

# Cognition and Semiotics

MA Cognitive Semiotics, Fall 2020

Lecture 5  
Monday Sept 28th

# Overview

- Today: Cultural dynamics of interacting minds I
  - Quick recap of Wisdom of Crowds paper
  - Cultural cognition
    - Drawing on the biological sciences
    - Cumulative culture and social learning
    - Social transmission mechanisms
  - Dean et al., 2012 paper
    - Cross-species look at cumulative culture
  - Summing up

# Concepts and notions ahead:

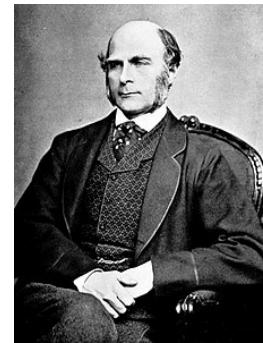
- **Cultural cognition and learning**
- Social & asocial learning
- (Social) Transmission
- Tradition & culture
- Innovation
- Technological improvement
- Cumulative culture
- **Roger's paradox**
- Population composition
- Copying and switching
- Immediate feedback
- Feedback's role in interaction
- 2HBT1 effect
- Social learning mechanisms
- Social learning strategies
- Fidelity of learning
- Emulation, Imitation
- Teaching
- Comparative evidence
- Covariance of experimental variables
- Prosociality
- Causation vs correlation

# Groups and crowds: Recap

- Pooling of information/**signal averaging**
  - cause uncorrelated errors to cancel out
- *Weighted majority rules* – based on a **reliability markers** (e.g. *metacognition*)
- **The power of language:** deliberation as a good strategy for **recalibrating markers of reliability** and assessing the **evidence**
- Information-limiting correlations:
  - Groupthink, conformity, information cascades and shared information bias – converging too much!

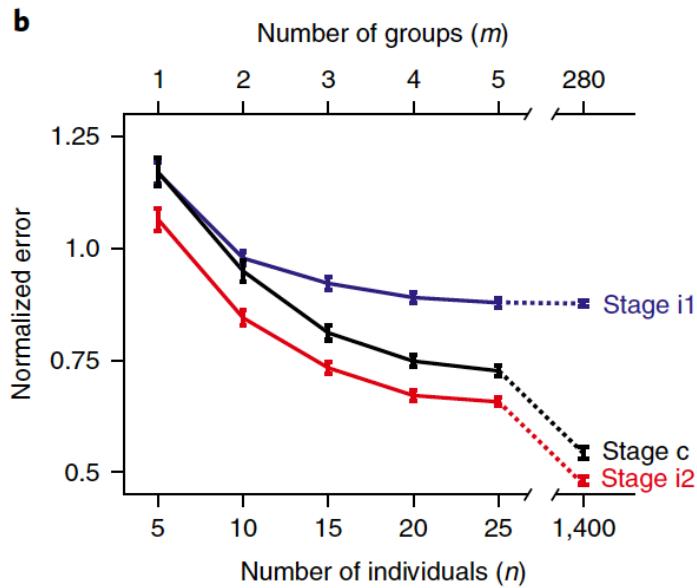
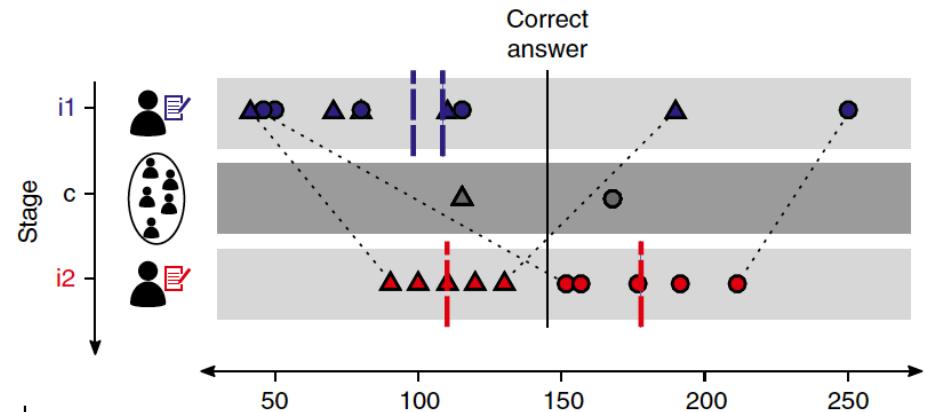
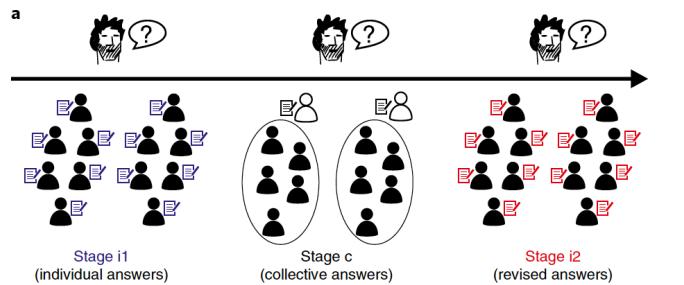


Condorcet  
(1743-1794)



