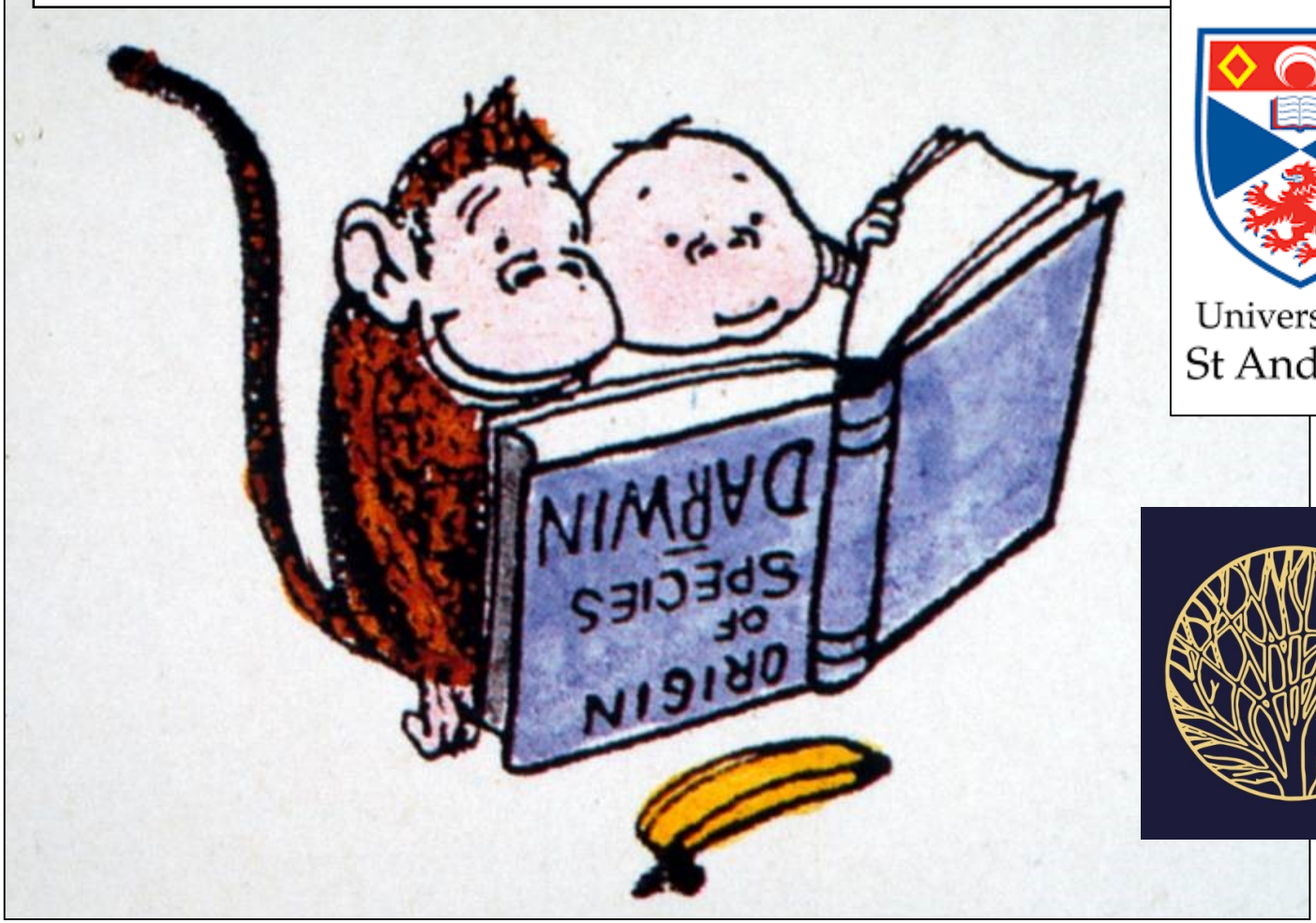
Animal Cultures – Core Discoveries and New Horizons

IMPLICATIONS FOR UNDERSTANDING THE EVOLUTION OF HUMAN CULTURE

Andrew Whiten ~ Centre for Social Learning and Cognitive Evolution



University of St Andrews

Cultural Evolution Society

"Human beings owe their biological supremacy to the possession of a form of inheritance quite unlike that of other animals: exogenetic or exosomatic inheritance.

In this form of heredity information is transmitted from one generation to the next through non-genetic inheritance … in general, by the entire apparatus of culture"

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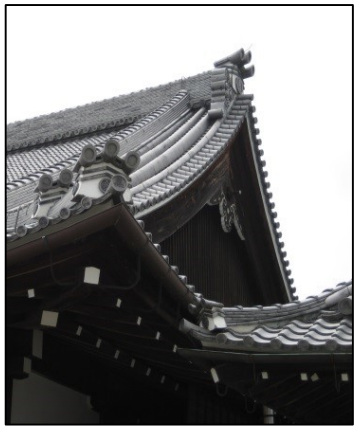
Dream

Professor Sir Peter Medawar, Nobel Laureate
The New York Review of Books, 1977



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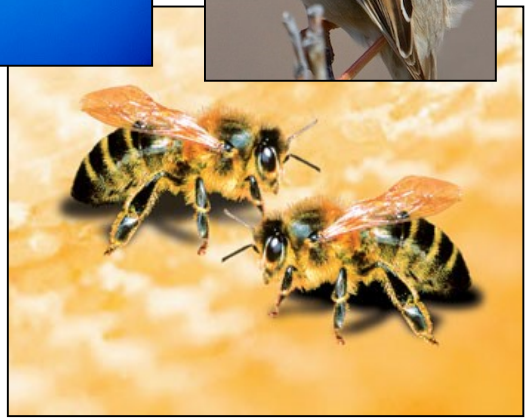

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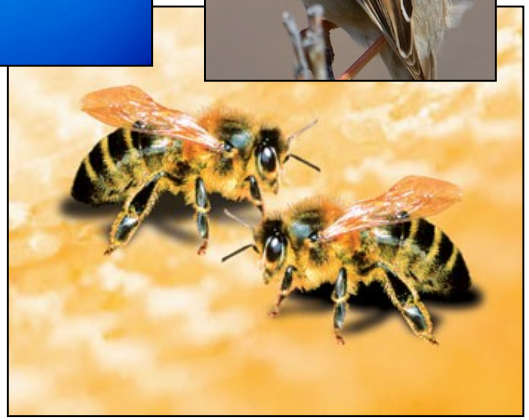
HUMAN CULTURE DID NOT SPRING OUT OF THE BLUE!









Two ways in which discoveries about animal culture can illuminate the evolution of human culture:

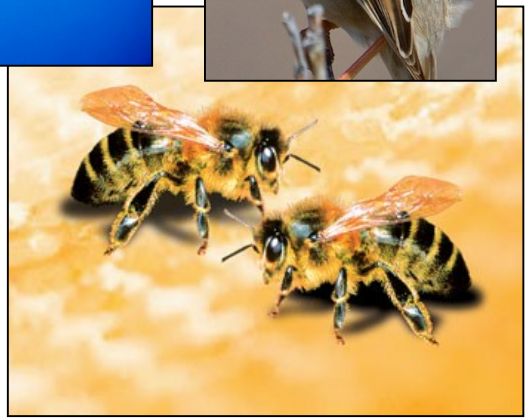
1. Phylogeny of culture

HUMAN CULTURE DID NOT SPRING OUT OF THE BLUE!









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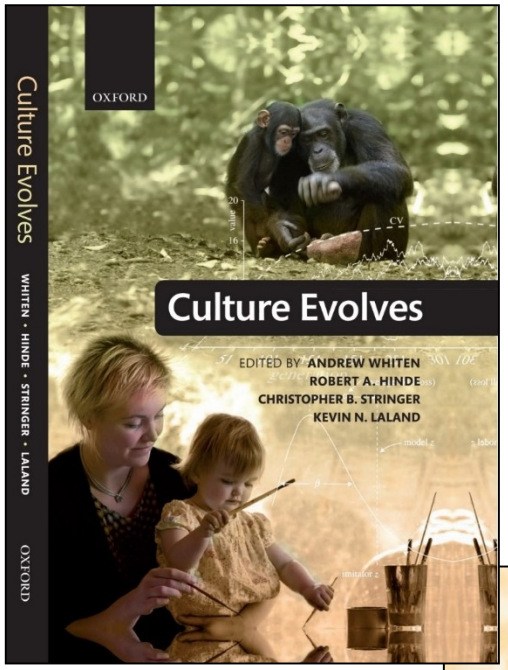
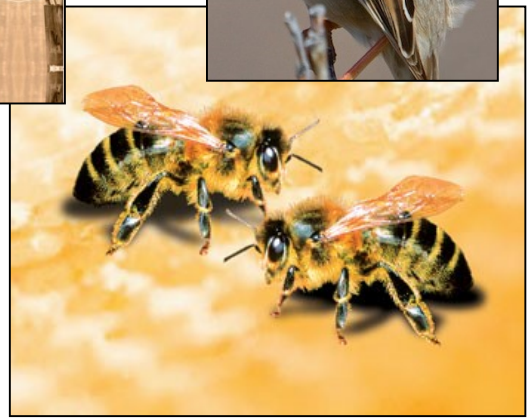
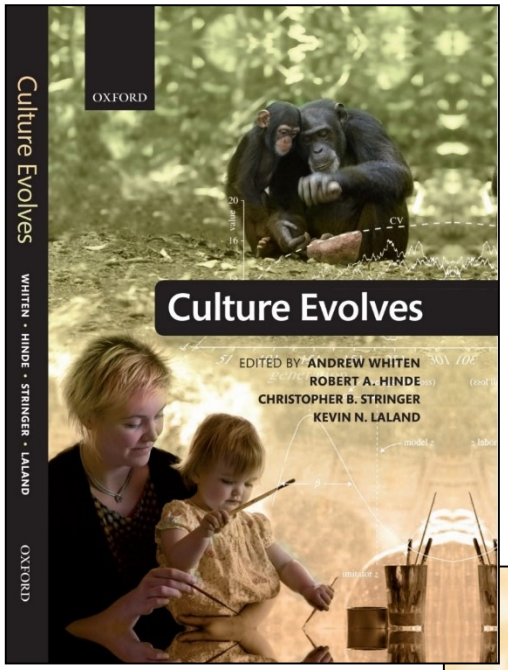
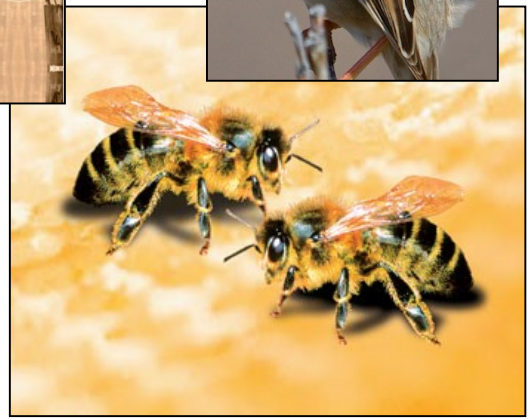




Two ways in which discoveries about animal culture can illuminate the evolution of human culture:

1. Phylogeny of culture
2. Convergent cultural evolution





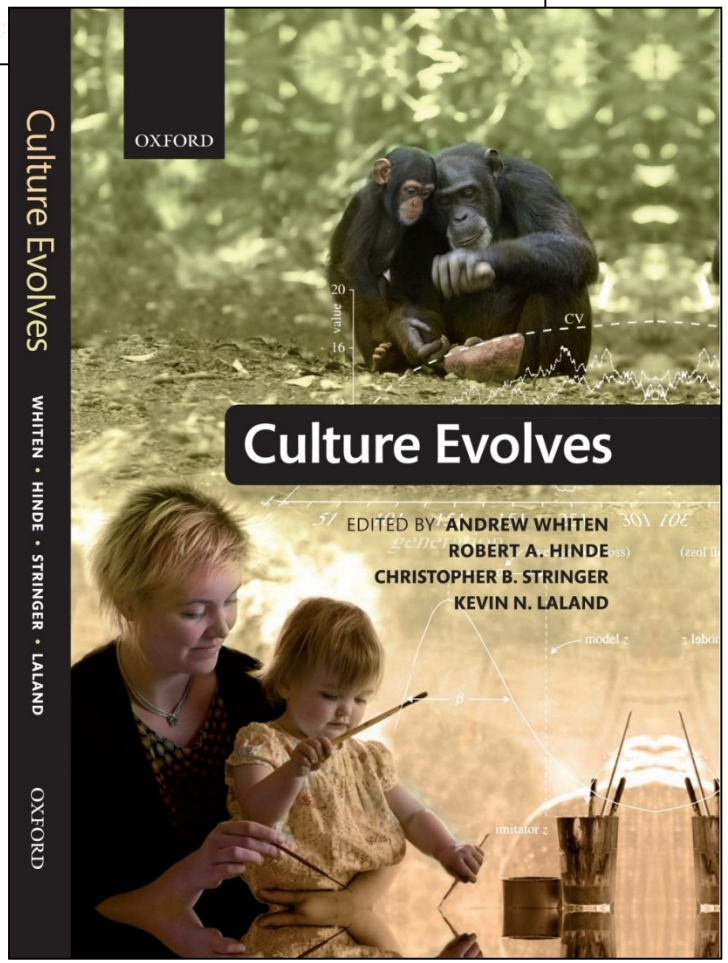
PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B

