

Cognition and Semiotics

MA Cognitive Semiotics, Fall 2020

Lecture 6

Monday Oct 5th

Overview

- Today's lecture: Cultural cognition II
 - Quick recap of Cultural cognition I
 - Social transmission mechanisms
 - Experimental approaches
 - Class assignment 1 – reviewing experimental designs
 - Class assignment 2 – you being experimentalists
 - Discussion and example experiment
 - Summing up

Concepts and notions ahead:

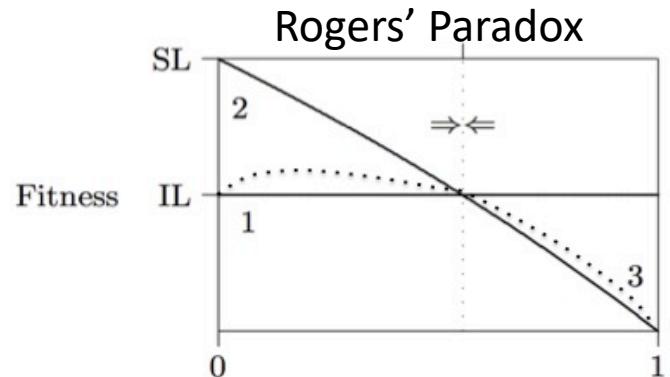
- Social learning mechanisms
- High-fidelity learning
- **Cultural transmission paradigms**
- Social transmission
- Linear chain tasks
- Microsocieties
- Replacement chain tasks
- Generational succession
- Confounding variables
- Skill refinement
- Innovation
- (Causal) Opacity
- Fitness rate
- Learning conditions
- **Operationalization**
- Underspecification
- Task demands
- Cumulative improvements
- Action-based tasks
- Cognition-based tasks
- Demand characteristics
- 2 x 2 design
- Orthogonal contrasts
- Main effects
- Mutual adaptation

Cultural cognition I recap

- 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
- Whereas many non-human animals display instances of culture, **human culture is cumulative** - aka *cultural ratchet*
- **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

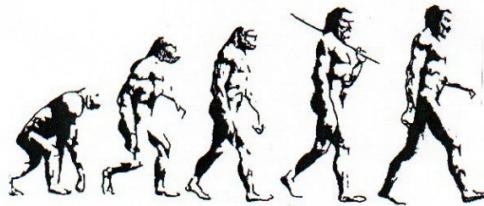


Cultural cognition I recap



- Social learning is **everywhere** around us – so, 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
- High-fidelity SLMs is widely agreed to be a key notion

Cultural cognition I recap



- 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

Cumulative culture & Cultural transmission chain studies

Chinese
whispers
aka
Telephone
game
aka
Russian
scandal
aka
Gossip

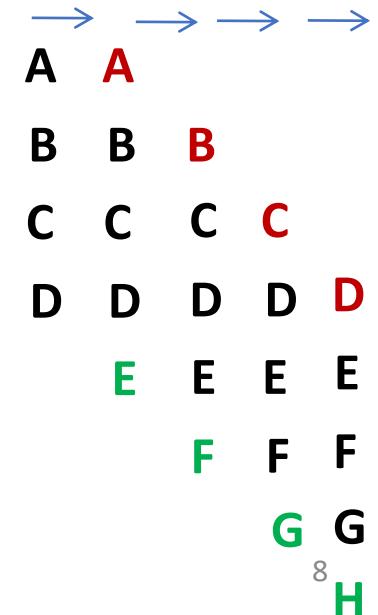


Cultural transmission chain tasks

- Primarily take the form of either (1) **linear** or (2) **replacement** transmission chains:
 - In **linear transmission chains**, the first participant is familiarised with a given task
 - then instructed to ‘**transmit**’ their task knowledge to the next individual in a **chain** of participants
- In **replacement transmission chains**, there are **more than one participant in each position** in the chain
 - on each step of the transmission, **only a subset of participants** are replaced with a naïve participant(s)
 - while the **others remain present** in one or several steps as *experienced* participants

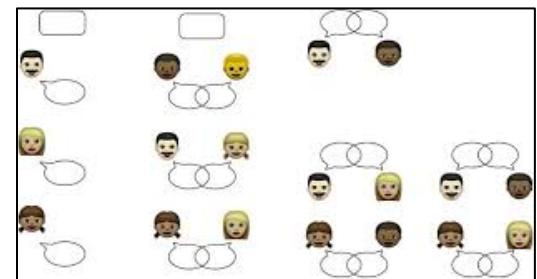
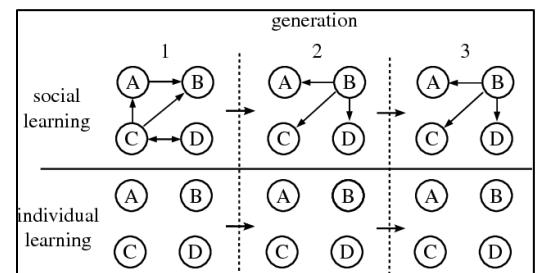
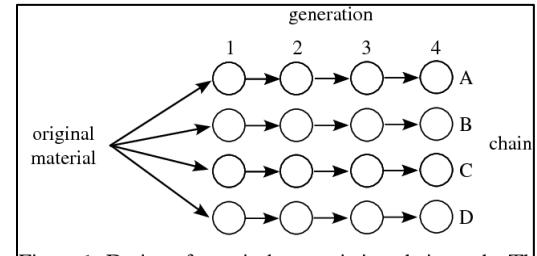