F Galton (1822-1911)  
Vox Populi

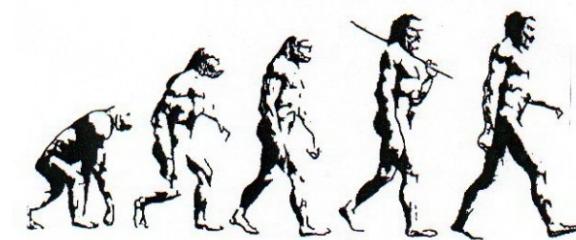
# Wisdom of large crowds paper



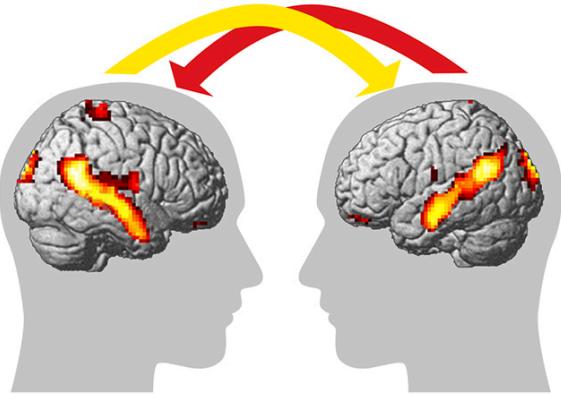
Deliberation procedure	Question 1	Question 2	Question 3	Question 4
We shared arguments and reasoned together	$8.0 \pm 0.2$ (10)	$7.5 \pm 0.2$ (10)	$7.9 \pm 0.2$ (10)	$7.4 \pm 0.3$ (8)
We followed the individuals who verbally expressed higher confidence during the debate	$6.4 \pm 0.3$ (8)	$6.0 \pm 0.3$ (8)	$6.1 \pm 0.3$ (8)	$6.9 \pm 0.3$ (10)

# Groups and large crowds in sum

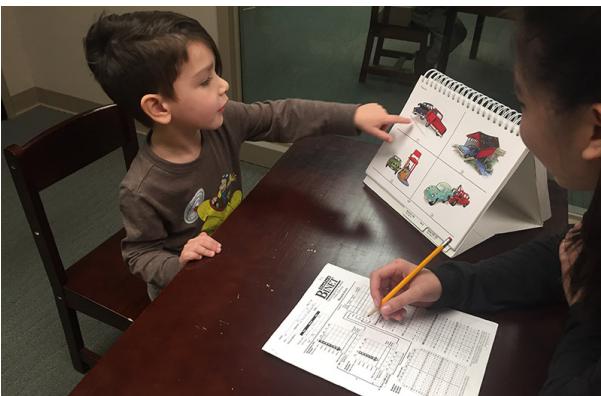
- Biases can be harnessed by **making them explicit** through linguistic interaction,
  - Biases are more obvious to (diverse) others
  - Malleable; can be alleviated by **deliberating other local peaks** and the **reasons for our actions** (sharing explicit metacognition)
  - Recalibration!
- Wisdom of crowds can be increased by simple face-to-face **linguistic interaction within groups**
  - And even further if coupled with diversity/between-group sampling
- Also on the crowd level do we observe a central role for 'peer discussion', interactive alignment and confidence sharing



Human evolution and archaeology



Social cognition and cognitive neuroscience



Developmental and educational psychology



Behavioural ecology and ethology

## Cultural transmission / Social learning



Behavioural economics and social anthropology



# Social learning (across species)

- Broadly defined as “Learning that is influenced by observation of or interaction with another individual, or its products” (Hevesi, 1994)
  - Or “Learning that is **facilitated** by observation of or interaction with another individual (or its products)” (Hoppit & Laland, 2014)
- Opposed to **asocial learning**; trial and error learning, statistical learning of the environment
- Social learning is often referred to as ‘**Culture**’: 
  - Socially transmitted information → cultural transmission of information across generations

- Cumulative culture:

– Process of information (knowledge,

technology, etc) **accumulating over time**, building

On previous generations – and resulting in cultural traits which  
would be **impossible to obtain in an individual's own lifetime**

- Culture:

**Group-typical behaviour patterns** shared by members of community  
that rely on socially learned and transmitted information

- Tradition:

Distinctive behaviour pattern **shared** by two or more (in a unit),  
**persisting over time** and acquired through social learning

- Social transmission

when a trait T exerts a **lasting positive causal influence** on the  
rate of acquisition or performance of T in another individual

# Cumulative cultural evolution

- Whereas many non-human animals display instances of culture, **human culture is cumulative**
  - Cultural traits or knowledge resulting from an **accumulation process over many generations** – impossible in an individual's own lifetime or without prior knowledge
- Aka *the cultural ratchet*; iterative improvements of technology requires a balance of both **accurate copying** and **innovation**
- Responsible for the outstanding success of human culture, civilization, and colonization of every terrestrial habitat on the planet



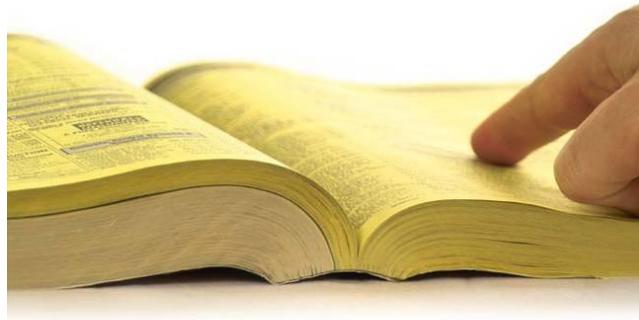
# Cumulative culture and human uniqueness

- In other words, cumulative culture is the ability to develop and maintain knowledge and expertise, through social transmission and innovation



