: development and **parental care**

Occurrence of Socially Biased Learning SBL in asocial species?

Hamsters: solitary and social species (Lupfer et al 2003)



Golden hamsters (*Mesocricetus auratus*) and dwarf hamsters (*Phodopus campbelli*) interacted with a conspecific demonstrator that had recently consumed a flavored food. When given a choice between their demonstrator's flavor and another flavor, the dwarf hamsters preferred the flavor their demonstrator had eaten. Golden hamsters did not prefer their demonstrators' diets when the demonstrators were unrelated adults or littermates, **but they did when the demonstrator was their mother**.

Socially Biased Learning in asocial species?

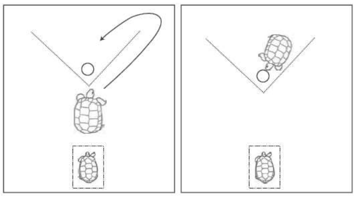


Figure 1. The experimental setup. The arrow indicates the direction in which the demonstrator moved.

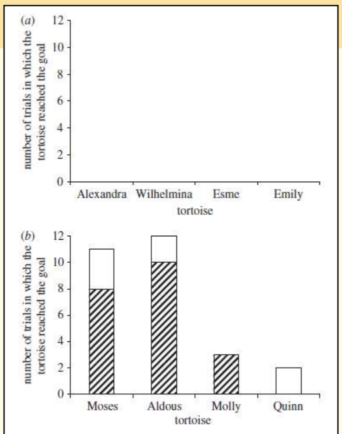


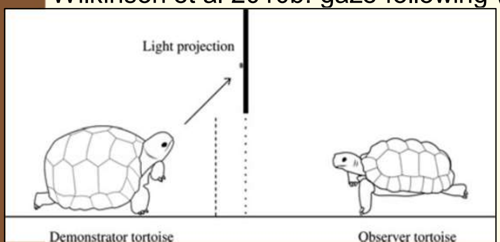
Figure 2. The number of trials in which the tortoises completed the detour and the direction taken for (*a*) the non-observer group and (*b*) the observer group. White bars, left; shaded bars, right.

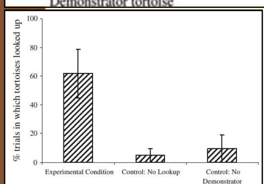
Wilkinson et al 2010a

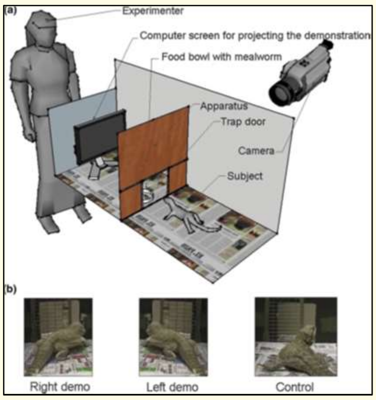
Social learning in a nonsocial reptile (*Geochelone carbonaria*)

Socially Biased Learning in asocial species?

Wilkinson et al 2010b: gaze following (*Geochelone carbonaria*)







Kis et al (2014): Social learning by imitation in a reptile (*Pogona vitticeps*) [bearded dragon]

Socially Biased Learning in asocial species?

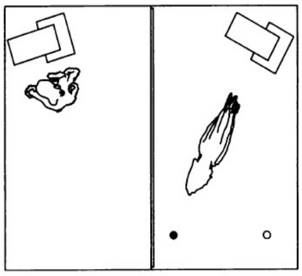
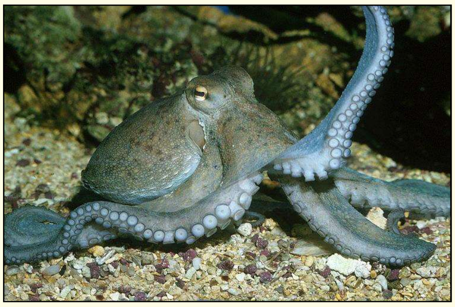


Fig. 1. Schematic of the experimental apparatus and protocol. An *Octopus vulgaris* is shown (right side of the figure) attacking a ball (the red one) and acting as a demonstrator for the other animal (observer, left side) that is standing outside of its home and watching its conspecific during the whole session through a transparent wall. Each tank had an independent supply of running water. Octopuses were allowed to visually interact for 2 hours before the start of the observational phase. Mean duration of the trials, which depended on the demonstrator's performances, was 40 s, and intertrial intervals were fixed at 5 min.



Fiorito & Scotto 1992
Observational Learning
in *Octopus vulgaris*

Looking for evidence of social learning

Learning what to eat – or not (*Rattus norvegicus*)
Galef & Laland 2005

Poison avoidance
Steiniger (1950):

Difficulty in poisoning a rat colony: some rats ate only small amounts of poisoned food, survived and started avoiding that food; new generations rejected the poisoned bait: did they learn to avoid it?

x Galef & Clark (1971): … no; rats do not learn which foods to *avoid*, BUT which to *eat* – and are reluctant to ingest foods not introduced by older members (the result is the same…)

Learning what to eat – or not (*Rattus norvegicus*)
Galef & Laland 2005

Prenatal influences
Hepper (1988): garlic (pregnant mothers) x onion

Taste cues in mothers' milk
Galef & Sherry (1973): flavored milk + poisoning

Cues during weaning
Galef & Clark (1973): co-feeding + scent marks

Cues after weaning
Behavior observation (Galef et al 1983, 2003)
Breath: scent + carbon disulfide (Galef et al 1988)