A → B → C → D



Cultural transmission chain tasks

- Note: Replacement chain designs are thought to **better simulate generational succession** within a population
 - thus often referred to as **microsocieties**,
 - But, **increases sample size** considerably!
 - **Less control** over the origin of the relative influences of individuals at each step in the transmission process
- If the emphasis is not on generational succession within a population, linear transmission chains are better suited
 - for **identifying the experimental variables that influence** social transmission at each step
 - minimising possible noise and confounds



Main Ingredients for a Transmission Chain study on cultural cognition

PSYCHOLOGICAL SCIENCE

Research Report

Social Learning Mechanisms and Cumulative Cultural Evolution

SCIENTIFIC REPORTS

OPEN

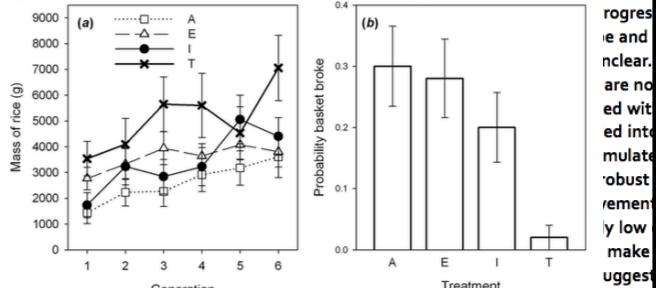
Cognitive requirements of cumulative culture: teaching useful but not essential

Received: 12 March 2015

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Published: 26 November 2015

Elena Zwirner^{1,2} & Alex Thornton¹



cultural prowess may lie in the interplay of strategic social learning with other cognitive abilities, including the ability to reverse engineer artefacts through causal reasoning.



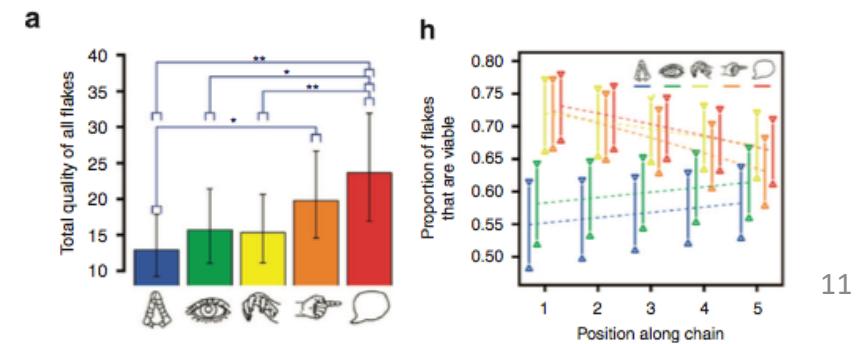
ARTICLE

Received 4 Sep 2014 | Accepted 3 Dec 2014 | Published 13 Jan 2015

DOI: 10.1038/ncomms7029

Experimental evidence for the co-evolution of hominin tool-making teaching and language

T.J.H. Morgan^{1,2}, N.T. Uomini^{3,4,5}, L.E. Rendell¹, L. Chouinard-Thuly^{1,6}, S.E. Street^{1,7}, H.M. Lewis^{1,8}, C.P. Cross^{1,7}, C. Evans¹, R. Kearney¹, I. de la Torre⁹, A. Whiten⁷ & K.N. Laland¹

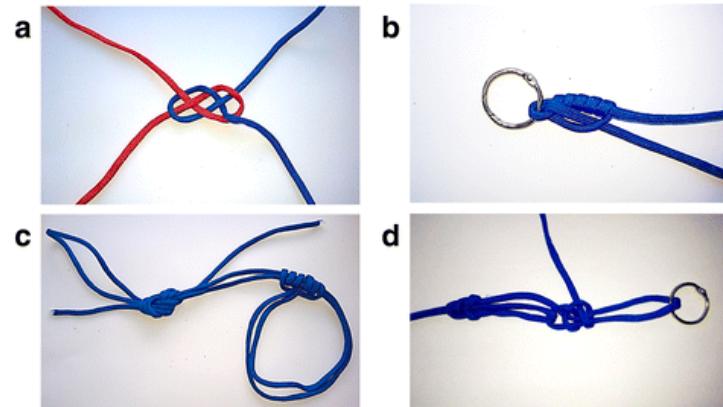


Main Ingredients for a Transmission Chain study on cultural cognition

- 1. **Transmission chain tasks** - to “transmit” information from one participant to the next, representing generations
- 2. Measure of some **fitness rate** = fidelity of cultural transmission
- 3. Various **SLM conditions**, e.g. imitation, teaching, etc.
- Examples:

1. Transmission chain tasks

- The tasks can include e.g.,
 - *stone knapping, building paper airplanes, constructing spaghetti-towers, baskets, constructing weight-bearing devices out of clay and reeds, making virtual fish-nets, tying knots, programming scripts, etc.*
 - Or whatever tasks **you** could think of that permit successive learning & improvement



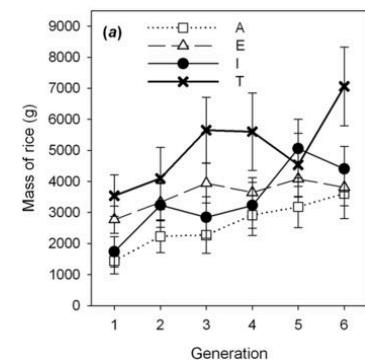
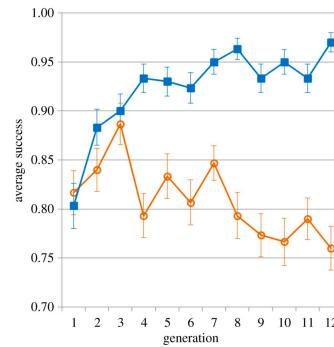
```
209 }  
210 .draw-option-layer  
211 {  
212   display: block;  
213   text-indent: 20px;  
214   width: 40px;  
215   height: 40px;  
216   background-color:  
217   background-color:  
218   background-color:  
219   background-color:  
220   background-color:  
221 }
```



2. Measure of fitness rate

- The fitness rate/measures: *Performance* in the ability required for the task, or related behaviours
 - E.g. height of tower, length and durability of bridge, weight carried by clay device, etc.