By Thomas Thwaites who constructed a toaster by sourcing, refining and processing the materials (copper steel, mica, plastic and nickel) himself

## Cultural/Social versus asocial learning



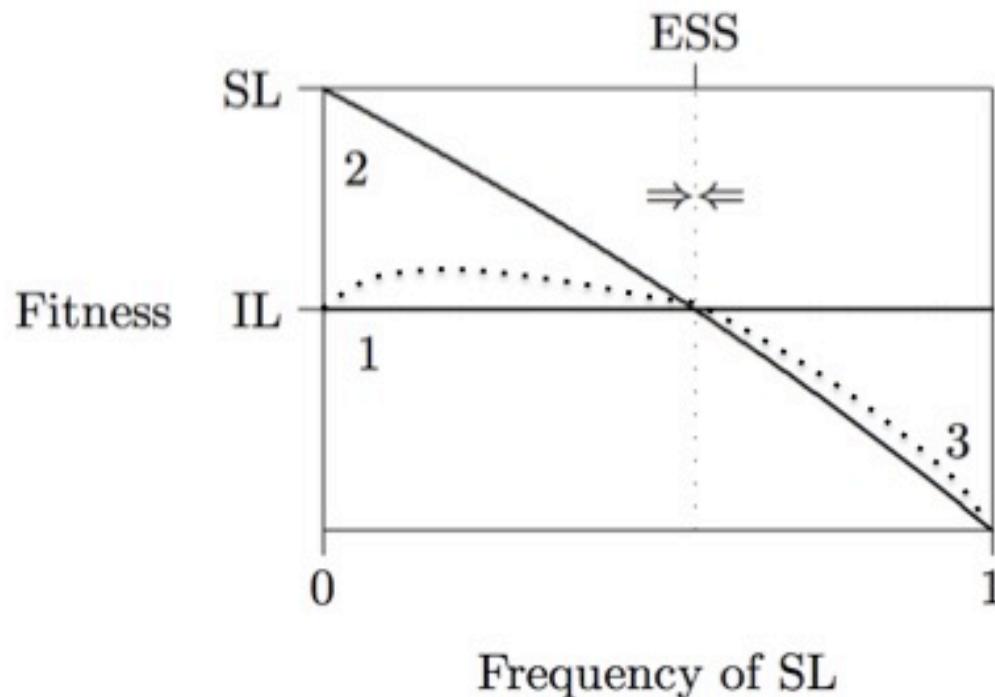
≠ Asocial learning (directly sampling the environment) **is costly** (e.g. in time and effort)

# Example: Social versus asocial learning

- Rogers' paradox: classic and still hotly debated
  - a counter-intuitive result: individual learners or social learners in a changing environment will, at equilibrium, acquire the “same level” of fitness,
  - so that there would not be selection for social learning
- In short, social learners are “information scroungers” that spare the cost of asocial learning,
  - thus the fitness of social learners depends on the composition of the population (i.e. the ratio):  
→ the more social learners, the less reliable information (copying other copiers), the smaller the fitness

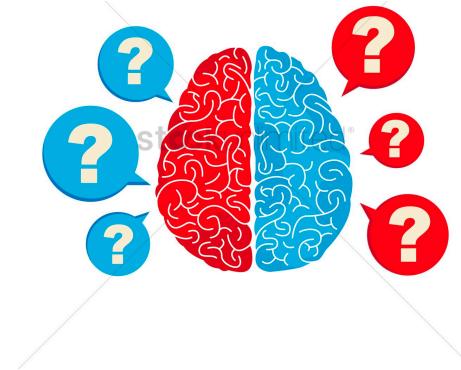
# Example: Social versus asocial learning

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# Rogers paradox

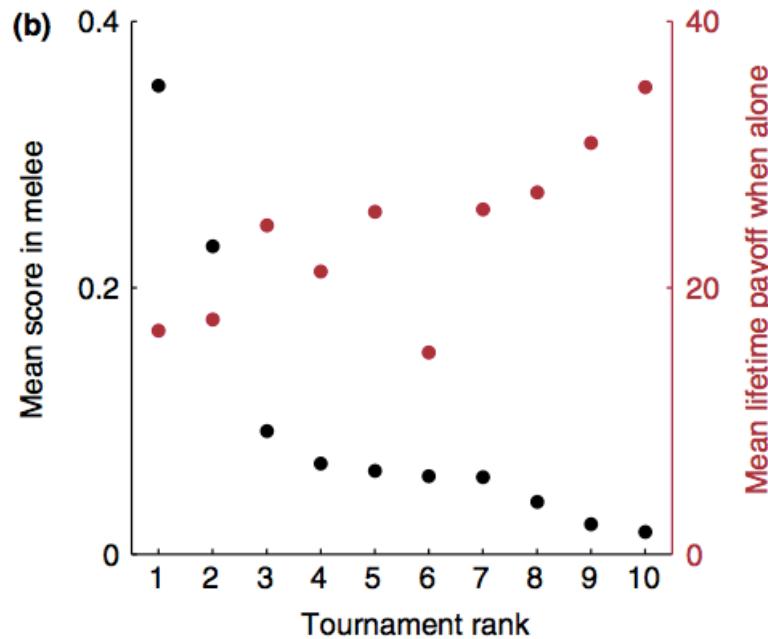
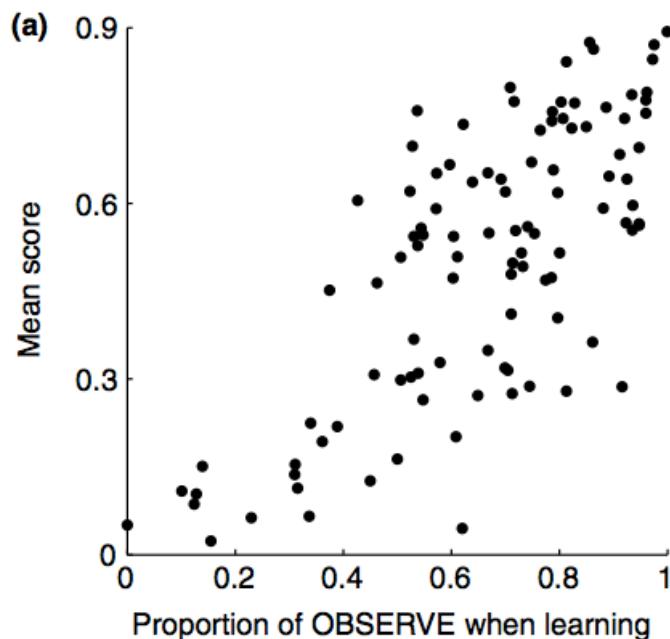
- Why is Rogers's paradox a paradox?
- (1) Write down your own answers
- (2) Take turns (in groups) explaining your answers and discuss why this is a paradox - and write it down
- (3) Then discuss what the solution may be, i.e. how could we explain this apparent paradox away - and write it down