Learning how to get food

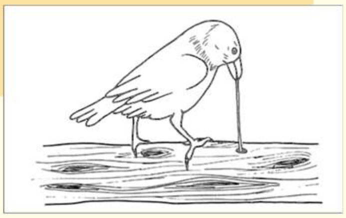
Defended food

Rats (*Rattus rattus*):
pine cone opening

- No individual trial-and-error learning
- No observational learning
- No effect of mother milk
- Cross-fostering: infants adopted by proficient females
- No learning from exposition to fully peeled pine cones
- Learning by exposition to PARTIALLY PEELED cones

Terkel 1996

Learning how to get food



Tool use

Galapagos woodpecker finches (Tebbich et al 2001)
Hyacinth macaws (Borsari & Ottoni 2005)
→NO evidence of SBL

New Caledonian crows?
(Hunt 2000, Hunt & Gray 2002 X Kenward *et al* 2005, 2006)

Primates (chimps, orangutans, capuchins...)?

Learning to choose a mate

Mate choice copying

Fish: guppies (*Poecilia*):

Dugatkin 1992: confined females observing a male paired with a female X solitary male; observer later preferred to mate with paired ("chosen") male.

(not all guppies' species, but)

Other species: Brown & Laland 2003

Social learning and mate choice in birds

Song (dialects) and partner choice

Quails, *Coturnix japonica*

Cowbirds, *Molothrus ater*

Kirkpatrick 1987
Galef & White 1998

laboratory: observationally transmitted preferences for males

Adult males learn [and females prefer] local song dialects (Freeeberg 1996, 2004)

Females "model" young males' song (West 2000)

Birdsong learning
Peter Marler
P. Slater

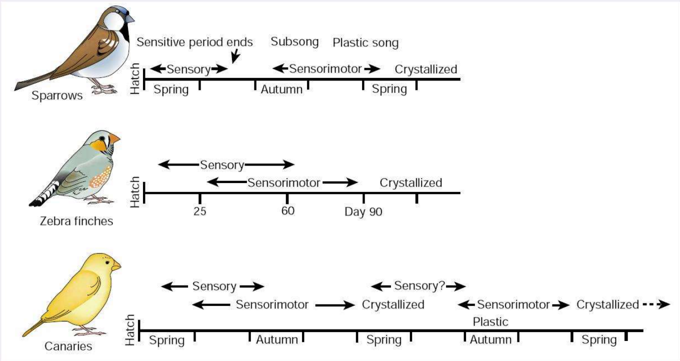


Figure 2 Timelines for song learning. **a**, In many seasonal species, such as the white-crowned sparrow, the sensory and sensorimotor phases of learning can be separated in time. The initial vocalizations, or 'subsong', produced by young birds are variable and generic across individuals, akin to the babbling of human infants. Subsong gradually evolves into 'plastic song', which remains highly variable from one rendition to the next, but also begins to incorporate some recognizable elements of tutor songs. Plastic song is progressively refined until the bird 'crystallizes' its stable adult song. **b**, Zebra finches develop rapidly, and their two phases of learning overlap extensively. **c**, 'Open learners', such as canaries, can continue or recapitulate the initial learning process as adults.

Brainard & Doupe 2002

Song learning and genetic predispositions

Zebra finches (Fehér et al 2009): song culture as a *multi-generational phenotype*, partly encoded genetically in an isolate founding population, influenced by environmental variables, and taking multiple generations to emerge.

Zebra finch isolates, unexposed to singing males during development, produce song with characteristics that differ from the wild-type song found in laboratory or natural colonies. In tutoring lineages starting from isolate founders, we quantified alterations in song across tutoring generations in two social environments: tutor-pupil pairs in sound-isolated chambers and an isolated semi-natural colony. In both settings, juveniles imitated the isolate tutors, but changed certain characteristics of the songs. These alterations accumulated over learning generations. Consequently, songs evolved toward the wild-type in 3–4 generations. Thus, species-typical song culture can appear *de novo*.

Song learning and genetic predispositions

Crossfostering in the lab: male zebra finches & Bengalese finches (Clayton 1989): mixed features in cross-fostered males' songs

Natural crossfostering: Galahs raised by cockatoos: begging calls ("innate"?) x flight, imprinting /courtship (Rowley & Chapman 1986)

Galah (*Eolophus roseicapilla*) Mitchell's cockatoo (*Cacatua leadbeteri*)

Janik & Slater 2000
The different roles of social learning in vocal communication

Contextual Learning: a **pre-existing signal** comes to be associated with a **new context** as a result of experience with the signals of other individuals. CL can occur in both the signaler and the receiver:

- **Usage Learning**: the individual learns to use the same signal in different contexts to encode different messages;
- **Comprehension Learning**: a receiver can learn to associate a pre-existing signal with a new context (…) and thus, extract a new meaning from it.

Production Learning refers to instances where the **signals themselves are modified** in form as a result of experience with those of other individuals. (to which the expression 'vocal learning' has traditionally been applied in studies of bird song).

Janik & Slater 2000
The different roles of social learning in vocal communication

INNOVATION AND INVENTION

Tyack 1997: bottlenose dolphins - novel signals for individual recognition?