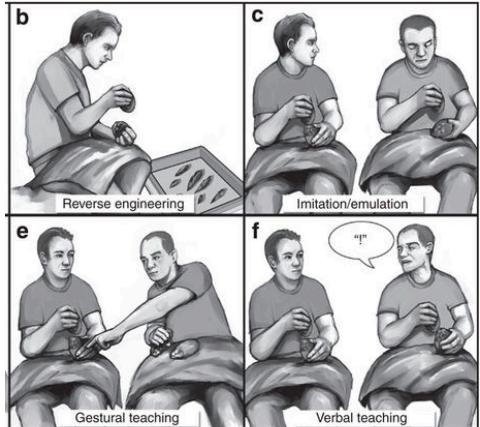
A → B → C → D



- Overall, these tasks and their measures have varied considerably
 - from familiar tasks (requiring skill refinement) to novel tasks (requiring innovation)
 - and have differed in the causal opacity of the task, which may affect the usefulness of cultural learning

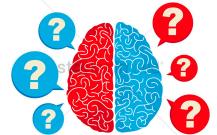
3. Various SLM conditions

- The conditions: Using **between-group comparisons** involving particular SLMs,
 - E.g. comparing ‘transmission using only emulation’ against ‘using only imitation’, etc.
- Using these contrasts, the CT studies **compare and identify the mechanisms and features necessary** to observe successful social transmission and cumulative improvements
- The **results have been mixed** at this stage,
 - Fx with some finding relative benefits for HiFi teaching over and above other mechanisms, in some measures of learning success
 - while others find no relative benefit for either imitation or teaching, in other measures of learning success



Process	Definition
Stimulus enhancement	Stimulus enhancement occurs when observation of a demonstrator exposes the observer to a single stimulus at time t_1 , and this effects a change in the observer detected, in any behaviour
Local enhancement	Local enhancement occurs when, after or during a demonstrator interaction with objects at a particular location, an observer interacts with objects at that location (Thorpe, 1963)
Observational conditioning	Observational conditioning is a subset of stimulus-stimulus learning; observation of a demonstrator exposes the observer to a 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 (often resulting in reward) increases the probability that a response is made (Byrne, 1994)
Social enhancement of food preferences	Social enhancement of food preferences occurs when after observing a demonstrator carrying cues associated with a particular diet, an observer becomes more likely to consume that diet (Galef, 1989)
Social facilitation	Social facilitation occurs when the mere presence of a demonstrator influences an observer's behaviour (Zajonc, 1965)
Contextual imitation	Contextual imitation occurs when, directly through observation of an action in a specific context, an observer becomes more likely to perform the same action in the same context (Byrne, 2002)
Production imitation	Production imitation occurs when, after observing a demonstrator performing a new action, or novel sequence... or combination of actions, non-represented in the observer's repertoire, an observer then becomes more likely to perform the same sequence of actions (Byrne, 2002)
Observational R-S learning	Observational R-S learning is a subset of response-reinforcement learning; observation of a demonstrator exposes the observer to a stimulus, 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 in a particular environment, an observer becomes more likely to perform similar actions in the same environment on those objects (Tomasello, 1994)
Opportunity providing	Opportunity providing occurs when the products of the behaviour of a demonstrator provide the observer with an opportunity to engage in otherwise be unlikely to arise – for example by providing a stimulus

Group assignment no 1



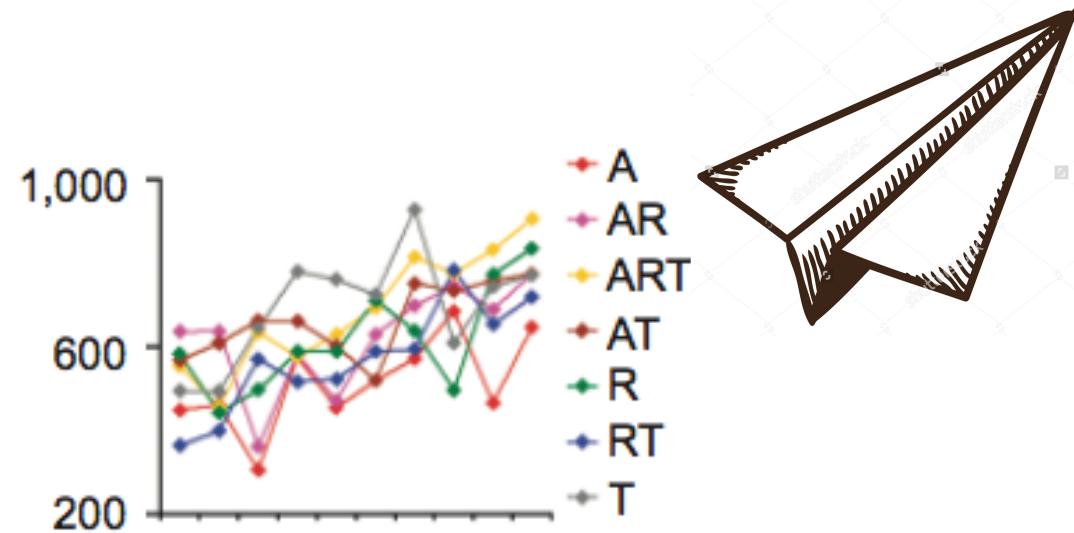
- In groups, look into the three papers for today:
 - A: Caldwell & Millen (2009), B: Zwirner & Thornton (2015), C: Morgan et al (2015)
- 1. What was the **transmission chain task**?
- 2. What was the **Fitness rate** measure?
- 3. What **conditions** (SLMs) were compared?
- Bonus question: Did they find evidence *for* or *against* an advantage for Hi-Fi SLMs in cultural transmission?