- Why is Rogers's paradox a paradox?
  - Because social learning (and reliance on social info) is **everywhere!**
  - Culture, and thus social learning, is thought to be the basis of human population growth, **implying increased fitness**
- The “solutions” of Roger’s paradox all basically involve the possibility that individuals are **both social and individual learners**
  - i.e. they may use both asocial and social learning selectively (i.e. **switching**)
  - Also, could “pure social learners” evolve? - unable to learn directly from the world, having to learn everything via social cues alone?

# The success of Copying

- In more recent modelling literature (permitting switching), social learning has been demonstrated as far more advantageous than previously thought
- The Tournament (*Rendell et al. 2010 Science*):



# The success of Copying

- In more recent modelling literature (permitting switching), social learning has been demonstrated as far more advantageous than previously thought
  - Across simulations, top strategies **almost exclusively social**
  - Even when extremely error-prone
  - Even non-selective copying (no need for filters of information as **copied individuals typically become a sample of reliable behaviour**)
  - i.e. always *switch* to best performers for copying
- Did Rogers' analysis take this into account?
  - no, social learners copied the same individual throughout, "**outdating**" the behaviour or info of that individual

# The success of Copying

- Problematic assumptions in the modelling/simulation approaches:
  - Some social learning strategies depend on knowing immediately the payoff of others' behaviours (e.g. to select best individual to copy)
  - *If most are planting potatoes, do you plant potatoes or another crop?*
    - Immediate objective feedback is needed
  - Likely a consequence of unidirectional information transfer
  - Restricted communication in simulations (signals of accuracy, success, fitness, payoff, history, etc.)
- How do these translate to real-life human interaction?



# More on the role of immediate feedback

- Empirical investigations also often depend on “knowing the immediate payoff of others’ choice”
  - i.e. to select the best individual to copy
- As mentioned, access to this info is often not available
  - fx. the restaurant, farming, politicians, investments, etc.
- When feedback is *absent*, theoretical models suggest that *then it's better to conform to local traditions*
  - i.e. conformist bias towards the majority
- However, we know *conformity can prevent the adoption and spread of new innovations*, - which is necessary for cultural development and, in turn, cumulative culture!