Janik 2000
"Signature whistle" of bottlenose dolphins (*Tursiops truncatus*)

Modes of Social Information Transfer

Social Information Transfer (King 1991, 1994): does not discuss *mechanism*: increase in behavioral homogeneity due to social interaction and its persistence in time.

Social facilitation (incl. "contagium")

Stimulus/Local Enhancement

Imitation and Emulation

(Functional) Teaching (or "scaffolding")

Social biases on learning
Visalberghi & Fragaszy (1990):

Social facilitation: an increase in the probability of the emission of a behavior (already present in the repertoire of the individual) as a consequence of the presence of other individuals exhibiting the same behavior (increases behavioral homogeneity of behavior by promoting motivational homogeneity; ex: mobbing)

Stimulus/local enhancement (Thorpe 1956): individual's attention attracted to elements of the environment as a function of other individual's activity – increasing probability of interaction of that element [Whiten & Ham 1992: enhancement ≠ observation learning]

Galef (1988): "S. Facilitation + St. enhancement = Social Enhancement"

Imitation: novel behavior acquired by its observation in another individual's repertoire

Heyes (1993): "imitative" X "non-imitative" social learning

Stimulus Enhancement
Local Enhancement

Observation of behavior x

Attention orientation to environmental elements

Contact with environmental alterations resulting from other individual activities *even in the immediate absence of the agent*

The fourth dimension of tool use: temporally enduring artefacts aid primates learning to use tools
Fragaszy et al 2013

All investigated cases of habitual tool use in wild chimpanzees and capuchin monkeys include youngsters encountering durable artefacts, most often in a supportive social context.

Enduring artefacts associated with tool use, such as previously used tools, partly processed food items and residual material from previous activity, aid non-human primates to learn to use tools, and to develop expertise in their use, thus contributing to traditional technologies in non-humans.

Therefore, social contributions to tool use can be considered as situated in the three dimensions of Euclidean space, and in the fourth dimension of time. **This notion expands the contribution of social context to learning a skill beyond the immediate presence of a model nearby.**

Sandstone “anvils” used by capuchin monkeys (FBV)

Lithic x probe tools...?
(Ottoni 2015)

St. enhancement, scrounging and Socially Biased Learning

Ottoni, Resende & Izar 2005

Capuchin monkeys: observation of nut-cracking by juveniles: "commensalism" (*tolerated scrounging)* as a proximal motivation? **(an *age-dependent* strategy...)**

Behavior observation x **endosperm leftovers** in nut cracking sites (*local enhancement* + reinforcement: "niche construction")

Young observers/scroungers seem capable of choosing the most proficient nutcrackers – which not only optimizes [adult-dependent] feeding, but also the conditions for SBL

Watching the best nutcrackers: Observation targets' choice by infant and juvenile scroungers

Ottoni, Resende & Izar 2005

Observation rates X social affinities?

X Spatial Social Proximity	Partial Tau K_r=.125, p_r=.8486	**NS**
X Dominance	Partial Tau K_r=.148, p_r=.1824	**NS**
X Age (X^2: p<.0001)	Partial Tau K_r=.076, p_r=.3123	**NS**
X **Proficiency***	Partial Tau K_r=.232, p_r=.0495	**S**
*[*Prof. X Cracking Abs.Freq.:*	*Partial Tau K_r=.114, p_r=.2569*	***NS**]*

(it does not require a complex "cognitive" explanation: reinforcement is sufficient!)

Coelho et al. (2015): When the behavior entered the "tradition phase", with highly proficient adult males, the correlations with Age & Dominance became significant (in this situation, youngsters can use a "rule-of-thumb": "follow dominant male").

Scrounging x learning

Perondi, Izar & Ottoni 1995

Scrounging x learning: frequency-dependent?

Pigeons unable to simultaneously scrounge & learn socially?

Giraldeau & Lefebrve 1987

Pigeons that learned socially to produce seed by removing the stopper from a test tube would switch from producing to scrounging and back again as a function of whether there were producers active in the population. Scroungers and producers maintained a frequency-dependent balance.

Giraldeau & Beauchamp 1999

Imitation and Emulation

Imitation: lack of agreement between authors:
(strict sense): a **novel** behavior in the individual's repertoire is copied through the **observation of another individual's behavior**
For some authors (ex: Tomasello), imitation implies an understanding of the observed individual's **goals** ("*joint attention*" etc) and/or "**metarepresentation**" of others' mental states (Whiten, Ham, Byrne)

Emulation (Tomasello 1987, Whiten & Ham 1992): a more "restricted" process than true imitation: copy of the final result of the behavior (but not of all procedural details).

Imitation and "over-imitation" (see lecture 8...)

Imitation and Emulation

Learning by imitation: a hierarchical approach
Byrne & Russon (1998)

"Program-Level" Imitation: "*a broader description of subroutine structure and the hierarchical layout of a behavioural "program.""*
A high-level, constructive mechanism, adapted for the efficient learning of complex skills and thus not evident in the simple manipulations used to test for imitation in the laboratory (ex: food processing by gorillas) [a possible reconsideration of "emulation"...]

"Action-Level" Imitation: "*a rather detailed and linear specification "of sequential acts*" Seldom observed in great ape skill learning, and may have a largely social role, even in humans.

Teaching in non-human animals?

Anecdotal reports (since Romanes)...