Phil. Trans. R. Soc. B (2011) **366**, 997–1007
doi:10.1098/rstb.2010.0334

Review

The scope of culture in chimpanzees, humans and ancestral apes

Andrew Whiten*



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PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

ISSN 0962-8436
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number 1567
pages 935–1187

In this Issue

Culture evolves

Papers of a Discussion Meeting issue organized and edited by Andrew Whiten, Robert A. Hinde, Christopher B. Stringer and Kevin N. Laland

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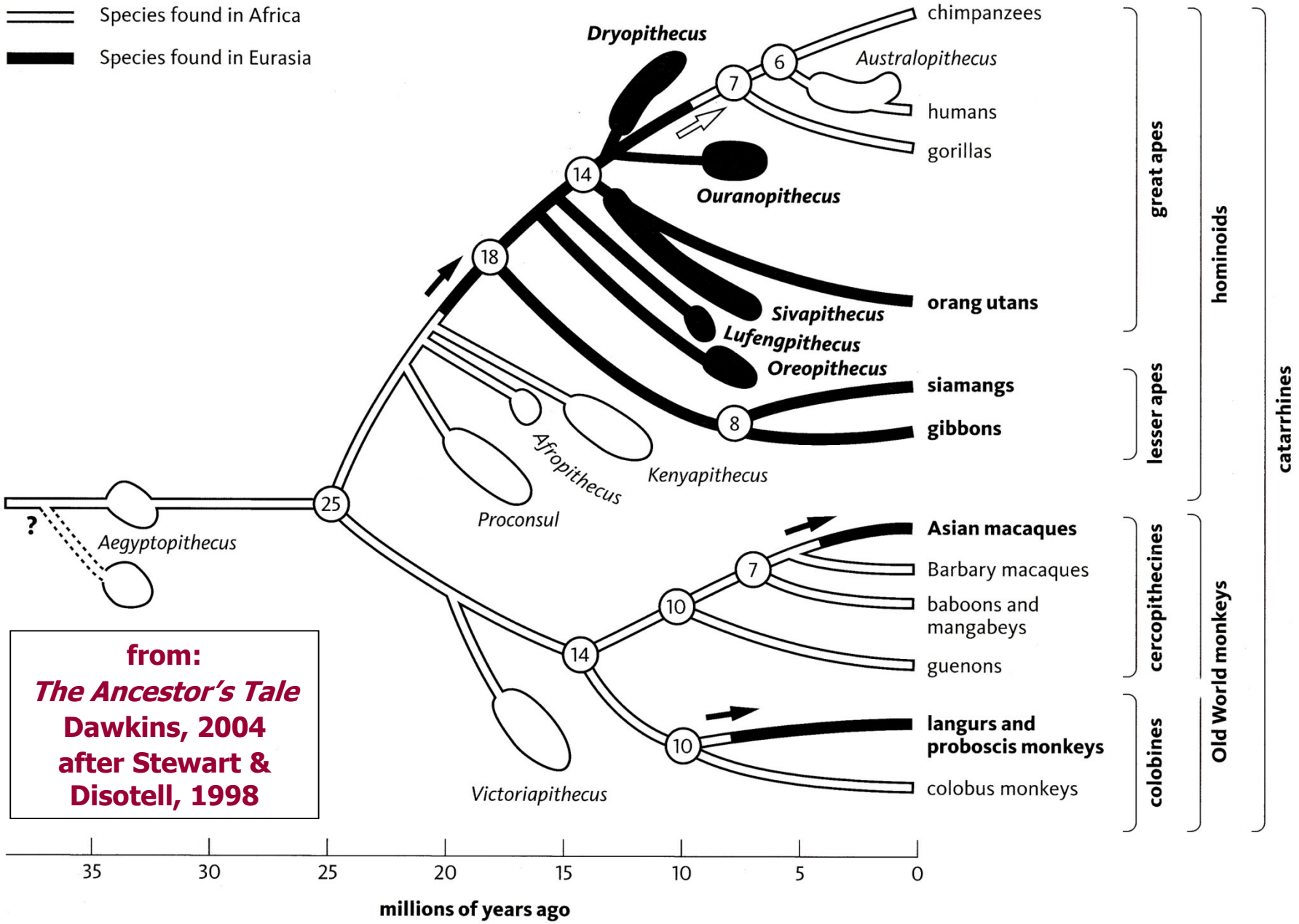
Annu. Rev. Psychol. 2017. 68:129–54

The *Annual Review of Psychology* is online at psych.annualreviews.org

Social Learning and Culture in Child and Chimpanzee

Andrew Whiten


Species found in Africa
Species found in Eurasia
chimpanzees
Australopithecus
humans
gorillas
Dryopithecus
6
7
14
Ouranopithecus
18
orang utans
Sivapithecus
Lufengpithecus
Oreopithecus
siamangs
gibbons
8
Afropithecus
Kenyapithecus
Proconsul
25
?
Aegyptopithecus
Asian macaques
Barbary macaques
baboons and mangabeys
guenons
7
10
14
10
langurs and proboscis monkeys
colobus monkeys
Victoriapithecus
great apes
lesser apes
hominoids
cercopithecines
colobines
Old World monkeys
catarrhines
35
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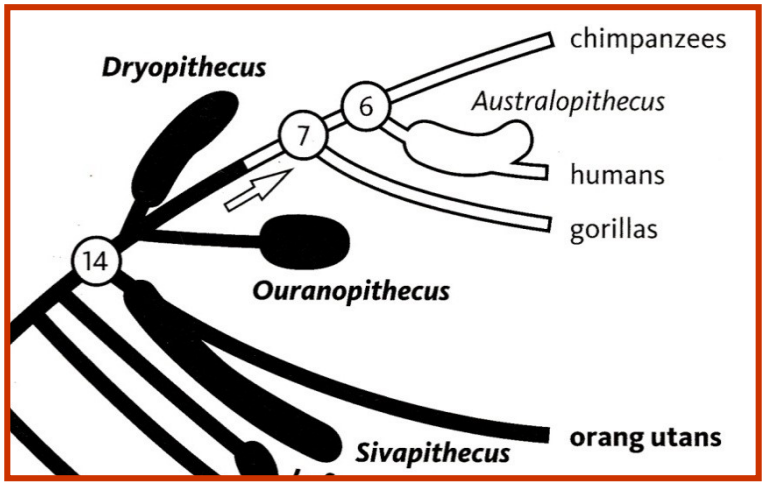
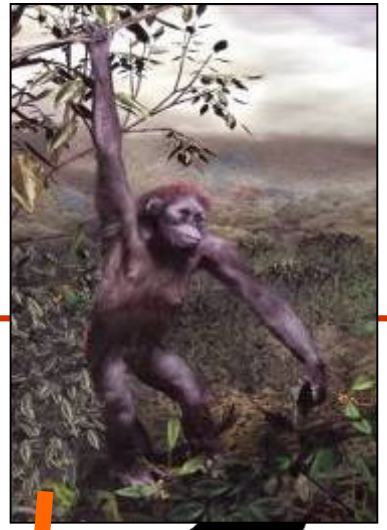
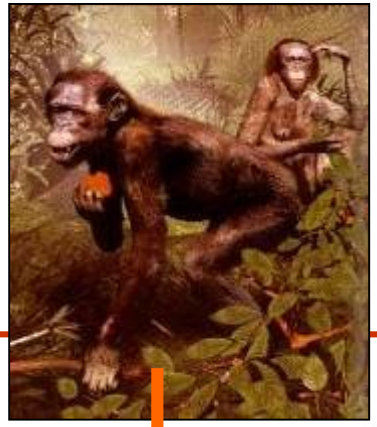
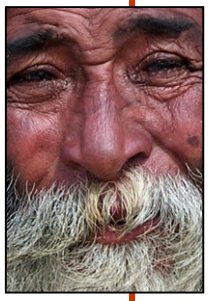
millions of years ago
from:
The Ancestor's Tale
Dawkins, 2004
after Stewart &
Disotell, 1998

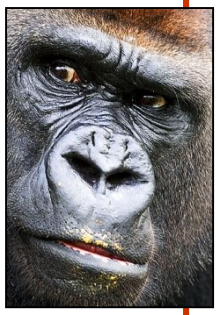

chimpanzees
Dryopithecus
6
Australopithecus
7
humans
gorillas
14
Ouranopithecus
orang utans
Sivapithecus

Images:
The Ancestor's Tale
Dawkins 2004









chimpanzees

Australopithecus

humans

gorillas

Ouranopithecus

Sivapithecus

orang utans

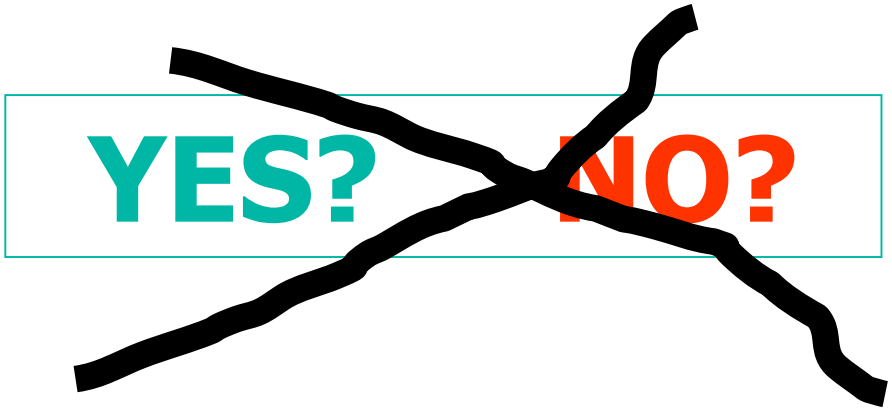
14

7

6

DISSECTING CULTURE

Does species 'X' "have culture"?



DISSECTING CULTURE

Population level patterning

Cultural contents

Transmission mechanisms

of -

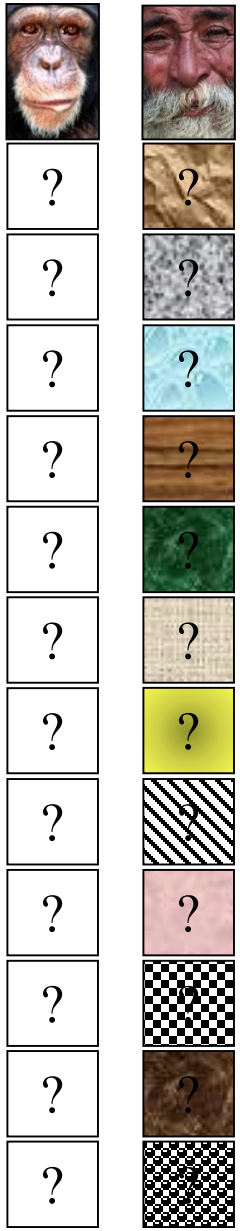
TRADITIONS

Whiten, A. The Second Inheritance System of Chimpanzees and Humans *Nature*, 2005