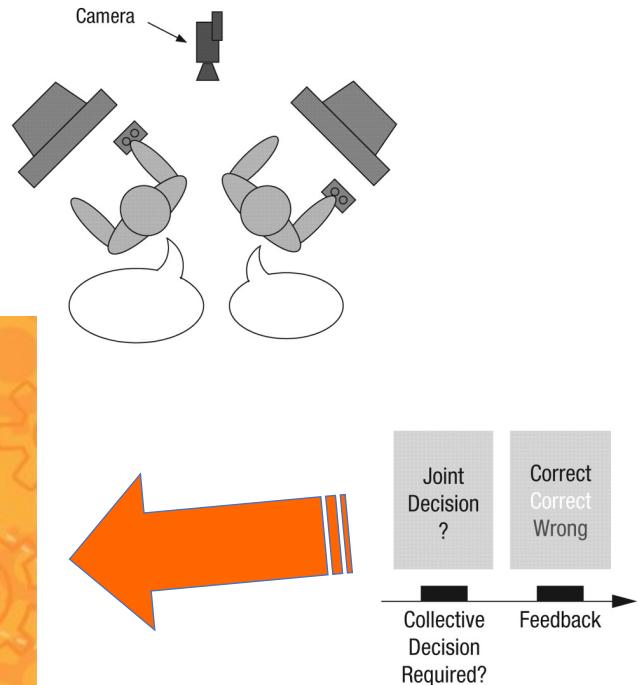
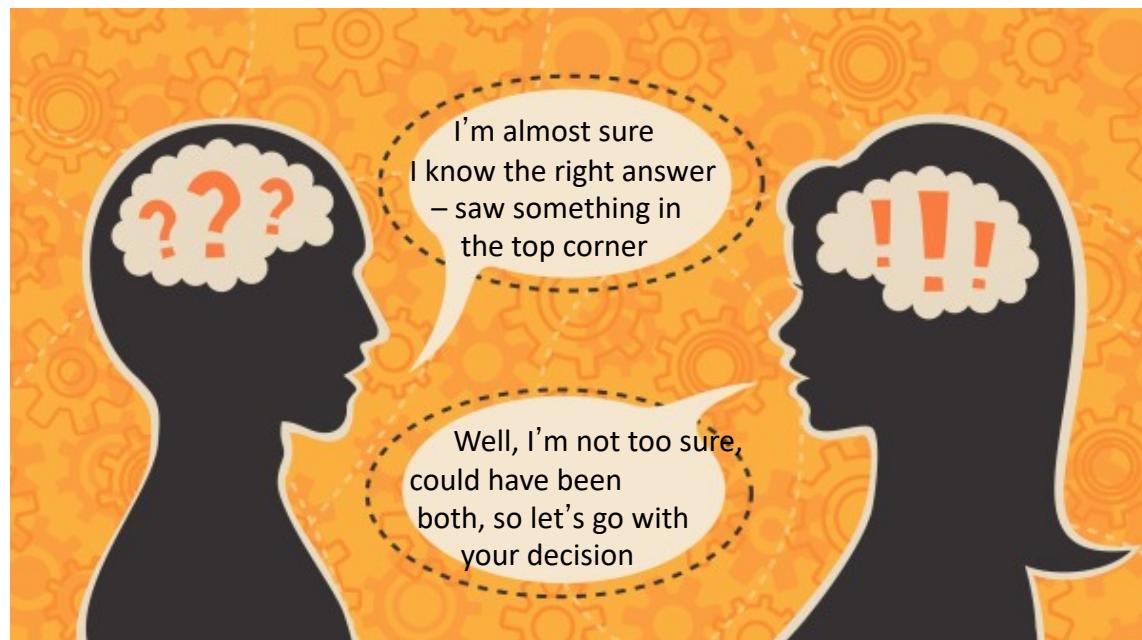


# Slight detour, linking back to our previous lectures

- The assumption that *immediate feedback is necessary* is associated with a research literature that **theoretically** and **empirically takes the perspective of individuals**
- We have discussed how the interactive perspective seems to affect cognition and behavior differently (sometimes dramatically)
  - e.g. **social interaction with mutual alignment**
- Thus, there is the possibility that **feedback may play a different role when interacting and learning from others in real-time**
- Recall our paper on the 2HBT1 effect:

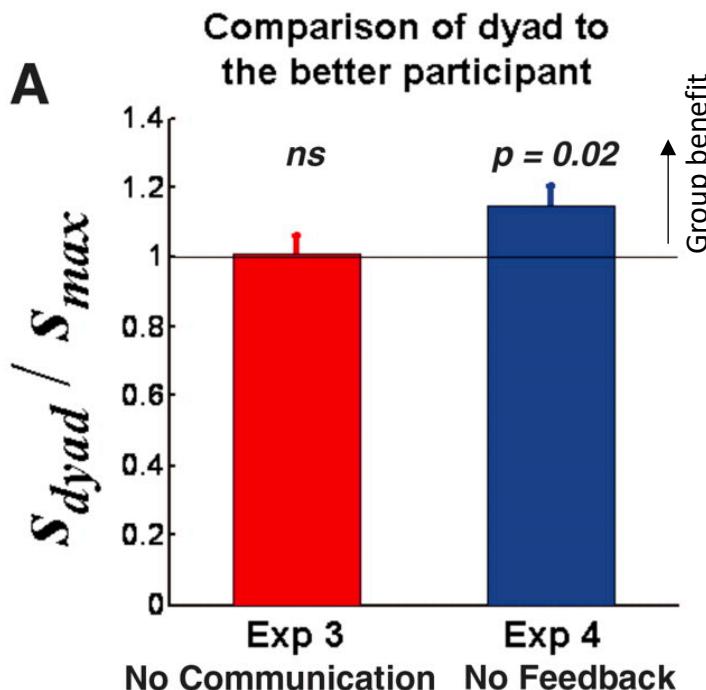
# Reminder of the 2HBT1 paradigm

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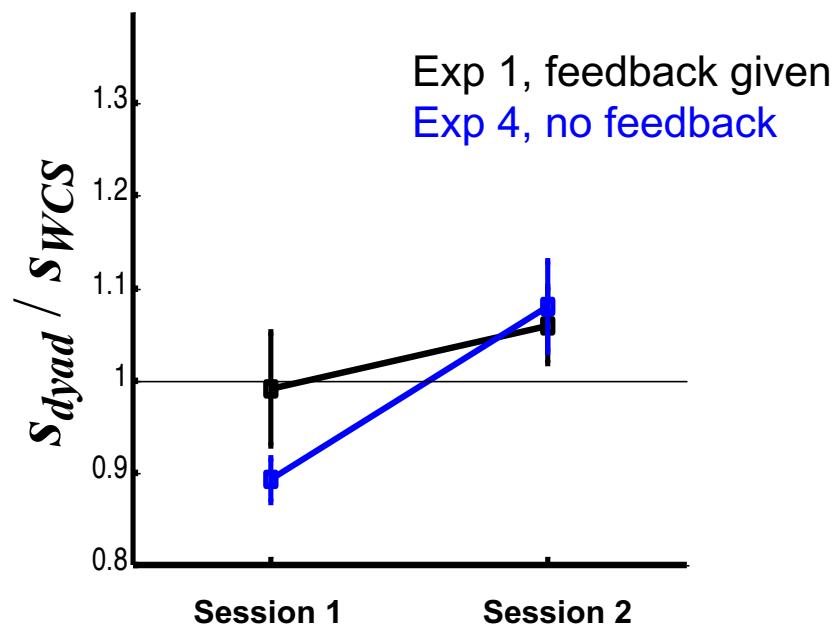