Rodrigues Islands' frugivore bats: Experienced female demonstrates birth posture (head up) to another (primiparous?) female?

T. Kunz 1997

Pteropus rodricensis

Teaching (strict sense)

Intentional information transfer by the model

X Youngster's readiness to watch older individuals

Humans

ToM, Imitation (Tomasello 2001)?

"Natural Pedagogy" (Csibra & Gergely 2011)

Chimpanzees ?

- Captivity: the infant Loulis learning Sign Language (Fouts 1998)
- Wild: mother "demonstrates" correct "hammer" use (Boesch 1991) (?)
  mother-infant hand-clasp grooming (Nakamura & Nishida 2013)

Other mammals and birds:

"Functional teaching" as "species-specific" patterns?
(= "***scaffolding***", ~ Fixed Action Patterns?)

Teaching in wild chimpanzees?

Boesch 1991: Teaching in wild chimpanzees

Teaching in language-trained chimpanzees

Loulis, adoptive son of Washoe learned sign language from the mother and an age peer

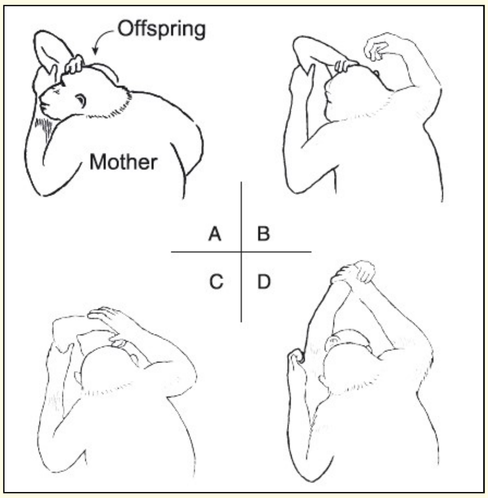
Washoe "molded" his hands into signs (as previously done to her)

Fouts 1998

Ontogeny of a Social Custom in Wild Chimpanzees: Age Changes in Grooming Hand-Clasp at Mahale
Nakamura & Nishida 2013

A mother "molding" the offspring gesture

(~ Washoe and Loulis!)



"Scaffolding"

Terkel 1996 (*Rattus rattus*)
Opening of pine cones for seed extraction through the removal of the "scales"

Functional Teaching

Caro & Hauser (1992) - Functional definition of "teaching":

(i) an individual, A, modifies its behavior only in the presence of a naïve observer, B;

(ii) A incurs some cost or derives no immediate benefit; and

(iii) as a result of A's behavior, B acquires knowledge or skills more rapidly or efficiently than it would otherwise, or that it would not have learned at all.

"Opportunity teaching" (put pupil in condition conducive to learning)
X "Coaching" (encouragement + punishing)

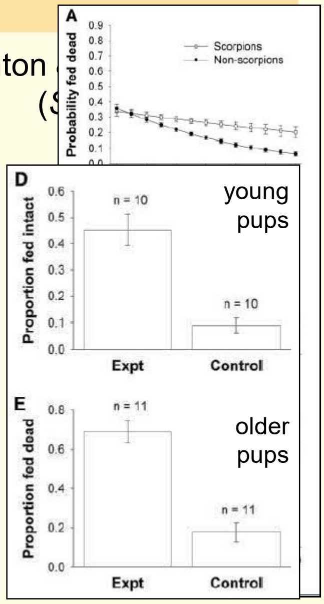
Lessons from animal teaching
Hoppitt et al 2008

" (…) we endorse Caro and Hauser's definition with one caveat. Their requirement that there be a **cost** or no immediate benefit to the tutor is only partially successful in **ruling out behaviour with alternative functions**. For instance, parental provisioning is costly and can transmit dietary preferences to offspring, but it might have evolved because selection benefits parents that provide nutrition to their young, rather than because provisioning functions to teach.

Consequently, for cases where behaviour increases the inclusive fitness of the tutor, irrespective of whether knowledge is transmitted to the pupil to be regarded as teaching, we would require evidence that the tutor's behaviour has been modified by selection to promote learning."

"Functional [opportunity] teaching" in meerkats

Thornton
(S



Handling of dangerous prey (scorpions) according to pups' age

Adults' behavior controlled by infants' vocalizations

"Functional Teaching" in pied babblers?

Raihani & Ridley 2008: Experimental evidence for teaching in wild pied babblers (*Turdoides bicolor*)
Association between "purr" calls and food "conditioned" in nestlings;
Nestlings beg in response to calls/ Fledglings approach calling adults:
Recruitment for foraging / Leading away from predators?

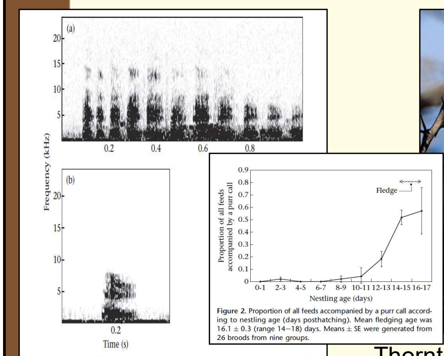
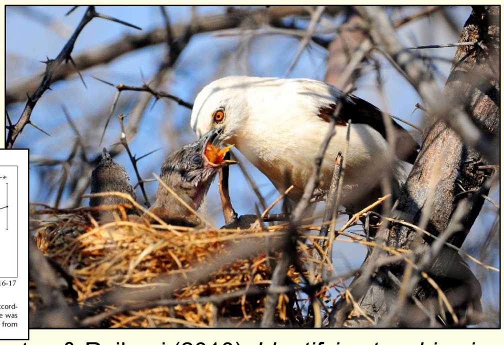


Figure 1. Sonogram to illustrate examples of (a) purr calls and (b) foraging calls used in experimental playbacks.