Population level patterning

Cultural contents

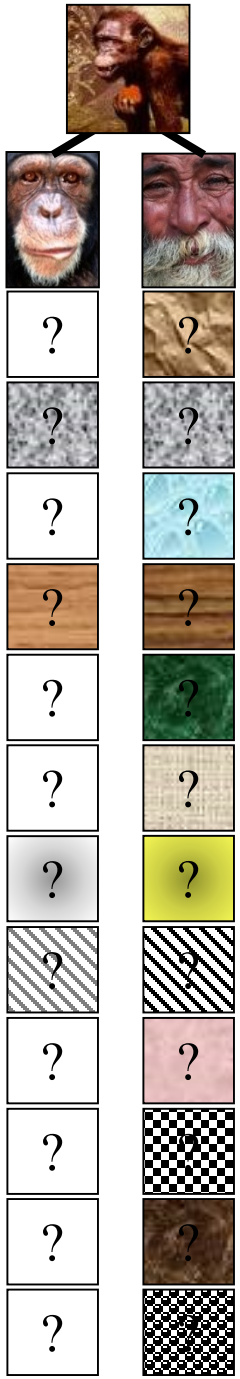
Transmission mechanisms



Population level patterning

Cultural contents

Transmission mechanisms



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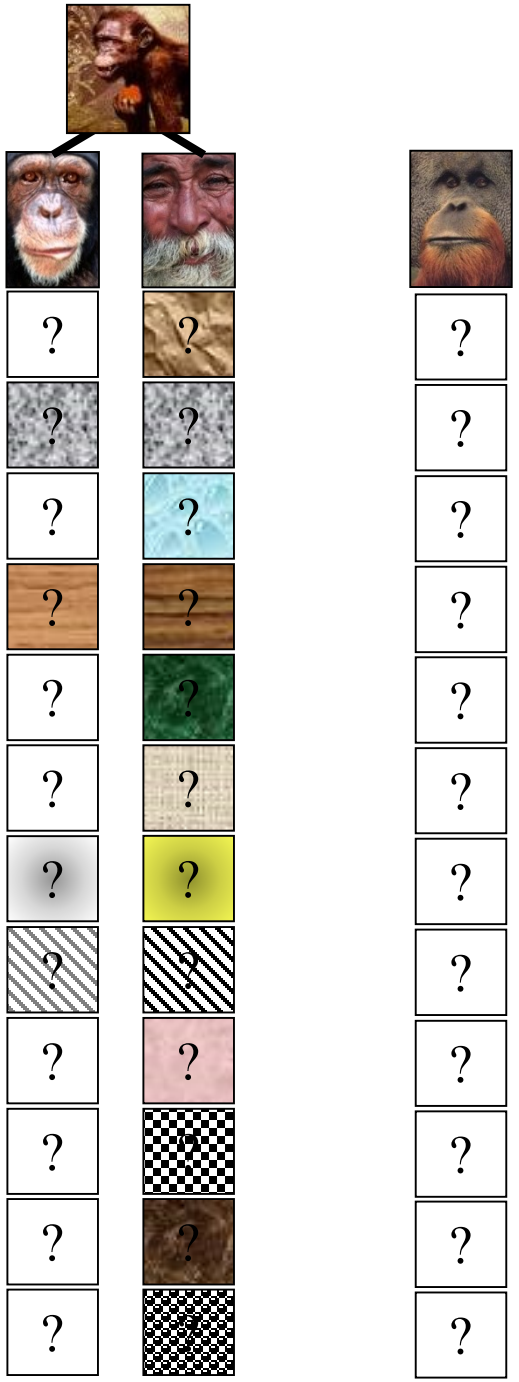
Cultural contents

Transmission mechanisms



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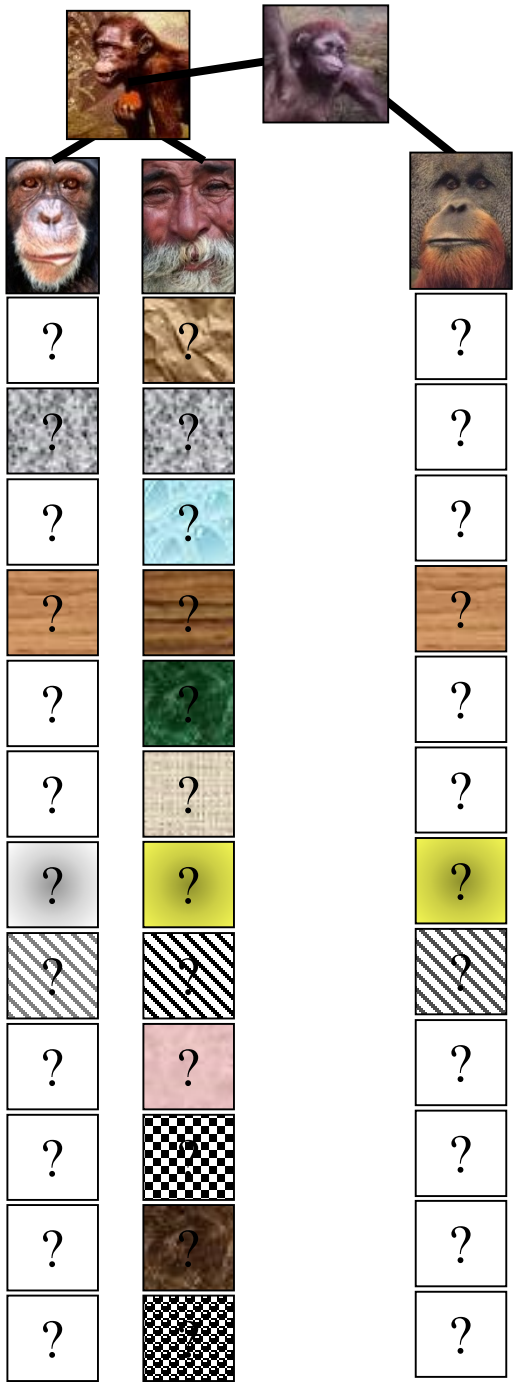


Population level patterning

Multiple diverse traditions

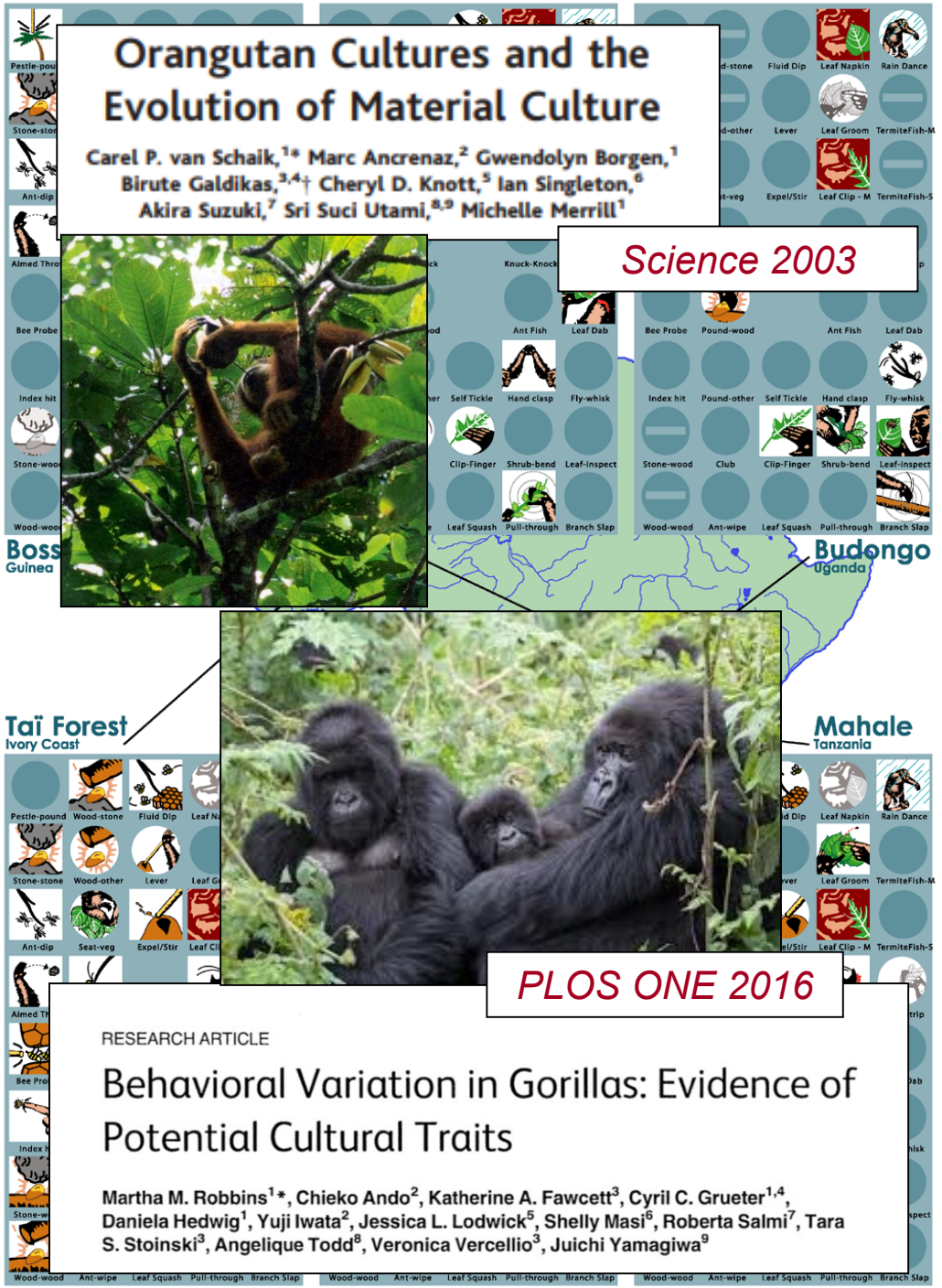
- Food processing
- Tool use
- Social behaviour
- Grooming style
- Courtship

Communities with unique arrays of traditions

1999

Cultures in chimpanzees

A. Whiten*, J. Goodall†, W. C. McGrew‡, T. Nishida§, V. Reynolds‖, Y. Sugiyama¶, C. E. G. Tutin#☆, R. W. Wrangham** & C. Boesch††



Traditions may be long lasting

Orangutan Cultures and the Evolution of Material Culture

Carel P. van Schaik,[1]* Marc Ancrenaz,[2] Gwendolyn Borgen,[1] Birute Galdikas,[3,4]† Cheryl D. Knott,[5] Ian Singleton,[6] Akira Suzuki,[7] Sri Suci Utami,[8,9] Michelle Merrill[1]

PNAS

4,300-Year-old chimpanzee sites and the origins of percussive stone technology

Julio Mercader*†, Huw Barton‡, Jason Gillespie§, Jack Harris¶, Steven Kuhn‖, Robert Tyler**, and Christophe Boesch††

*Department of Archaeology, University of Calgary, Calgary, AB, Canada T2N 1N4; ‡Department of Archaeology and Ancient History, University of Leicester, Leicester LE1 7RH, United Kingdom; ¶Department of Anthropology, Rutgers, The State University of New Jersey, New Brunswick, NJ 08901; ‖Department of Anthropology, University of Arizona, Tucson, AZ 85721; **Department of Applied Microbiology and Food Science, University of Saskatchewan, Saskatoon, Canada S7N 5A8; ††Department of Primatology, Max Planck Institute for Evolutionary Anthropology, Deutscher Platz 6, 04103 Leipzig, Germany; and §Department of Anthropology, University of Alberta, Edmonton, AB, Canada T6G 2H4

Edited by Ofer Bar-Yosef, Harvard University, Cambridge, MA, and approved December 7, 2006 (received for review September 8, 2006)

2007

Bossou
Guinea

Kibale
Uganda

Taï Forest
Ivory Coast

Mahale
Tanzania

PLOS ONE 2016

RESEARCH ARTICLE

Behavioral Variation in Gorillas: Evidence of Potential Cultural Traits

Martha M. Robbins[1]*, Chieko Ando[2], Katherine A. Fawcett[3], Cyril C. Grueter[1,4], Daniela Hedwig[1], Yuji Iwata[2], Jessica L. Lodwick[5], Shelly Masi[6], Roberta Salmi[7], Tara S. Stoinski[3], Angelique Todd[8], Veronica Vercellio[3], Juichi Yamagiwa[9]

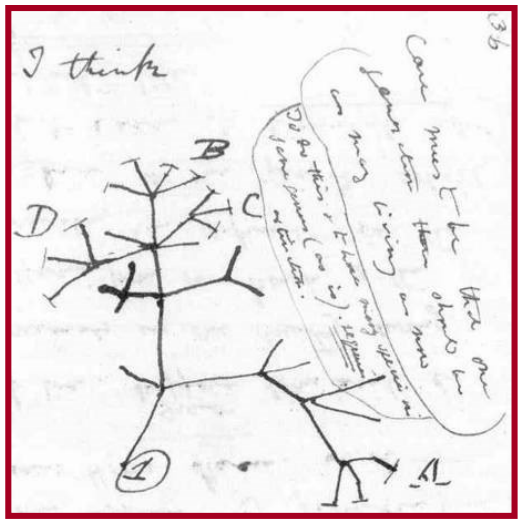
1999

Cultures in chimpanzees

A. Whiten*, J. Goodall†, W. C. McGrew‡, T. Nishida§, V. Reynolds‖, Y. Sugiyama¶, C. E. G. Tutin#☆, R. W. Wrangham** & C. Boesch††