# Social learning (in interaction) without feedback

Communication of confidence is necessary for the group benefit  
– only as good as the best member



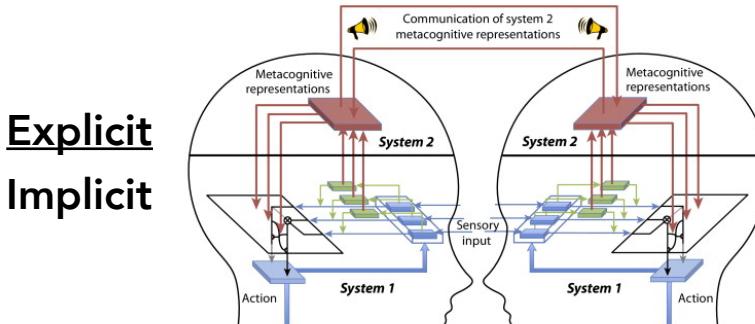
But task feedback (on correctness) is not always necessary as long as they can communicate confidence:



Thus, without feedback collective benefit took longer to achieve: Feedback seems to accelerate the process of effective communication

# Detour summed up

- Social learning *in social interactions* can succeed **without immediate feedback** - it just **takes a bit longer** to take effect
  - Suggesting that social learners can establish **subjective estimates** of correctness through **repeated** interactions
- Why? Recall that bidirectional interaction allows **mutual adaptation** and **alignment** which helps information exchange
- However, the degree to which we depend on immediate feedback may **vary across cultural contexts** and **environment**



## Mutual adaptation in bidirectional interaction

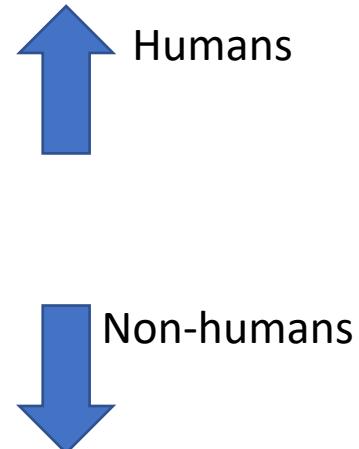
Sharing of metacognitive information, e.g. confidence, experiences, and other learning-related information

# Back on track: Explaining cultural learning a bit closer

- Social learning is everywhere around us – what are the heuristics for switching and facilitating its usefulness?
- We distinguish between **social learning mechanisms (SLMs)** and **social learning strategies (SLSs)**
  - **SLMs**: E.g. *imitation, emulation* (obs learning/copying), social facilitation, “*teaching*” - all prevalent across animals
  - although in humans, the *high-fidelity mechanisms* are much more pervasive and advanced
  - **SLSs**: *When* strategies (e.g. copy *when* uncertain) and *Who* strategies (e.g. copy the most successful)
- High-fidelity SLMs is widely agreed to be a key notion
  - What is fidelity and what mechanisms allow for High fidelity?

# What is Fidelity (of social transmission)

- Social transmission we take to be
  - "cases of social learning that exerts *a lasting increase in learning or performance in another individual that extends beyond the period of the learning situation*"
- As such, different kinds social learning can result in varying degrees of successful social transmission, depending on the fidelity (i.e. the *accuracy* or *precision*) of the social learning
- Prevailing theoretical consensus: high-fidelity socials learning is key to facilitating the accurate and more precise information transfer necessary for accumulating process of cultural learning
- Meanwhile, non-human animals, incl. those exhibiting simple forms of culture, rely on lower-fidelity forms of social learning
  - i.e. rarely result in accumulating cultural improvements



# Social learning mechanisms (SLMs)

*Low- and High-fidelity social learning mechanisms*  
(= accurate/faithful)

“Emulation”

“Imitation”

“Teaching”

NB: Somewhat similar to ‘Types of interactions’ which facilitate transmission of information

Process	Definition
Stimulus enhancement	Stimulus enhancement occurs when observation of a demonstrator (or its products) exposes the observer to a single stimulus at time $t_1$ , and single stimulus exposure effects a change in the observer detected, in any behaviour, at $t_2$ (Heyes, 1994)
Local enhancement	Local enhancement occurs when, after or during a demonstrator's presence, or interaction with objects at a particular location, an observer is more likely to visit or interact with objects at that location (Thorpe, 1963)
Observational conditioning	Observational conditioning is a subset of stimulus-stimulus learning in which observation of a demonstrator exposes the observer to a relationship between stimulus at $t_1$ , and exposure to this relationship effects a change in the observer detected, in any behaviour, at $t_2$ (Heyes, 1994)
Response facilitation	Response facilitation occurs if the presence of a demonstrator performing an act (often resulting in reward) increases the probability that an observer will do the same (Byrne, 1994)
Social enhancement of food preferences	Social enhancement of food preferences occurs when after being exposed to a demonstrator carrying cues associated with a particular diet, the observer becomes more likely to consume that diet (Galef, 1989)
Social facilitation	Social facilitation occurs when the mere presence of a demonstrator affects the observer's behaviour (Zajonc, 1965)
Contextual imitation	Contextual imitation occurs when, directly through observing a demonstrator perform an action in a specific context, an observer becomes more likely to perform that action in the same context (Byrne, 2002)
Production imitation	Production imitation occurs when, after observing a demonstrator perform a novel action, or novel sequence or combination of actions, none of which are in its own repertoire, an observer then becomes more likely to perform that same action or sequence of actions (Byrne, 2002)
Observational R-S learning	Observational R-S learning is a subset of response-reinforce learning (R-S) in which observation of a demonstrator exposes the observer to a relationship between a response and a reinforce at $t_1$ , and exposure to this relationship effects a change in the observer detected, in any behaviour, at $t_2$ (Heyes, 1994)
Emulation	Emulation occurs when, after observing a demonstrator interacting with objects in its environment, an observer becomes more likely to perform any action that have similar effect on those objects (Tomasello, 1994)
Opportunity providing	Opportunity providing occurs when 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 (Hoppitt <i>et al.</i> , 2008)
(Inadvertent) coaching	Inadvertent coaching occurs when the response of a demonstrator to the behaviour of the observer inadvertently acts to encourage or discourage that behaviour (Caro & Hauser, 1992; Hoppitt <i>et al.</i> , 2008)