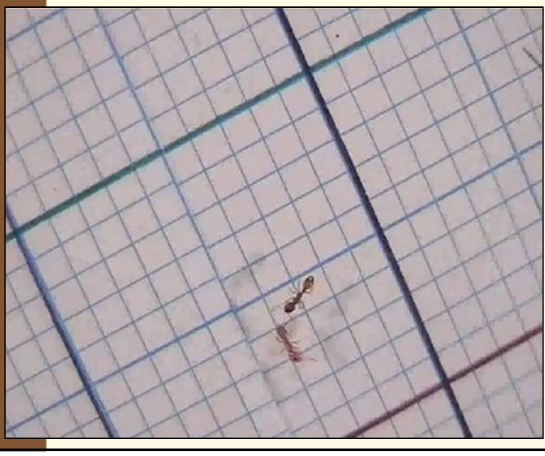
Figure 2. Proportion of all feeds accompanied by a purr call according to nestling age (days posthatching). Mean fledging age was 16.1 ± 0.3 (range 14–18) days. Means ± SE were generated from 26 broods from nine groups.

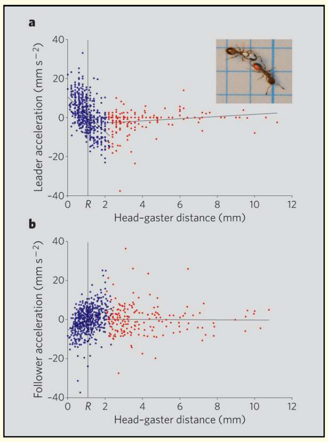


Thornton & Raihani (2010): *Identifying teaching in wild animals*: parental care / cooperative breeders?

"Functional Teaching" in ants

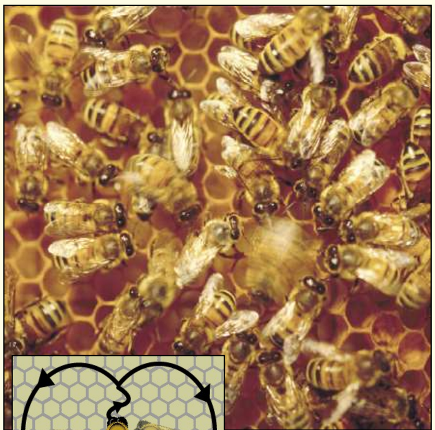
Franks & Richardson 2006: Teaching in tandem-running ants (*Temnothorax albipennis*): leaders and followers adjust velocities, leaders wait while followers stop and (presumably) search for landmarks.

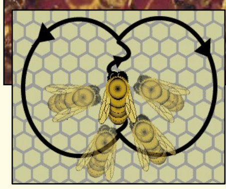




Hoppitt et al 2008
Honeybees' waggle dance as teaching?

"According to the criteria of Caro and Hauser, the waggle dance of honeybees (…), historically not considered as teaching, could be seen in a similar light to tandem running in ants. (…) We suggest that the waggle dance, and indeed other forms of communication in bees, constitute strong cases of teaching."





Apis mellifera

Lessons from animal teaching
Hoppitt et al 2008

The evolution of teaching

Instead of being seen as a separate set of mechanisms for information transfer, teaching can usefully be regarded as introducing another dimension to social learning: **whether the role of the demonstrator is active or passive**. Teaching will often arise as signals, or responses, given by tutors that take advantage of **pre-existing social learning mechanisms.**

We expect that **specific forms of teaching will have evolved from the ancestral condition of the equivalent form of inadvertent social learning.** For example, teaching by local enhancement is only likely to evolve in a population that exhibits inadvertent local enhancement. This is because, to teach in this way, a tutor need only evolve signals or other behaviour necessary to increase the likelihood or efficiency of local enhancement in the pupil.

Lessons from animal teaching
Hoppitt et al 2008

Table 2. Parallel classification of processes involved in social learning based on 'inadvertent'[a] information and social learning based on teaching, with plausible examples