Traditions may be long lasting

Traditions may evolve like a branching tree



1999

Cultures in chimpanzees

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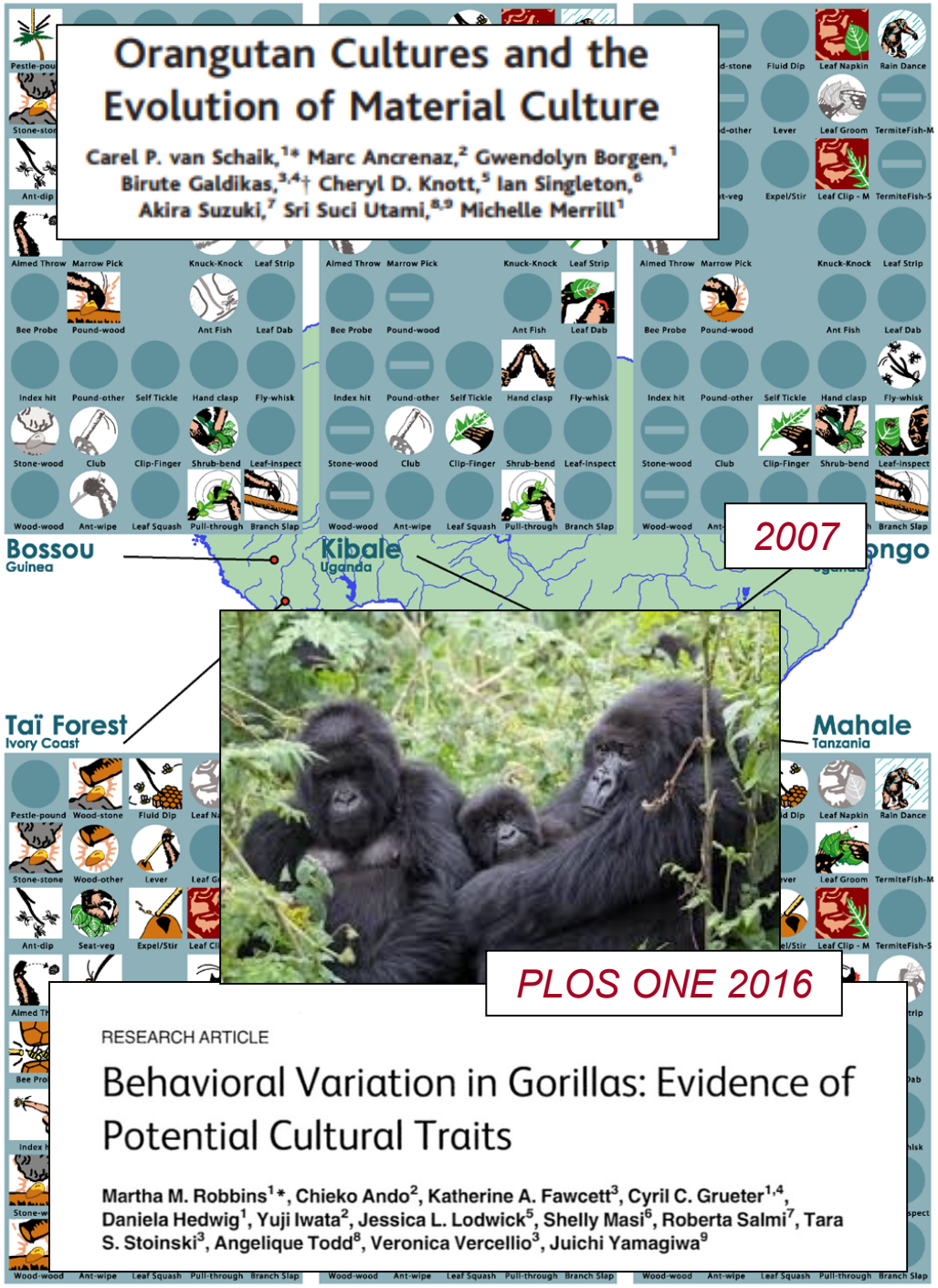

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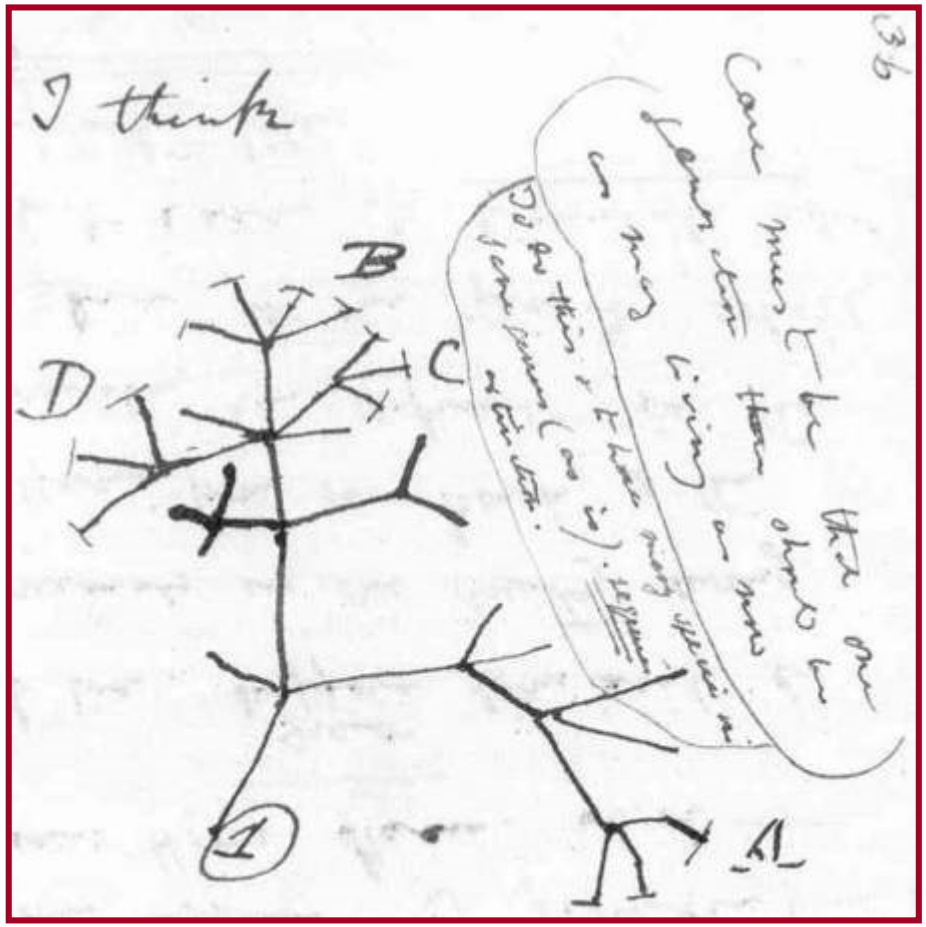
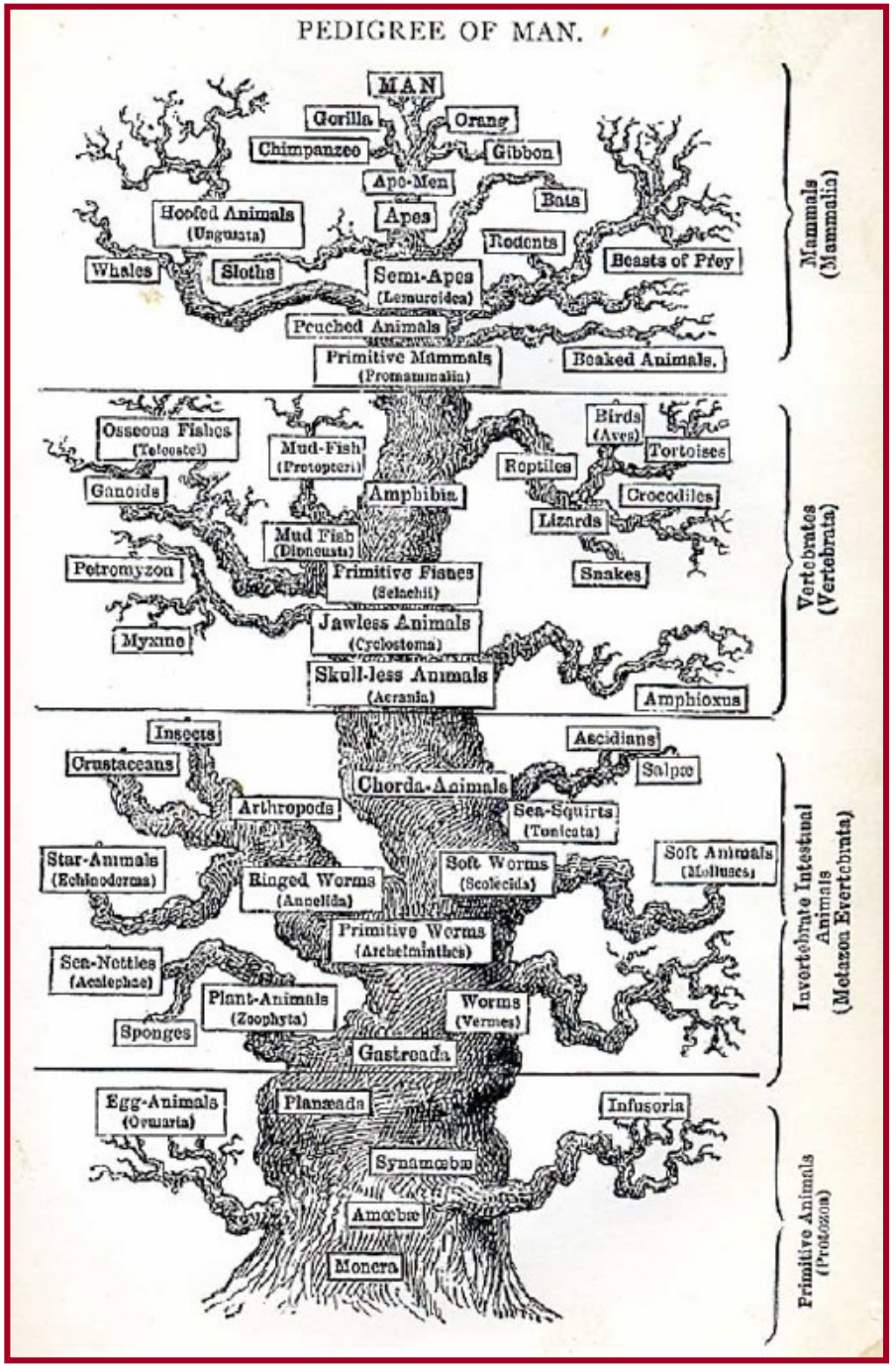
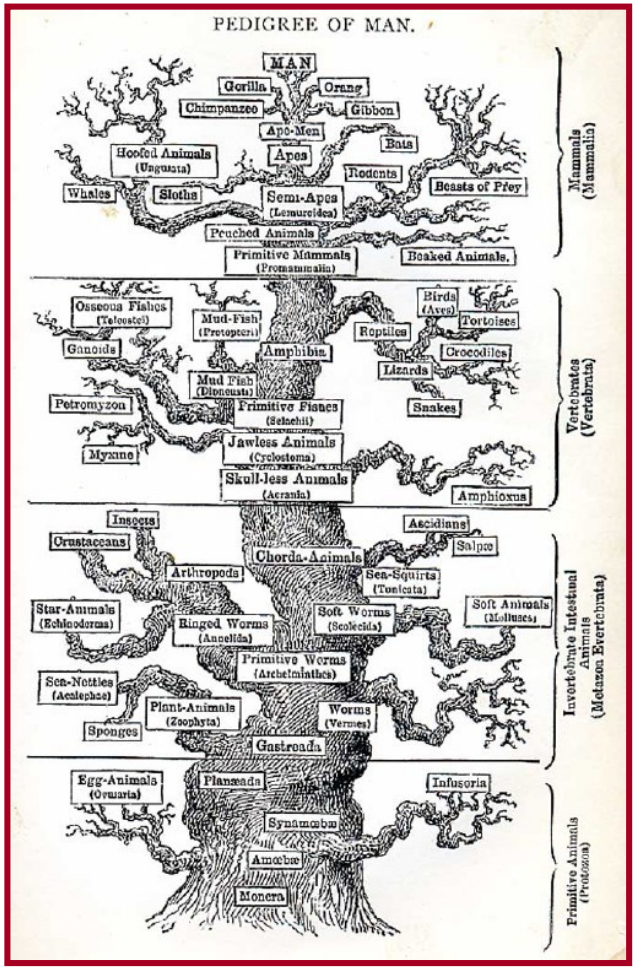






after A. Sleicher 1863 --- 'Die Darwinische Theorie und die Sprachwissenschaft'