Table 1: Classification of social learning processes, adapted from Hoppitt & Laland (2013).

# SLMs explained: Imitation and emulation

- *Imitation:*

observes the (sequence of) **actions of a demonstrator** in a specific context, and is then more likely to perform that (sequence of) action in the same context

→ simple and complex imitation

- *Emulation:*

observes the **end-product**, or the environmental results, **of the actions** of a demonstrator, rather than learning based on the actions - and then becomes more likely to perform any action that have similar effect on those objects performed

→ a form of reverse engineering, as it were

# SLMs explained: Teaching

- social learning situation exhibiting “**behaviour that evolved to facilitate learning in others**”, and which is observed in a range of non-human animals (meercats, ants, babblers, etc)
- Inadvertent social learning *versus* “teaching” mechanisms
  - Demonstrator and observer *vs* **tutor and pupil**
  - E.g., for imitation it the difference between *Observing* a tennis player *vs* a tennis player **demonstrating**
  - In human research, often operationalised as “direct verbal instruction”

From a “cognitive science” interactive perspective, these are very open and underspecified conceptualisation, as we will discuss later



“OK, now that we all agree, let’s all go back to our desks and discuss why this won’t work.”

# Summing up

- Social learning: learning that is facilitated by *observation of or interaction with* another individual – Underlying most of what we call culture!
  - Social transmission → Traditions → Culture → Cumulative culture
- Copying: It's not enough to just copy or imitate – Rogers' Paradox (unable to evolve → switching, strategies, heuristics)
- SLMs in humans involve *hi-fi* copying, e.g. *imitation* or *teaching* (e.g. direct verbal instruction), in order to transmit information (*cultural transmission*) across generations
- Let's see an example of how we may test if this is the case:

# Social and cognitive processes underlying human cumulative culture

- Questions about the Dean et al. (2012) paper?

## Identification of the Social and Cognitive Processes Underlying Human Cumulative Culture

L. G. Dean,<sup>1</sup> R. L. Kendal,<sup>2\*</sup> S. J. Schapiro,<sup>3</sup> B. Thierry,<sup>4</sup> K. N. Laland<sup>1\*</sup>

The remarkable ecological and demographic success of humanity is largely attributed to our capacity for cumulative culture, with knowledge and technology accumulating over time, yet the social and cognitive capabilities that have enabled cumulative culture remain unclear. In a comparative study of sequential problem solving, we provided groups of capuchin monkeys, chimpanzees, and children with an experimental puzzlebox that could be solved in three stages to retrieve rewards of increasing desirability. The success of the children, but not of the chimpanzees or capuchins, in reaching higher-level solutions was strongly associated with a package of sociocognitive processes—including teaching through verbal instruction, imitation, and prosociality—that were observed only in the children and covaried with performance.

The success of humanity in colonizing virtually every terrestrial habitat on the planet and resolving countless ecological

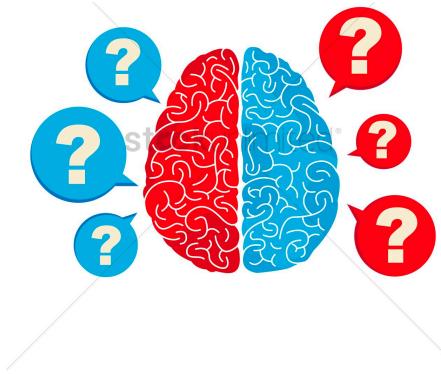
The resulting debate has spawned a large number of distinct hypotheses concerning the cognitive capabilities or social conditions thought

to underlie cultural learning that simultaneously tests humans and other animals using the same apparatus and that is capable of evaluating all of the aforementioned hypotheses. Here, we present such an investigation.