Type	Inadvertent social learning	Teaching
Local enhancement	*A demonstrator inadvertently attracts an observer to a specific location, leading to the observer learning.* Naïve guppies follow informed individuals to food [56].	*The behaviour of the tutor functions to attract a pupil to a specific location, leading to the observer learning.* Tandem running in ants [15], in which leader ants slow down to ensure followers keep in touch (Box 3).
Observational conditioning	*The behaviour of the demonstrator inadvertently exposes an observer to a relationship between stimuli, allowing the observer to form an association between them.* Blackbirds learn to recognise predators through observing birds mobbing unfamiliar objects [69].	*The behaviour of the tutor functions to expose a pupil to a relationship between stimuli, causing the pupil to form an association between them.* Adult babblers expose nestlings to the relationship between the 'purr' call and food [20].
Imitation	*After observing a demonstrator perform a novel action, an observer learns to reproduce that action.* Birds learn to produce novel sounds through vocal imitation [70].	*The behaviour of the tutor functions to demonstrate a novel action, causing the pupil to learn how to perform it.* A human tennis coach demonstrates a shot.
Opportunity providing	*The products of the behaviour of the demonstrator provide the observer with an opportunity to engage in operant learning that would otherwise be unlikely to arise, for example by providing an easier, less dangerous or more accessible version of the task.* Black rat pups in Israel steal semiprocessed pinecones from their mothers [23].	*The behaviour of the tutor functions to produce products which provide the pupil with an opportunity to engage in operant learning that would otherwise be unlikely to arise, for example by providing an easier, less dangerous or more accessible version of the task.* Adult meerkats provide pups with dead, disabled or live scorpions depending on the pups' age [14].
Coaching/inadvertent coaching	*The response of a demonstrator to the behaviour of the observer inadvertently acts to encourage or discourage that behaviour.* Female cowbirds respond to preferred male songs with 'wing stroking,' which acts to reinforce that song in the male [25].	*The response of the tutor to the behaviour of the pupil functions to encourage or discourage that behaviour.* Mother hens attract their chicks away from food the mother perceives to be unpalatable [24].

Lessons from animal teaching
Hoppitt et al 2008

The evolution of teaching

As with altruism, **we would expect teaching behaviour ultimately to benefit the tutor's inclusive fitness**, either through kin selection or because the tutor benefits directly from the pupil learning. In the case of kin selection, teaching will evolve according to **Hamilton's rule**: if the fitness cost to the tutor (c) is less than the fitness benefit to the pupil (b), multiplied by the degree of relatedness between them (r), or $c < br$.

Teaching is more likely to evolve in species where the average relatedness between interacting individuals is high, or to occur selectively between individuals of high relatedness. This could explain why teaching appears to be present in many **eusocial insect** colonies, where the average relatedness tends to be higher than in other animal populations.

Lessons from animal teaching
Hoppitt et al 2008

The evolution of teaching

The benefits of teaching clearly depend on the resulting increase in the probability that pupil learning occurs, or increase in the rate or efficiency of learning X the probability that learning occurs asocially or via an inadvertent demonstrator.

Therefore, **we only expect teaching to evolve when the equivalent form of inadvertent social learning is relatively ineffective or when there are few opportunities for social or individual learning**.

This might explain **why teaching is rare in chimpanzees and other non-human apes** [extremely capable social learners]. Young chimpanzees generally feed alongside their mothers for extended periods of their life, which potentially provides youngsters with considerable opportunities for social learning, with little selective advantage to active information transfer.

Teaching in chimpanzees?
Musgrave et al (2016)

Tool transfers are a form of teaching among chimpanzees

Socially Biased Learning and behavioral traditions

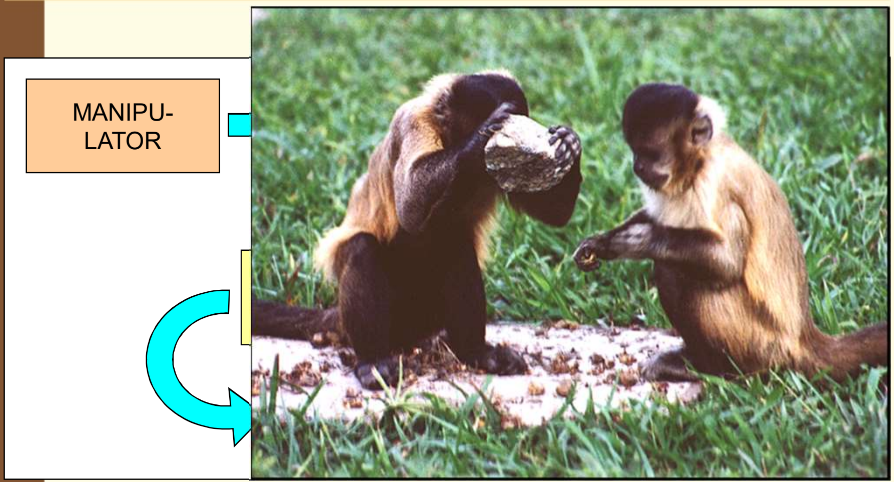
Fragaszy DM & Visalberghi E (2001). Recognizing a swan: socially-biased learning. *Psychologia* 44:82-98:

Any form of SBL can sustain the establishment of traditions (not only imitation)

"Emotional Contagion" and associative learning
example: snake avoidance by rhesus monkeys (Mineka & Cook 1988)

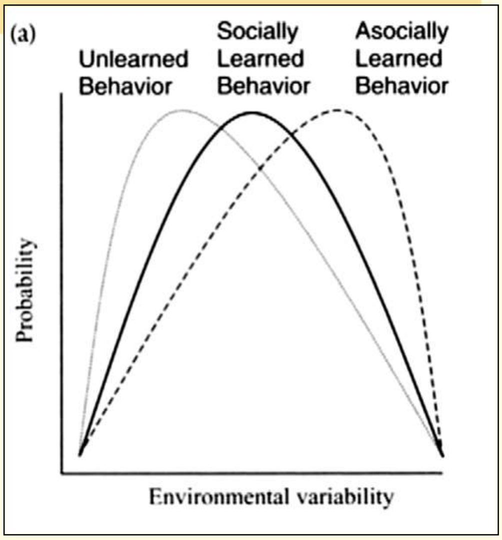
Conditioned Modulating Experiences
example: "*occasion setting*" (in Terkel 1996 rats):
Infants' responsivity to pine cones altered by the mother's presence