Caldwell & Millen, 2009 – Is imitation necessary?

- 1. **Transmission chain task:** Building “paper airplanes” (chain of 10)
- 2. **Fitness rate** = Distance of flying
- 3. **Social learning conditions** (emulation, imitation, teaching, microsociety)

- Reported cumulative effects in **all conditions**, i.e. no increased performance for the Hi-Fi conditions

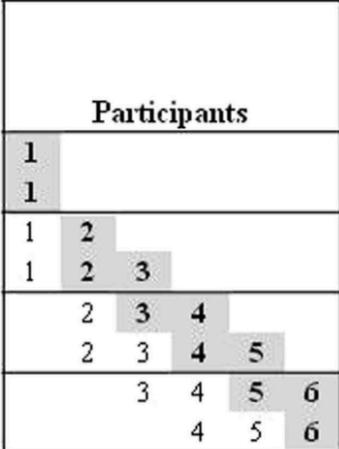
Time (min)	Participants Present in Test Group									
0:00–2:30	1	2	3							
2:30–5:00	1	2	3	4						
5:00–7:30	1	2	3	4	5					
7:30–10:00	1	2	3	4	5	6				
10:00–12:30	2	3	4	5	6	7				
12:30–15:00	3	4	5	6	7	8				
15:00–17:30	4	5	6	7	8	9				
17:30–20:00	5	6	7	8	9	10				
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22:30–25:00	7	8	9	10						
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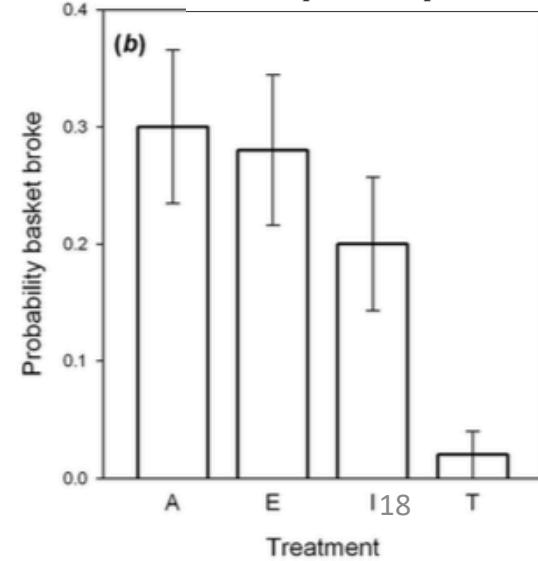
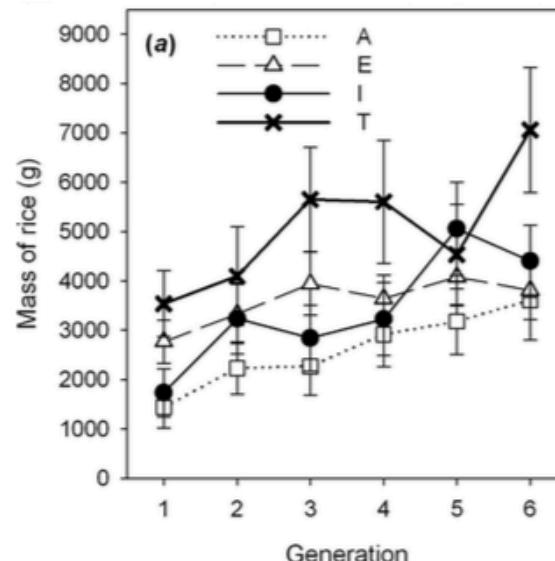
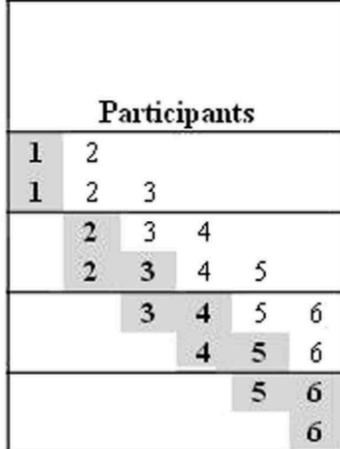
Zwirner & Thornton, 2015 – Teaching is not necessary!