We designed a puzzlebox (Fig. 1) that could be solved at three stages of difficulty, with success at stage 2 building on stage 1 and success at stage 3 building on stage 2. We presented appropriately scaled versions, under a variety of conditions, to groups of children ( $N = 35$ , eight groups of 3- to 4-year-olds from three nurseries in Fife, UK), chimpanzees (*Pan troglodytes*;  $N = 74$ , eight mixed juvenile and adult groups at the Michale E. Keeling Center for Comparative Medicine and Research, University of Texas), and capuchin monkeys (*Cebus apella*; one group over 2 years, year 1  $N = 22$ , year 2  $N = 18$ , at the Centre de Primatologie, Strasbourg) (see supporting online material). All stages could be completed through two parallel options (Fig. 1), allowing us to investigate cooperation, tolerance, and social learning at the task presentation in

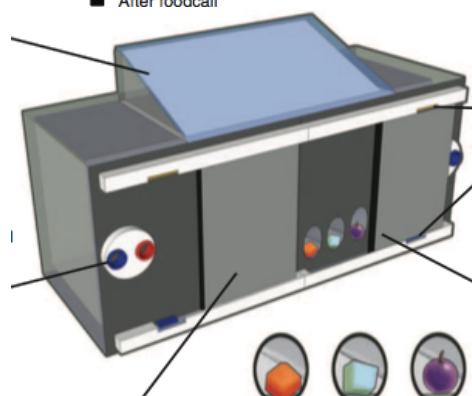
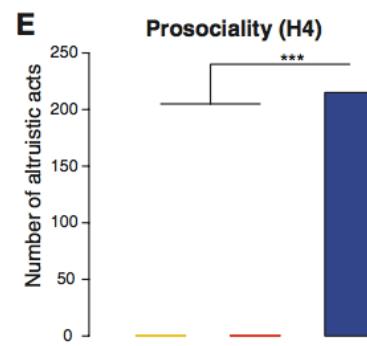
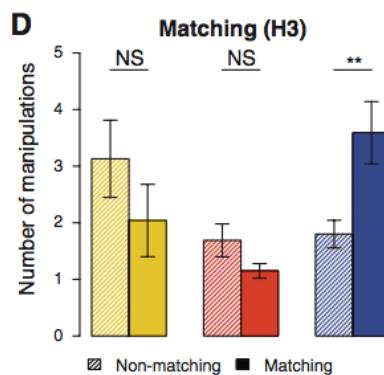
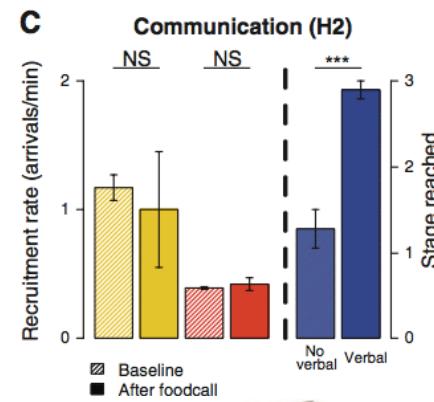
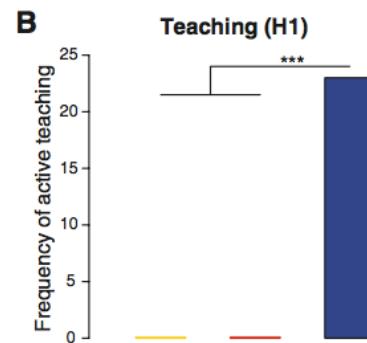
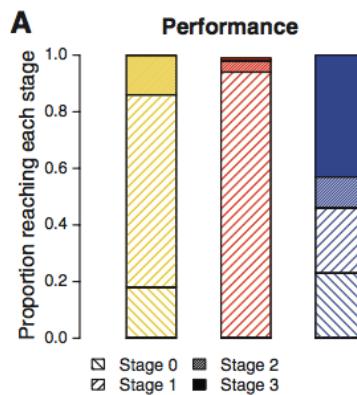
# Dean et al. (2012) paper

- What is the paper trying to investigate?
- How did they attempt to achieve this?
- Why is this (scientifically) interesting in the first place?



# Dean et al. (2012) paper

- The **capacity for cumulative culture** in chimpanzees, capuchin monkeys, and children – and the cognitive requirements
- Success on a 3-stage “**cumulative culture puzzlebox**” and covariance with a package of sociocognitive processes



# Dean et al. (2012) paper

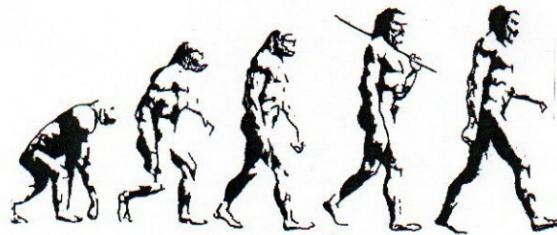
- Demonstrated cumulative culture **only in humans**
  - “Requires teaching” (defined as *direct instruction*)
  - was positively associated with task performance & other sociocognitive processes such as imitation and prosociality
- Reservations against this interpretation?

Inference about the causal effects of teaching requires a control (restricting children from teaching, etc.)

Inherently correlational in nature

This particular task may involve sequential problem-solving rather than cumulative or cultural learning (as in e.g. technological improvement)

# Summing up the cumulative culture paper



- Comparative studies suggest that 'package', involving **imitation, teaching & language**, is key for cumulative culture – but inconclusive (correlational) evidence
  - Supports the view that high-fidelity copying may be involved
- **Other follow-up questions** – leading into next lecture
  - What exactly is involved in teaching?
  - Is this (or any?) task analogous to cumulative culture?
- What other ways could we investigate cumulative culture or cultural cognition perhaps?
- The way in which individuals *interact* (be it SLMs or Interaction types) and **communicate plays a central role for cultural learning**
  - This relationship needs more detailed research

# Recap – concepts and notions

- **Cultural cognition and learning**
- Social & asocial learning
- (Social) Transmission
- Tradition & culture
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See you next week