Nut cracking by capuchin monkeys:
Social information transfer mechanisms



When is it advantageous to learn with conspecifics?
Learning and environmental variability

Environmental variability and social x asocial learning

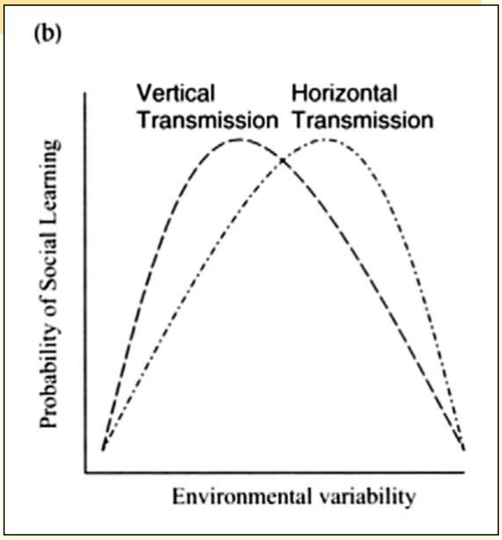


Laland & Kendal 2003

When is it advantageous to learn with conspecifics?

Learning and environmental variability

Vertical x horizontal transmission

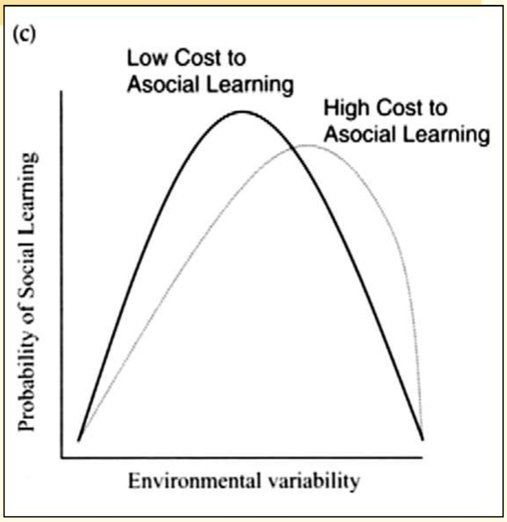


Laland & Kendal 2003

When is it advantageous to learn with conspecifics?

Learning and environmental variability

Asocial learning costs

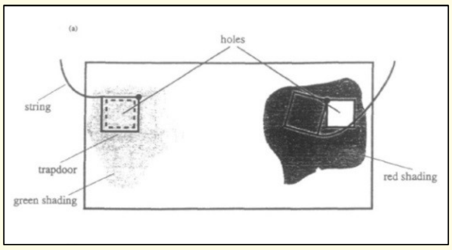


Laland & Kendal 2003

Potential costs of social learning

Laland & Williams 1998

Social transmission of maladaptive information in the guppy



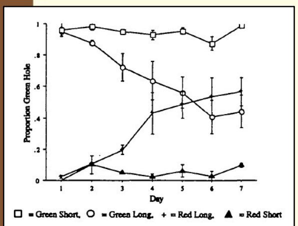


Figure 2
Proportion (mean ± SE) of times that experimental subjects take the green hole to feed for fish with founders trained to take green or red routes, and where the trained route could be long ($n = 4$) or short ($n = 2$).

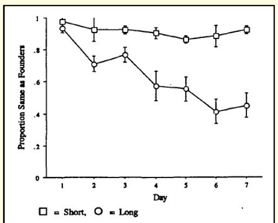


Figure 3
Proportion (mean ± SE) of times that experimental subjects took the same hole as their founders over 7 days. The route preference traditions are much more stable for populations with founders trained to take the short route ($n = 4$) than for populations with founders trained to take the long route ($n = 8$).

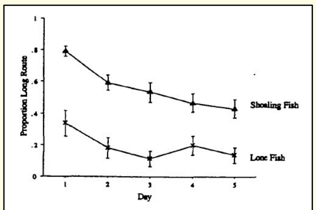
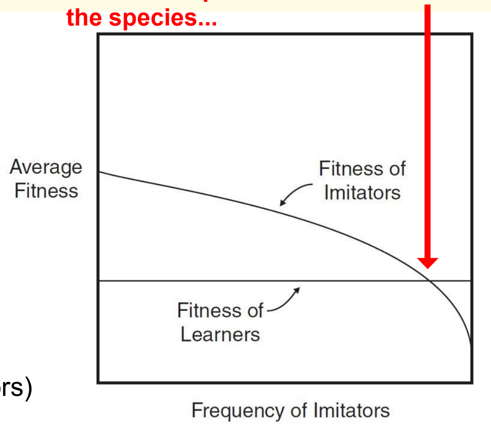


Figure 4
The longevity of route preferences within a subject, scored as the proportion (mean ± SE) of occasions that subjects took the long route. Shoaling fish in the experimental condition ($n = 24$), with founders trained to take the long route, acquire a short route preference slower than lone fish ($n = 10$) in the control condition.

Boyd & Richerson 1995
Why does culture increase human adaptation?

Why **avoiding learning costs** does ***not*** increase average fitness of the population (cf. Rogers 1989)
(even if Imitators can select model Learners)

Natural selection favors culture, but culture provides no benefit to the species...