- 1. **Transmission chain task:** Building “baskets” (chain of 6)
- 2. **Fitness rate:** Mass of rice, probability of breakage
- 3. **Conditions:** Asocial, emulation, imitation, teaching
- Reported cumulative effects in **all social conditions**, i.e. no increased performance for the Hi-Fi conditions

(b) Emulation and
Teaching chains



(c) Imitation chains

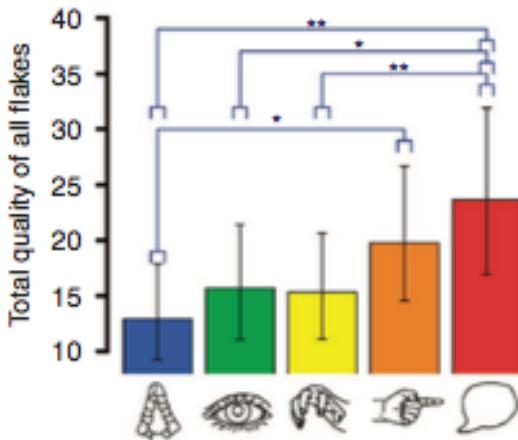


Material and dimensions
String (40 cm)
Fabric gauze (25 × 27 cm)
Sheet of newspaper
Bubble wrap (40 × 10 cm)
Wooden stick (42 × 1.5 × 1.5 cm)
Bottle tops
Strips of adhesive tape (42 cm)
Drawing pins
Rubber bands
Drinking straws (21 cm)
Skewers (25 cm)
Paper napkin
Stapler with staples

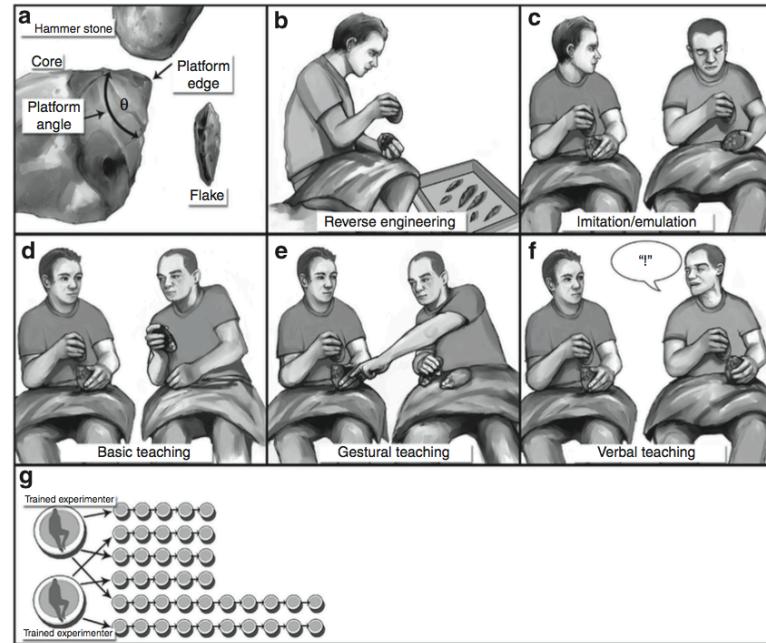
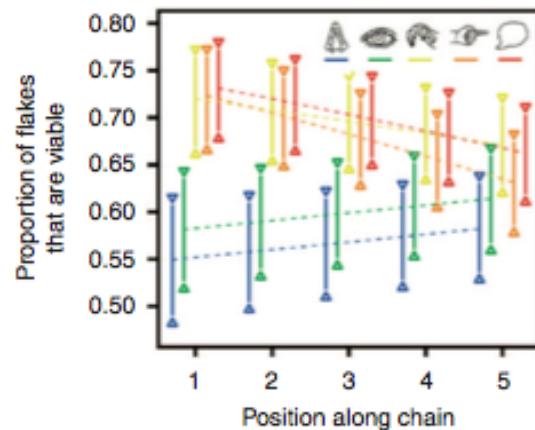
Morgan et al, 2015 – Tool making, teaching and language

- 1. Transmission chain task: Stone knapping
- 2. Fitness rate = Quality of viable flake
- 3. Conditions rev. engineering, emulation/imitation, basic/gestural/verbal teaching
- Reported increased improvement in particular for “Verbal teaching”

a



h



Group assignment on CT studies

- Evidently, the success of cultural transmission in the lab is highly task-dependent
 - Making the bonus question even harder
- Other observations?



Summing up

- **Transmission chain studies** are potential methods for investigating social transmission and the social cognitive requirements for cumulative culture
- Diverge in terms of demonstrating, or rejecting, a clear advantage for **Hi-Fi SLMs** in cultural transmission
 - What exactly is involved in teaching?
 - Are the tasks analogous to cumulative culture?
 - Last time: Comparative studies suggest that '**package**' of sociocognitive processes, involving imitation, teaching & language, is key – but inconclusive evidence
- Thus, we have great and interesting methods but some conceptual challenges



Conceptual challenges – Teaching?

1. The notion of “teaching” often rather broad and typically refers to “*behaviour that evolved to facilitate learning in others*”, as observed in a range of non-human animals
 - underspecified in terms the experimental instructions and the type of interactions; sometimes operationalised as “direct verbal instruction” or “communication between tutor and pupil”
 - Similarly for other SLMs

These all had different operationalizations!

Research Report

Social Learning Mechanisms and Cumulative Culture

Is Imitation Necessary?

Christine A. Caldwell and Ailsa E. Millen

ARTICLE

Received 4 Sep 2014 | Accepted 3 Dec 2014 | Published 13 Jan 2015

DOI: 10.1038/ncomms7029

Experimental evidence for the co-evolution of hominin tool-making

T.J.H. Morgan^{1,2}, N.T. Uomini^{3,4,5}, L.E. Renée⁶, C.P. Cross^{1,7}, C. Evans¹, R. Kearney¹, I. de L

Identification of the Social and Cognitive Processes Underlying Human Cumulative Culture

L. G. Dean,¹ R. L. Kendal,^{2,*} S. J. Schapiro,³ B. Thierry,⁴ K. N. Laland^{1*}

SCIENTIFIC REPORT

OPEN

Cognitive requirements of cumulative culture: teaching is useful but not essential

Received: 12 March 2015

Accepted: 20 October 2015

Elena Zwirner^{1,2} & Alex Thornton¹

Conceptual challenges – Task types?