Traditions may evolve like a branching tree

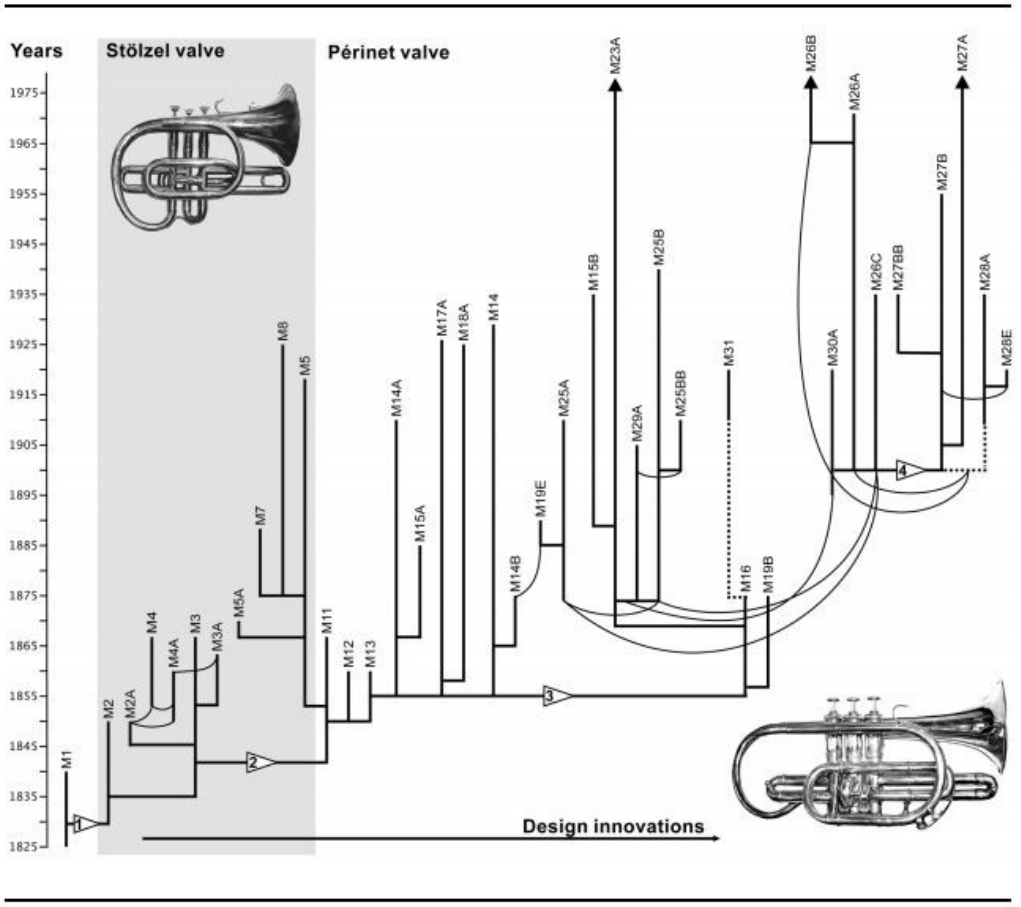
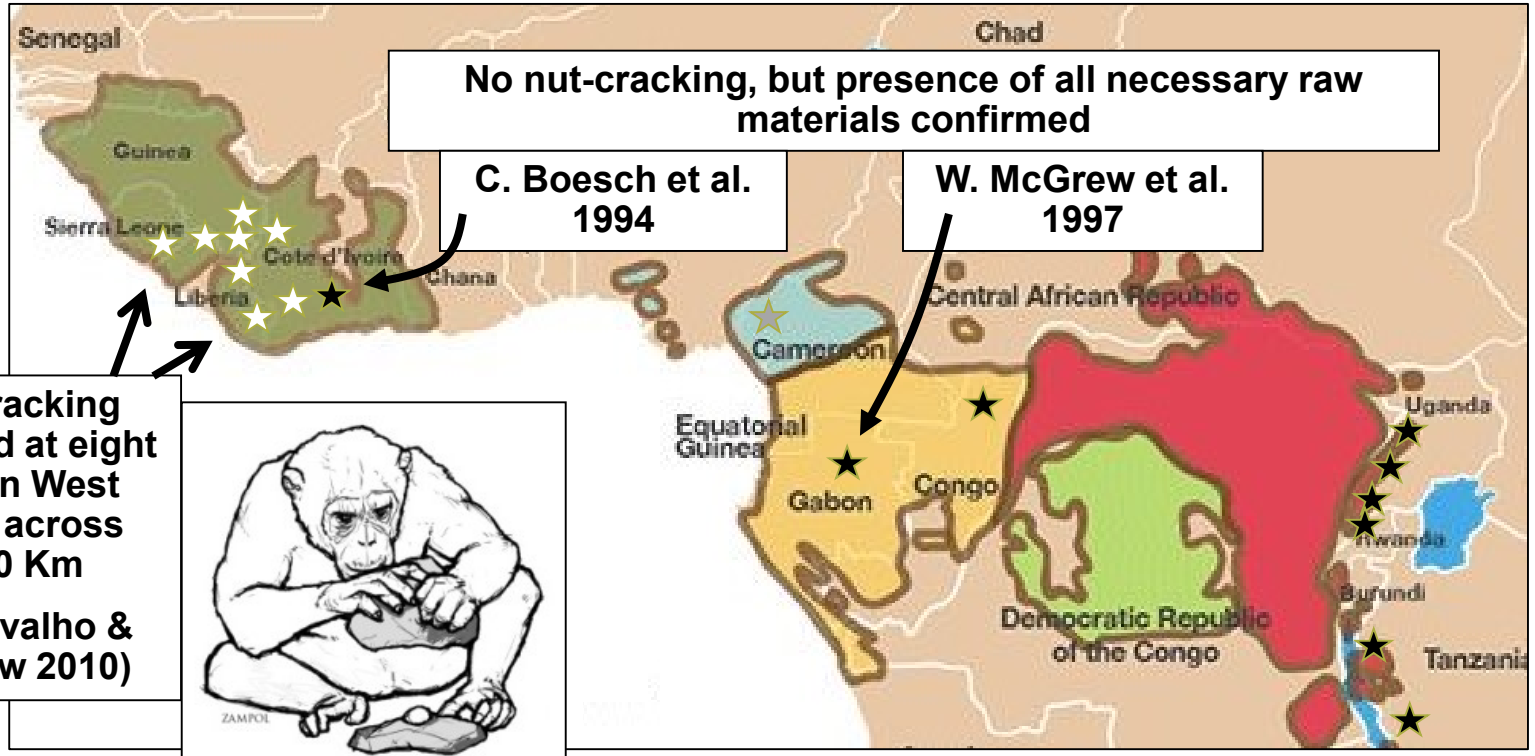
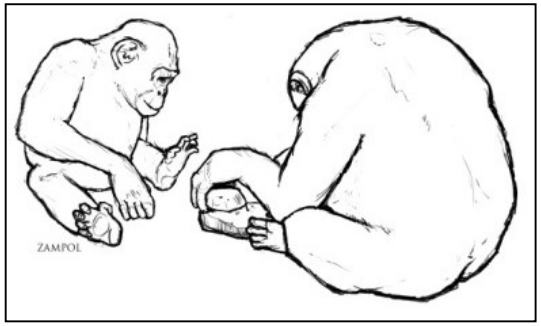


Figure 2. Evolutionary tree of cornets. The relationships among different models (*M*) are calibrated against the timeline so that the vertical branches correspond to periods of manufacture of particular models. *Shaded left and non-shaded right areas,* instruments equipped with Stölzel and Périnet

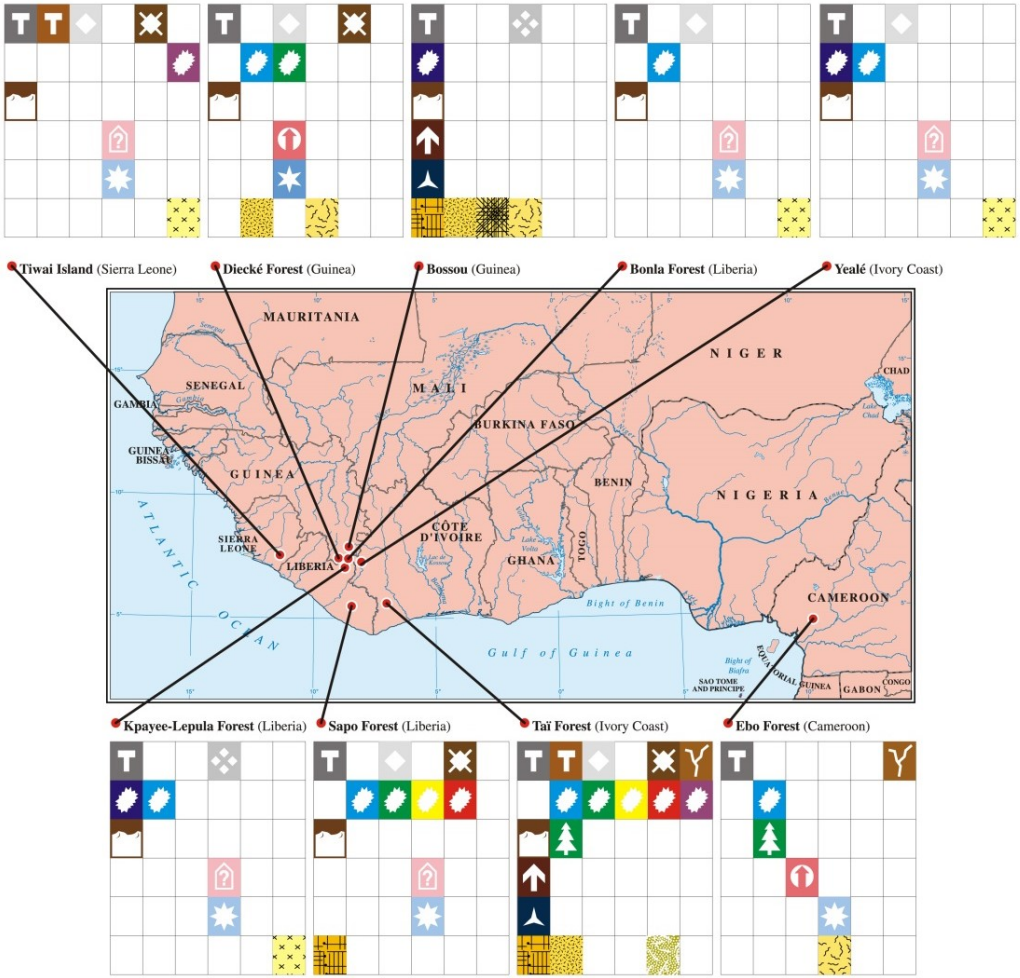
I. Temkin & N. Eldredge
Current Anthropology 2007



after A. Whiten, PNAS 2017



Chimpanzee Nut-cracking



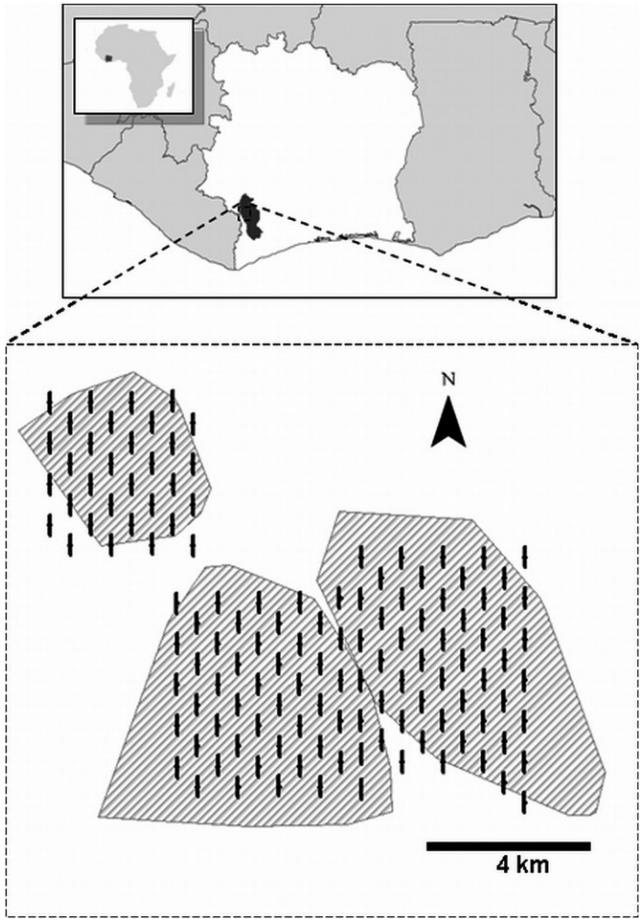
S. Carvalho & McGrew in M. Domínguez-Rodrigo 2010