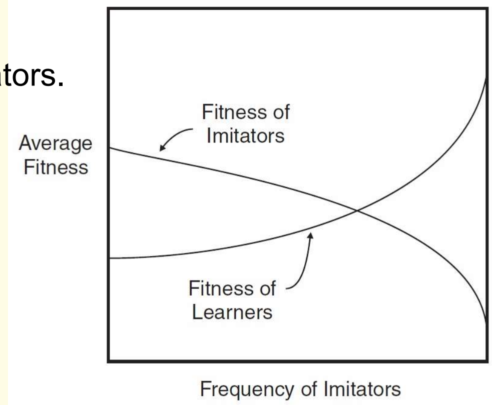


Environment: DRY x WET
($P_{dry} = P_{wet}$, slow x fast)
Behaviors: B_{dry} X B_{wet}
2 genotipes (Learners x Imitators)

At equilibrium, the average fitness of the population is the same as that of a population without culture

Boyd & Richerson 1995
Why does culture increase human adaptation?

Culture can increase average fitness *if increasing the frequency of Imitators increases the fitness of Learners* as well as Imitators.



Boyd & Richerson 1995
Why does culture increase human adaptation?

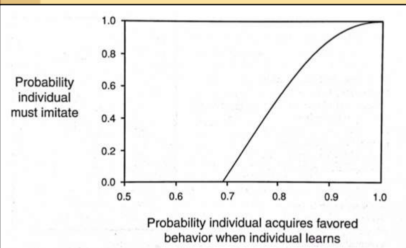
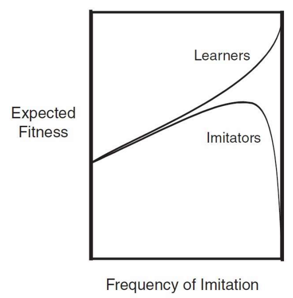


Figure 2.3. The trade-off between imitation and learning, assuming that the outcomes of learning trials are normally distributed, with mean equal to 0.5 and variance equal to 1.0.

Imitation allows selective learning

Individuals try to learn, adopt better alternative if difference in payoff is big enough, otherwise imitate (genetically inharitable learning rule).

Figure 2.4. Individuals either learn or imitate according to the outcome of their learning trial. As individuals become more selective, the frequency of imitating individuals increases. This figure plots the expected fitness of individuals who imitate and those who learn as a function of the frequency of imitating individuals, assuming the outcome of learning experiments is normally distributed with mean 0.5 and variance 1.



Social enhancement x Imitation:

Imitation allows cumulative improvement (if learning is costly and environment change, slow: initial guess [fixed x imitation], followed by learning).

Learning strategies: *whom* and *when* to copy

Mathematical/theoretical modeling of social learning "biases":

Copy the majority? (Boyd & Richerson 1985) ("conformity bias")
Copy the successful? (Boyd & Richerson 1985)
Copy the older? (Kirpatrick & Dugatkin 1994)
Copy the dominant?
Copy those doing better? (Schlag 1998)
Copy if dissatisfied? (Schlag 1998)

Humans: "Prestige Bias" (Henrich)

Heyes 2012
What's *social* about Social Learning?

"A great deal is known about the adaptive functions of social learning, including its role in the social or cultural transmission of behavior, but ***very little is known about the cognitive mechanisms that make social learning possible****.*

Social learning has been isolated from cognitive science*, not just by the usual barriers to cross-disciplinary integration, but by the long-standing and largely implicit* ***assumption that it depends on social–cognitive adaptations*** *- learning mechanisms distinct from those mediating asocial learning.*

Social and asocial learning depend on the same basic cognitive mechanisms*; these mechanisms are adapted for the* ***detection of predictive relationships in all natural domains****; they are* ***associative mechanisms*** *(…) and they mediate human as well as nonhuman social learning."*

Heyes 2012

What's *social* about Social Learning?

Then what is special about social learning?

*"I suggest that **social learning is distinctive when input mechanisms— perceptual, attentional, and motivational processes—are biased or tuned to a particular channel of social information** (...) this kind of tuning can be achieved **phylogenetically or ontogenetically**, by **evolution** or via **developmental processes**".*

Heyes 2012

What's *social* about Social Learning?

Social and asocial learning come in the same varieties

Animal learning theory (concerned primarily with asocial learning): three basic types of learning according to the kind of experience that provokes a change in behavior:

- *Exposure to **a single stimulus***
  (S learning, e.g., habituation and sensitization)
- *Exposure to **a relationship between two stimuli***
  (S-S learning, or Pavlovian conditioning)
- *Exp. to **a relationship between a stimulus and a response***
  (S/R; instrumental learning, habit formation).

Heyes 2012

What's *social* about Social Learning?

Social and asocial learning come in the same varieties

- **St. Enhancement** *corresponds to* ***Single Stimulus Learning.***
- **Observational Conditioning** *corresponds to* ***S-S Learning.***
- **Observational Learning** *corresponds to* ***S/R Learning.***

Socially mediated exposure to an R-S or S-R relationship sometimes results in the observer exhibiting behavior that is topographically similar to the behavior of the demonstrator; in these cases, observational learning is also known as ***"imitation"****.*

Next lecture:

Animal social learning in the laboratory and in the wild: improving methodologies