2. Examples of tasks include: Subjects construct
 - paper airplanes, spaghetti-towers, baskets, weight-bearing devices out of clay and reeds, stone knapping, making virtual fish-nets, etc.
 - Inherently motor **action-based tasks**, i.e. ‘transmitting’ information about how to manually construct sth or perform motor actions
 - No **cognition-based tasks**, in the more classical sense of algorithmic transformations (Marr, 1982) or involving higher-order cognitive computations to be accumulated
3. If investigated, the **social-cognitive mechanisms** typically involved prosociality, empathy, etc.
 - No role for Implicit/explicit mentalising, explicit metacognition, etc
 - No mechanistic distinction between interaction types or communication channels

1. Why does it matter how learning is specified or operationalized?

Recall: the taxonomy of interaction types:

(1) *Off-line social cognition*, which involves one system (the observer) who can observe the other system (the actor), but the actor cannot align with the observer

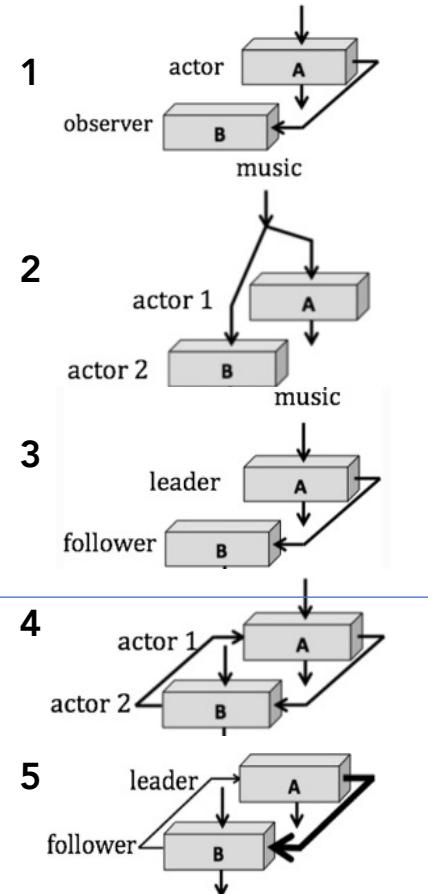
(2) *Coordination without alignment*, which involves alignment of the two systems, but no information exchange between them

(3) *On-line social cognition without mutual alignment*, which involves input available to both systems, but the first system available to the second system does not affect the interaction, and the two systems are not cooperating although only one system can influence the interaction

(4) *On-line social cognition with mutual alignment*, which involves both systems exchanging information reciprocally and adapting to each other

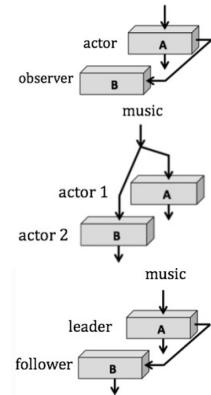
(5) *On-line social cognition with mutual alignment*, with leader-follower relationship. To preserve the interaction the follower is required to adapt more or less depending on leader information

Where would we place imitation?
teaching?

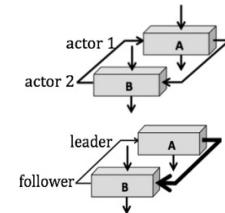


The degrees of alignment between two interacting individuals

- Recall, a broad distinction between **unidirectional** (1-3) and **bidirectional** (4-5) exchanges of information, which differ in **mutual adaptation**
 - This conceptualisation provides us **with qualitatively different interactive situations**, which all have **different resulting influence** on the patterns of behaviour that emerges!
- Relating this distinction to cultural transmission studies?
- Can the **diverging results in high-fidelity conditions** be related to the **underspecified operationalisation** of the interaction types involved?



Information exchange
is learning



Group assignment no 2



Consider challenge 2 and 3 about task types and designs

As experimentalists, what are your ideas for a study?

- a. What would the transmission chain **task** be?
- b. What would the fitness rate **measure** be?
- c. What interactions (conditions) would be **compared**?

See more details in
“Assignment 6” on
Blackboard!

- For example, regarding the concept ‘teaching’ in class 4, we discussed
 - Can we dissociate the relative roles of bidirectional interaction and verbal interaction?
- One could then ask:
 - Is it **the opportunity to use “full” language** that is primary in a cultural transmission, or actually the **way in which communication is used** (i.e. in bi- vs unidirectional interaction)?

An experimental example using the Rubik's cube

Is bidirectional interaction more conducive of social transmission than linguistic interaction?



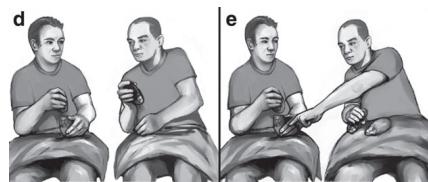
		Bi-directionality	
		+	-
Verbal comm.	+	Two-way verbal condition	One-way verbal condition
	-	Two-way non-verbal	One-way verbal condition

Predictions: Main effect of interaction type (bidirectional interaction) and no main effect of language (verbal communication)

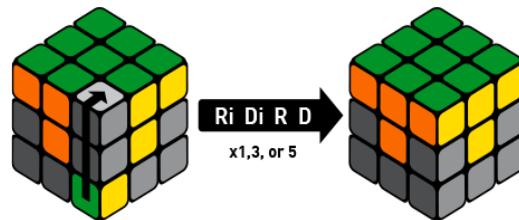
Experimental conditions

		Bi-directionality	
		+	-
Verbal comm.	+	Two-way verbal condition	One-way verbal condition
	-	Two-way non-verbal	One-way verbal condition