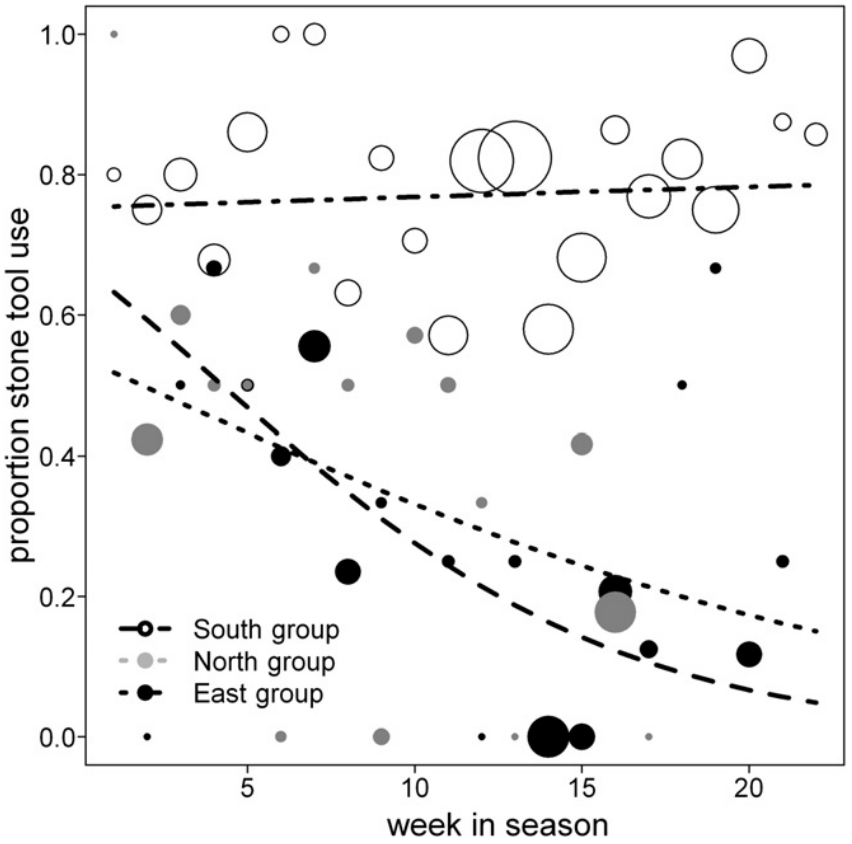
- Tool types
- Species of nut
- Type of rock
- Tool transport
- Tool re-use
- Terrestrial/arboreal

Current Biology 22, 922–926, May 22, 2012 ©2012 Elsevier Ltd All rights reserved DOI 10.1016/j.cub.2012.03.031

Evidence for Cultural Differences between Neighboring Chimpanzee Communities

Lydia V. Luncz,[1,*] Roger Mundry,[1] and Christophe Boesch[1]
[1]Department of Primatology, Max Planck Institute for Evolutionary Anthropology, Leipzig 04103, Germany





Traditions may be long lasting

Traditions may evolve like a branching tree

Traditions may evolve cumulatively

BEHAVIORAL AND BRAIN SCIENCES (1993) 16, 495–552
Printed in the United States of America

Cultural learning

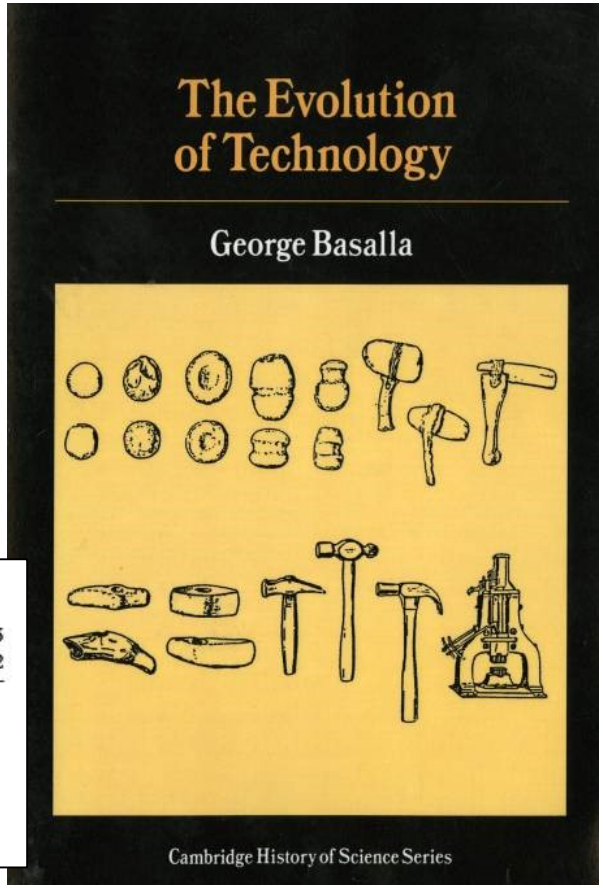
Michael Tomasello
Department of Psychology, Emory University, Atlanta, GA 30322
Electronic mail: *psymt@unix.cc.emory.edu*

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B

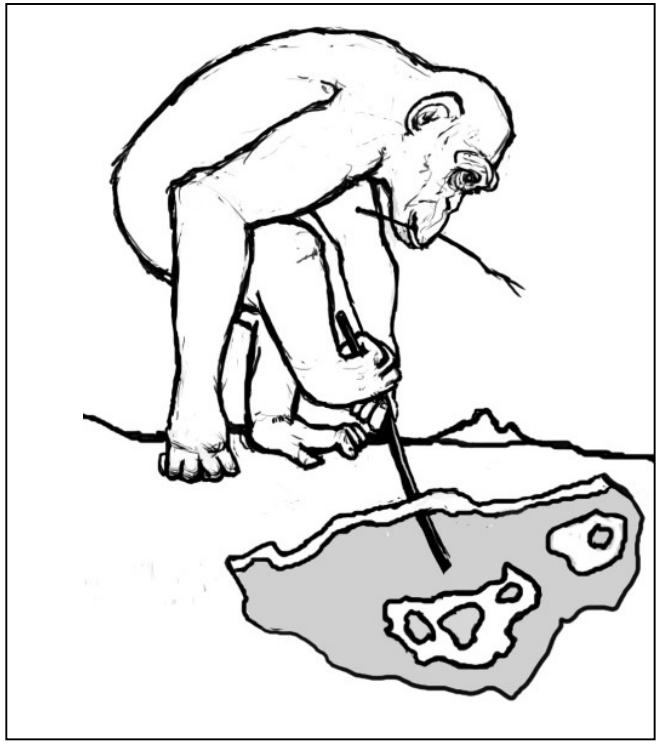
Phil. Trans. R. Soc. B (2009) **364**, 2405–2415
doi:10.1098/rstb.2009.0052

Ratcheting up the ratchet: on the evolution of cumulative culture

Claudio Tennie*, Josep Call and Michael Tomasello

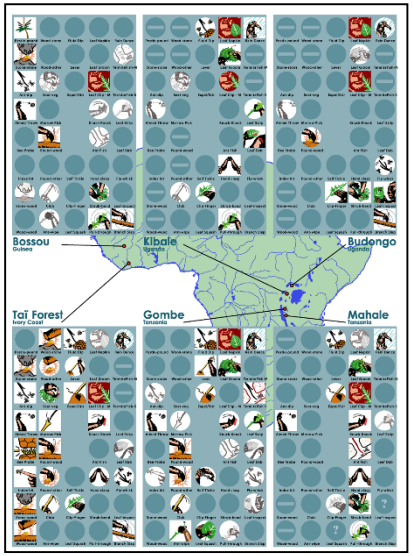


Cumulative Culture in apes?



Sanz, C., Call, J. & Morgan, D. 2009 Design complexity in termite-fishing tools of chimpanzees (*Pan troglodytes*). *Biology Letters* **5,** 293-296.

Population level patterning



Multiple Diverse Traditions

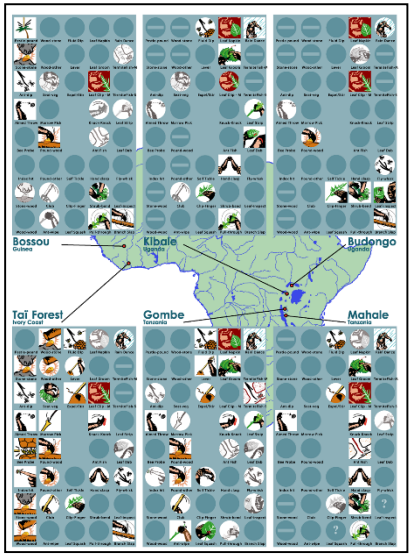
Communities have unique traditions arrays

Traditions may be long lasting

Traditions may evolve like a branching tree

Traditions may evolve cumulatively

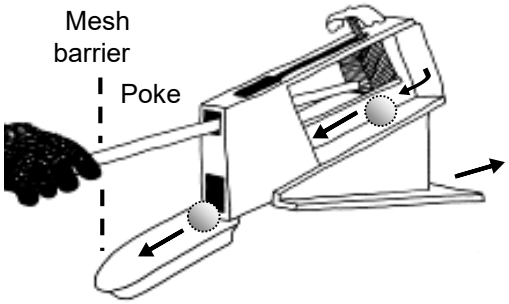
Population level patterning



~~Transmission~~ mechanisms

- Innovation
- Transmission processes
  - Social learning
  - Teaching

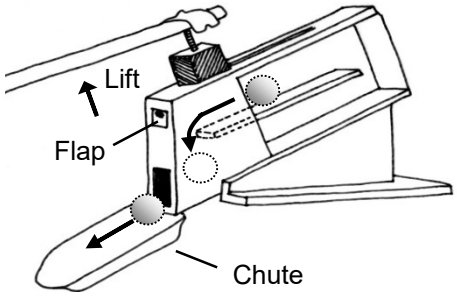
Can chimpanzees sustain (multiple) traditions?