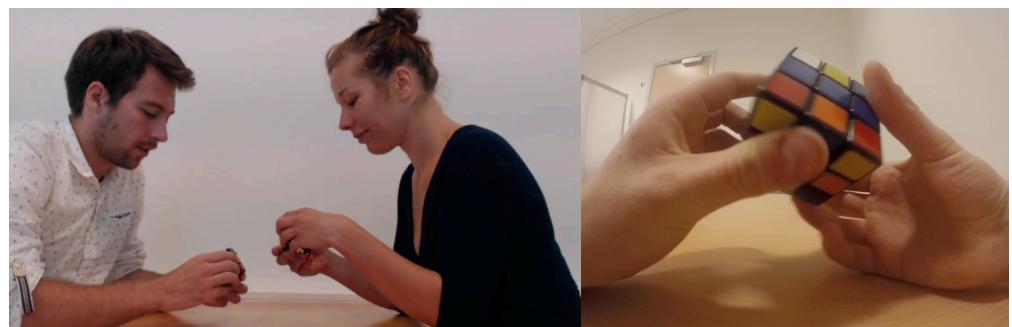
- **Two-way verbal** – allowed any form of communication to demonstrate the learnt information.
- **One-way verbal** – any form of communication to demonstrate the learnt information, but only one-way communication (although both still had a cube), i.e. the receiver could not reciprocate
- **Two-way non-verbal** – identical to “two-way verbal”, except they were not allowed to use linguistic communication (i.e. spoken language), but instead any form on nonverbal communication (were also given earmuffs)
- **One-way non-verbal** – identical instructions to “one-way verbal”, except no linguistic communication (i.e. as in Two-way non-verbal).
- **(Imitation** - not allowed to communicate in any way (verbal or non-verbal), they could simply act out the knowledge that they had acquired, which the receiver could observe and subsequently imitate (screen))



≠



Time	Participants
0:00-12:00	1
12:00-15:00	1 2
15:00-27:00	2
27:00-30:00	2 3
30:00-42:00	3
42:00-45:00	3 4
45:00-57:00	4
57:00-60:00	4 5
60:00-72:00	5



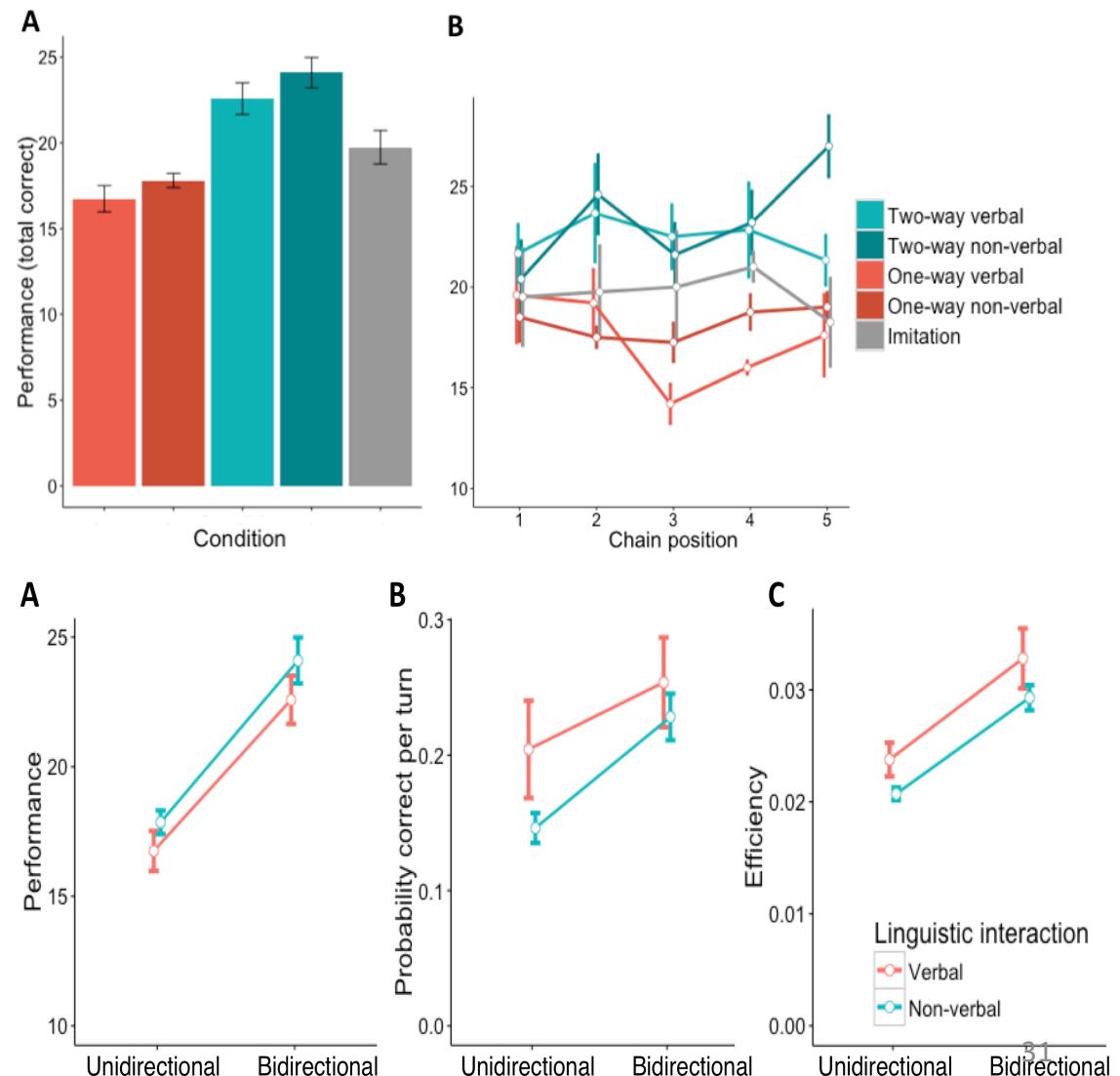
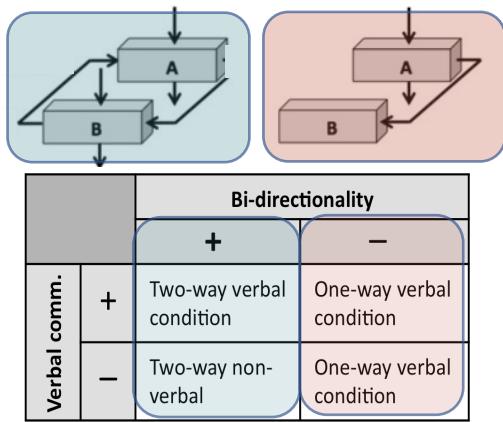
In-class demo – simplified

- One showcase of each condition
 - Always start from scratch/scramble
 - Transmission stage vs.
 - Performance stage (we'll skip this)
- What *information* can be exchanged?
- Measuring *total turns, time, and performance* (correct placements)
- What is your predictions?

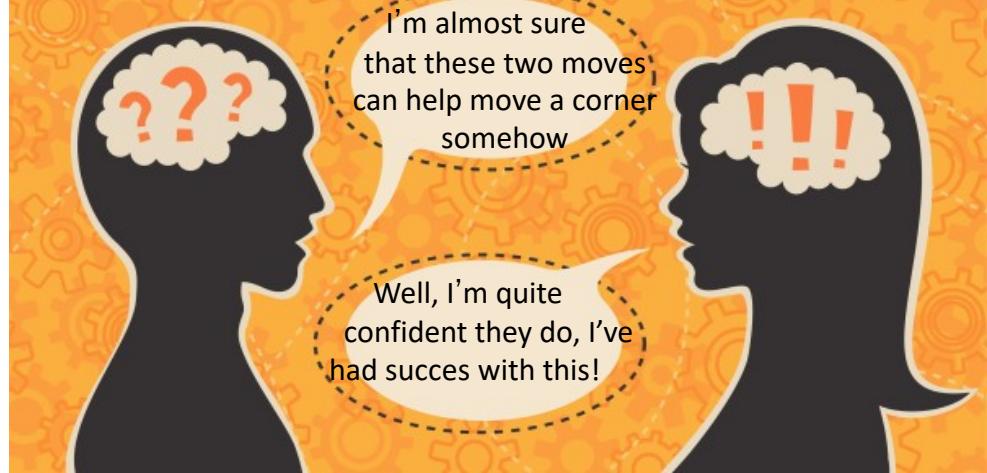
		Bi-directionality	
		+	-
Verbal comm.	+	Two-way verbal condition	One-way verbal condition
	-	Two-way non-verbal	One-way verbal condition

Time	Participants
0:00-12:00	1
12:00-15:00	1 2
15:00-27:00	2
27:00-30:00	2 3
30:00-42:00	3
42:00-45:00	3 4
45:00-57:00	4
57:00-60:00	4 5
60:00-72:00	5

Results – comparing interaction types



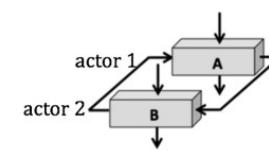
Results



- Advantage for bidirectional interaction in the performance, efficiency, and probability of being successful *in a given trial*.
 - On the other hand, **no advantage for full-blown language** over non-verbal
 - Bidirectional interaction is **more conducive to social transmission**
- With a more cognition-based task, there is more reliance on the information sharing (rather than visuo-motor copying)
 - And to facilitate more accurate information integration, recall the mechanism of shared explicit metacognition (via bidirectional interaction)
- Results did not show that language is *not* important, but rather **that it is unlikely to enhance social coordination or learning if not used in its primary function**; namely, in social interaction *between* people

Cultural cognition II

- Understanding cultural transmission and cumulative culture is important for many aspects of our society, environment, etc.
- To get a grip of these processes we can use empirical paradigms, fx *transmission chain studies*, in combination with our knowledge about *cognitive basis of social interactions*
- The way in which individuals *interact* (be it SLMs or Interaction types) and *communicate* plays a central role for cultural learning
 - Despite terminology, there is a link/relationship
- Cultural cognition is task-dependent and variable (affected by cultural factors, not surprisingly) – so selection of tasks and paradigms depends on the question of interest



Recap – concepts and notions

- Social learning mechanisms
- High-fidelity learning
- **Cultural transmission paradigms**
- Social transmission
- Linear chain tasks
- Microsocieties
- Replacement chain tasks
- Generational succession
- Confounding variables
- Skill refinement
- Innovation
- (Causal) Opacity
- Fitness rate
- Learning conditions
- **Operationalization**
- Underspecification
- Task demands
- Cumulative improvements
- Action-based tasks
- Cognition-based tasks
- Demand characteristics
- 2 x 2 design
- Orthogonal contrasts
- Main effects
- Mutual adaptation

See you after the vacation