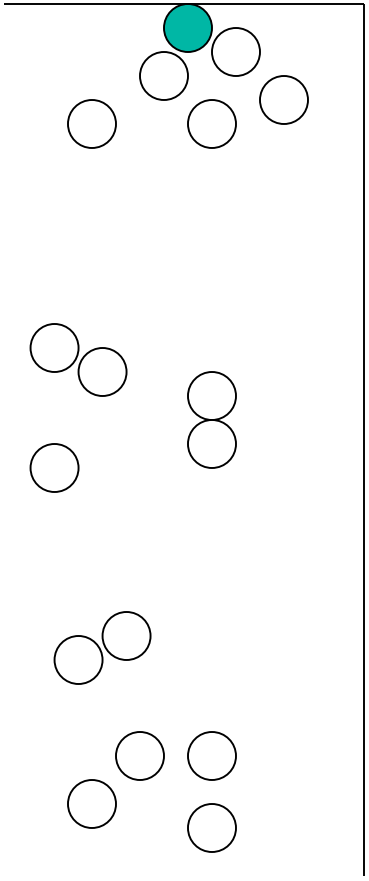


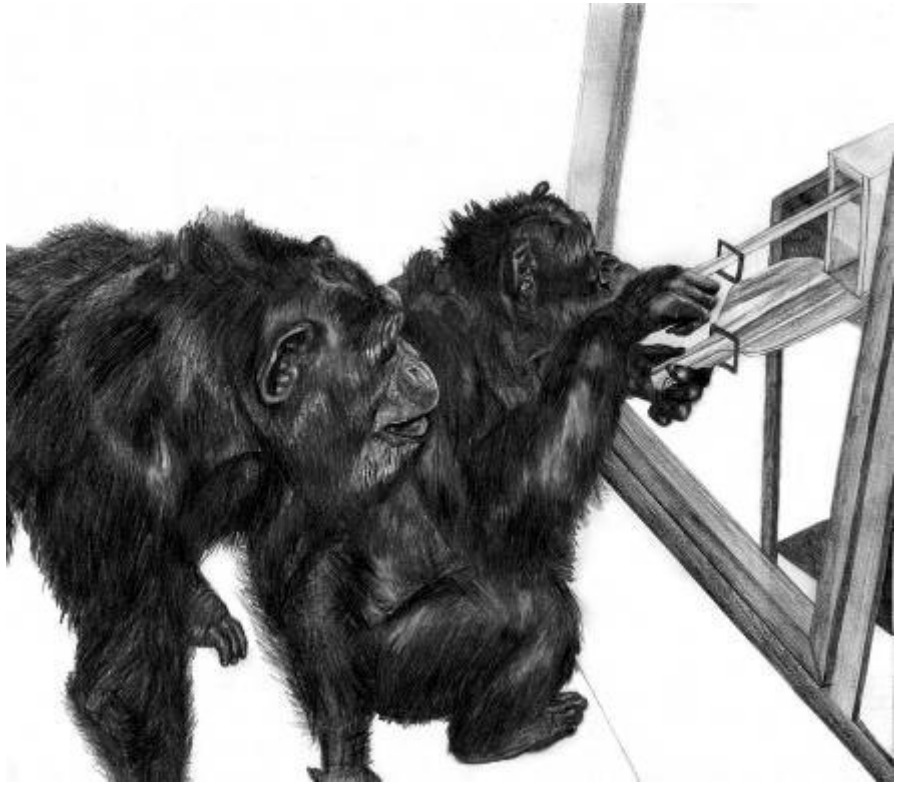
An 'open diffusion' experiment

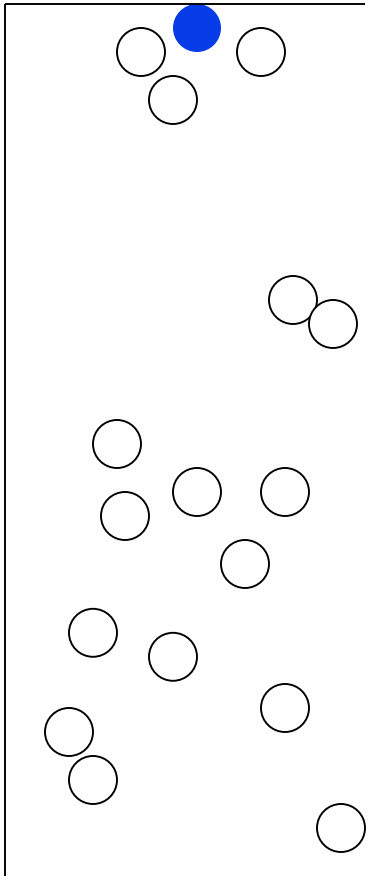
Whiten, Horner & de Waal

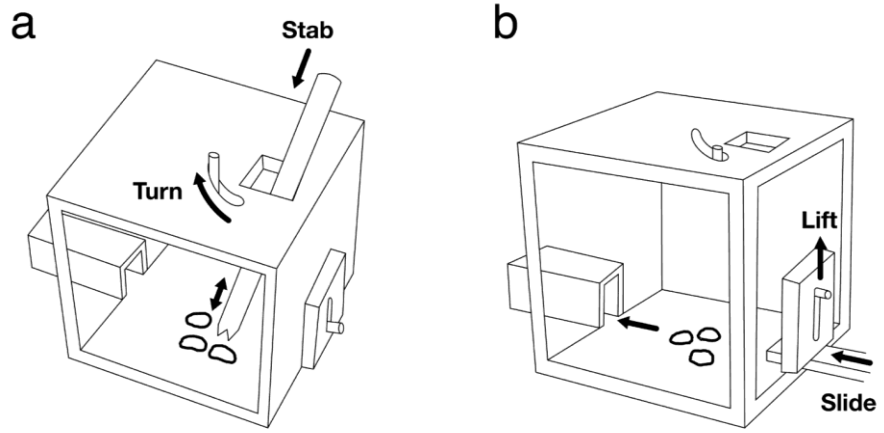
Nature 2005



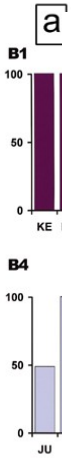


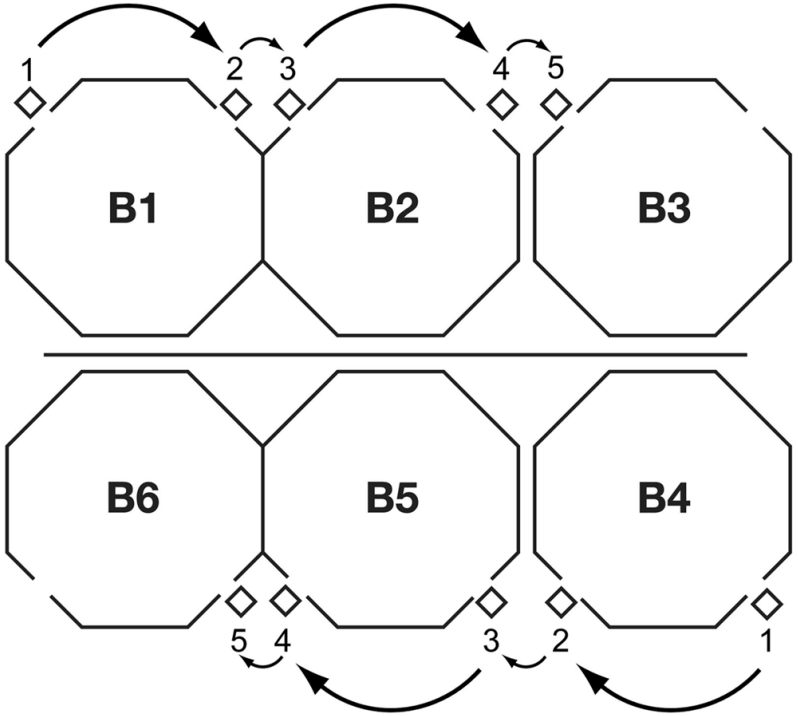


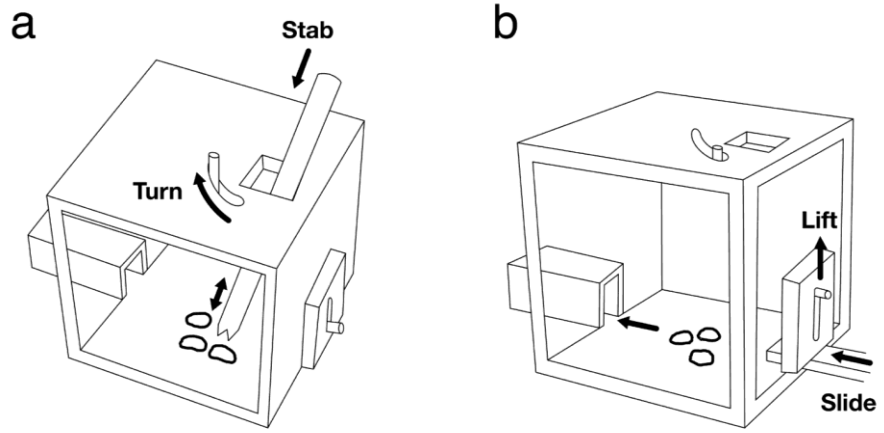




Whiten, A., Spiteri, A. et al. (2007) Transmission of multiple traditions within and between chimpanzee groups. *Current Biology* 17, 1038-43







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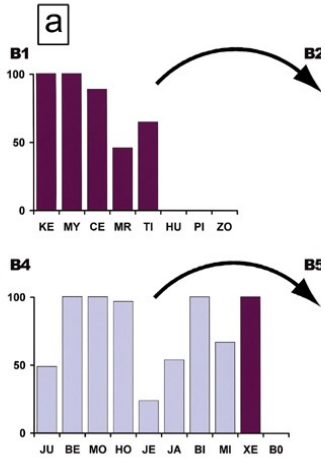
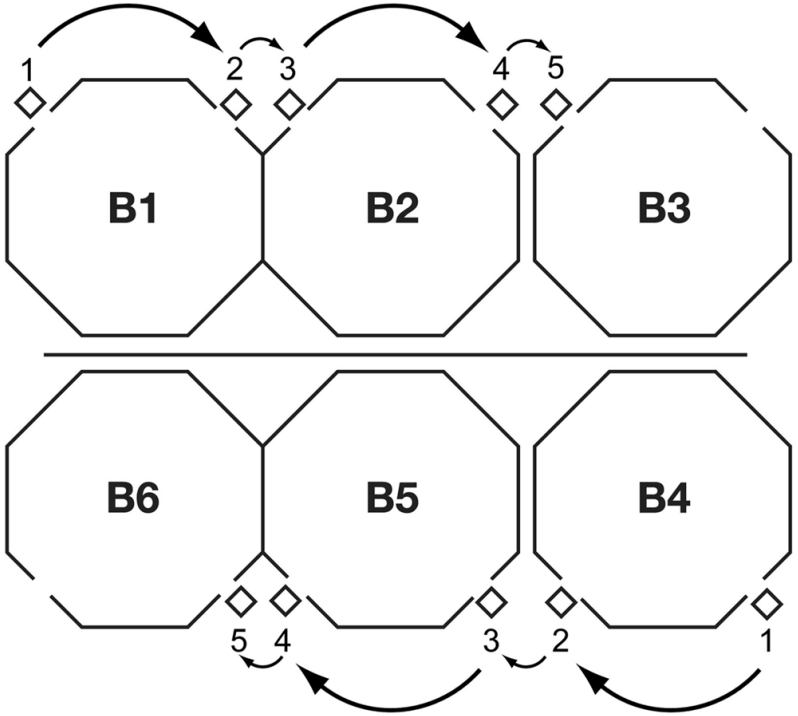
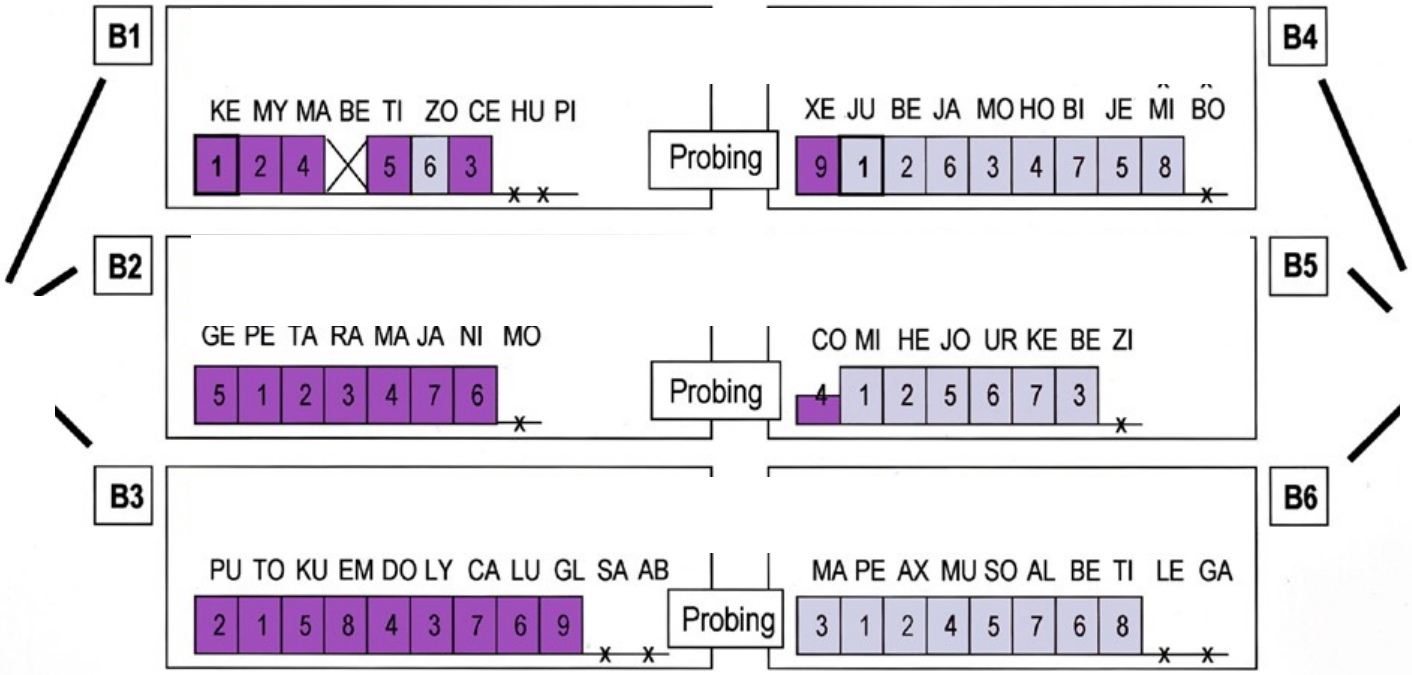
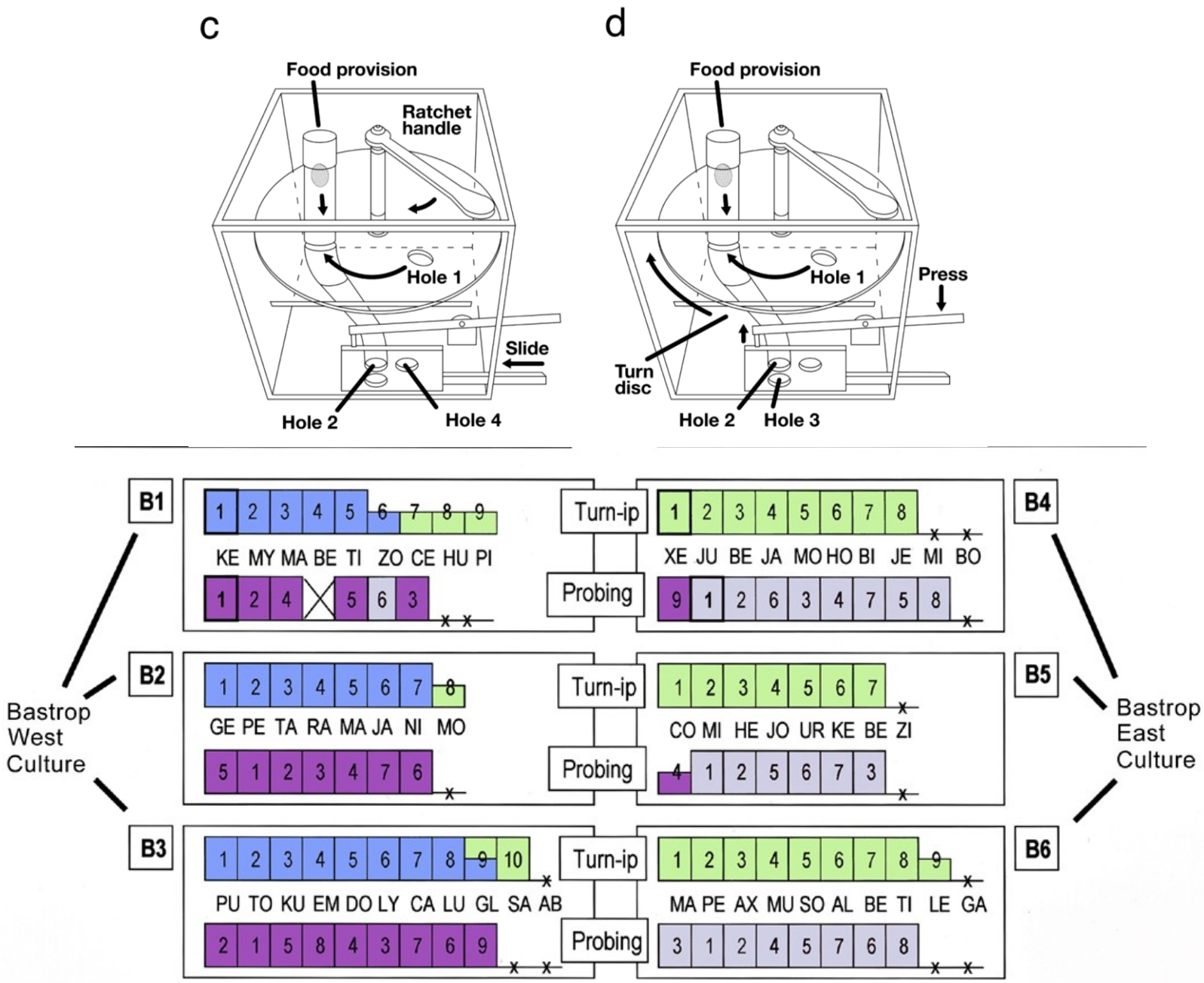
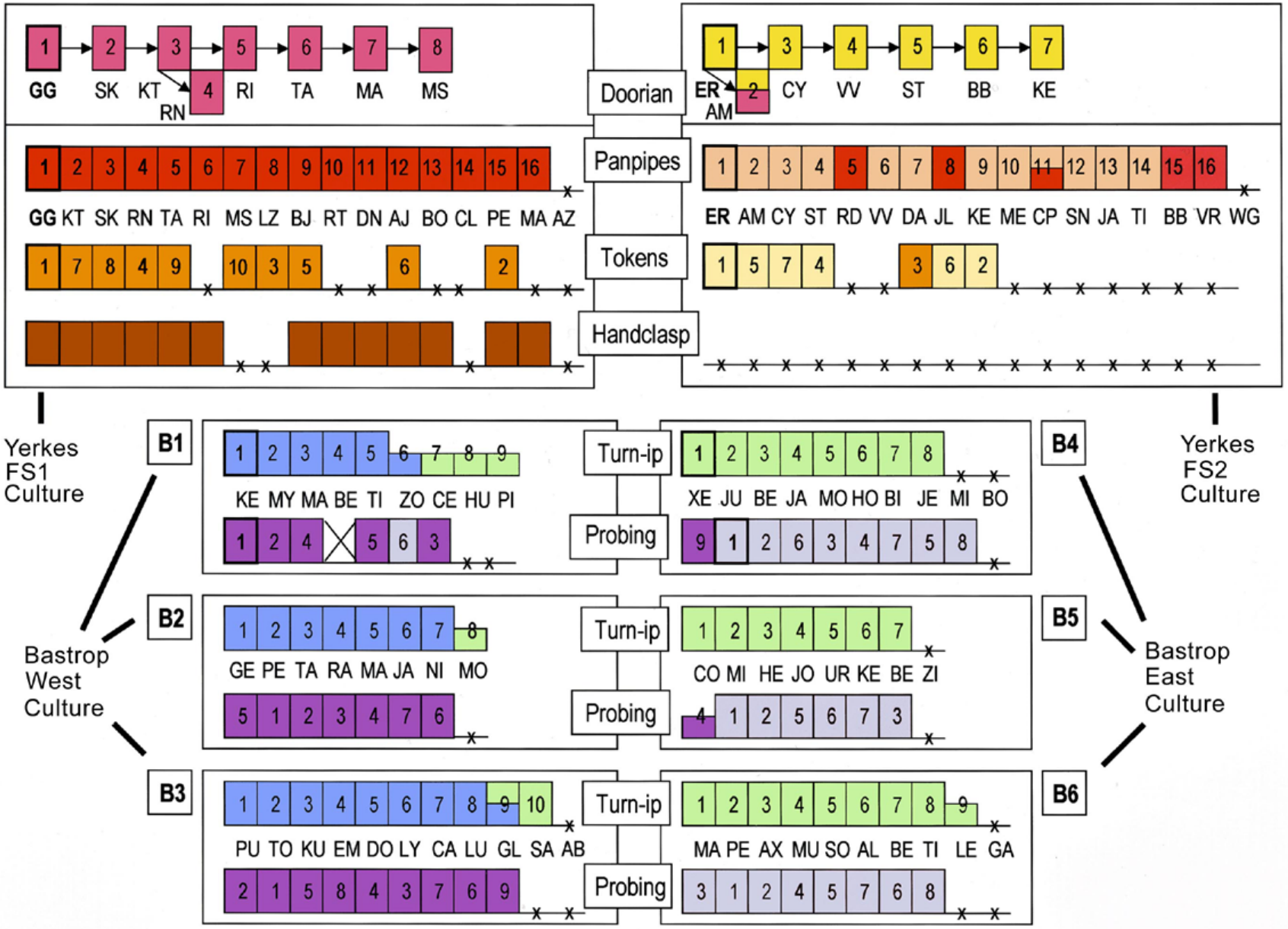




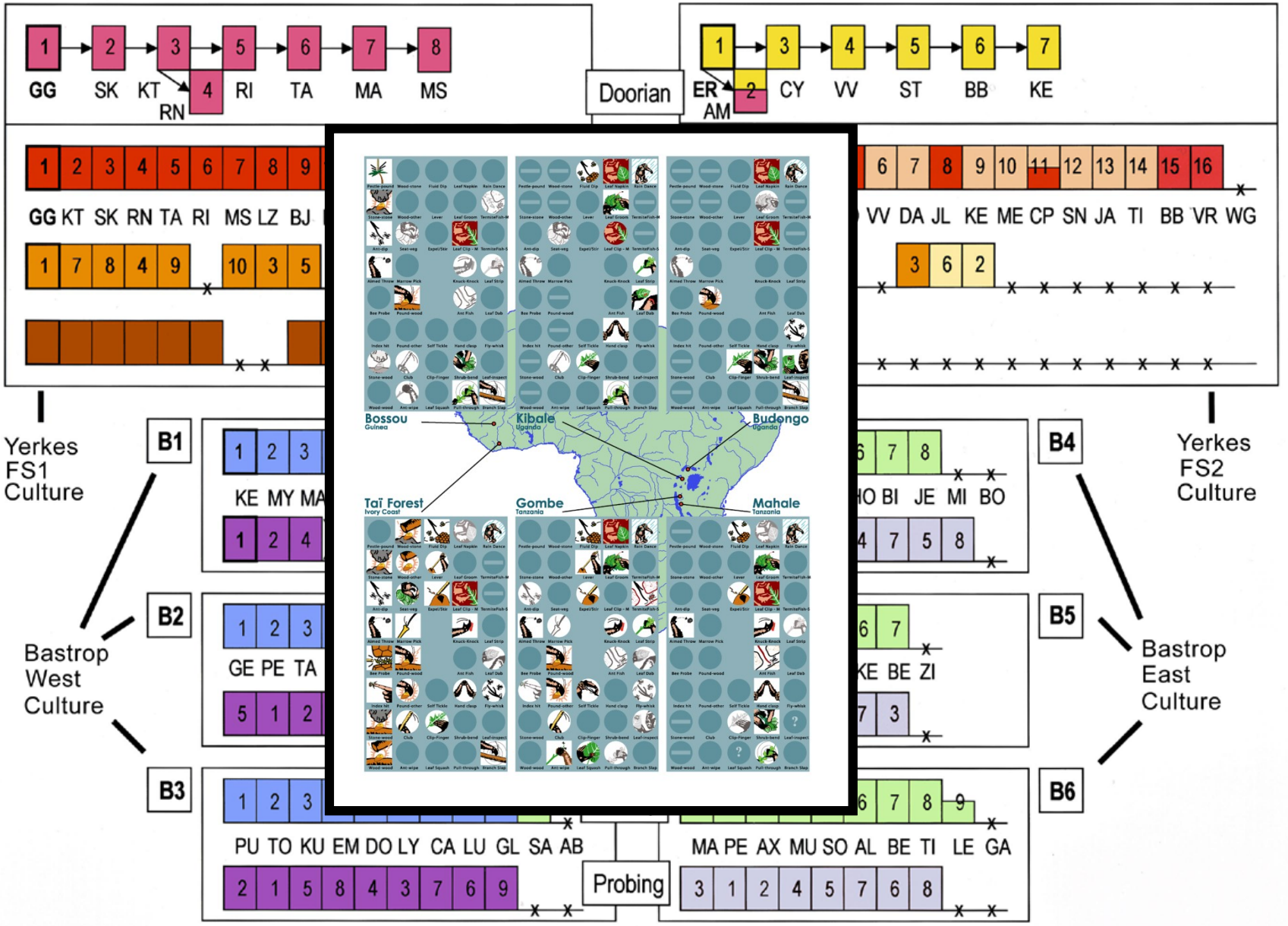

B1
KE MY MA BE TI ZO CE HU PI
1 2 4 5 6 3
Probing
XE JU BE JA MO HO BI JE MI BO
9 1 2 6 3 4 7 5 8
B4
B2
GE PE TA RA MA JA NI MO
5 1 2 3 4 7 6
Probing
CO MI HE JO UR KE BE ZI
4 1 2 5 6 7 3
B5
B3
PU TO KU EM DO LY CA LU GL SA AB
2 1 5 8 4 3 7 6 9
Probing
MA PE AX MU SO AL BE TI LE GA
3 1 2 4 5 7 6 8
B6


c
Food provision
Ratchet handle
Hole 1
Slide
Hole 2
Hole 4
d
Food provision
Hole 1
Press
Turn disc
Hole 2
Hole 3
B1
1 2 3 4 5 6 7 8 9
KE MY MA BE TI ZO CE HU PI
1 2 4 5 6 3
Turn-ip
Probing
1 2 3 4 5 6 7 8
XE JU BE JA MO HO BI JE MI BO
9 1 2 6 3 4 7 5 8
B4
B2
1 2 3 4 5 6 7 8
GE PE TA RA MA JA NI MO
5 1 2 3 4 7 6
Turn-ip
Probing
1 2 3 4 5 6 7
CO MI HE JO UR KE BE ZI
4 1 2 5 6 7 3
B5
Bastrop West Culture
Bastrop East Culture
B3
1 2 3 4 5 6 7 8 9 10
PU TO KU EM DO LY CA LU GL SA AB
2 1 5 8 4 3 7 6 9
Turn-ip
Probing
1 2 3 4 5 6 7 8 9
MA PE AX MU SO AL BE TI LE GA
3 1 2 4 5 7 6 8
B6

Whiten, A., Spiteri, A. et al. (2007) Transmission of multiple traditions within and between chimpanzee groups. *Current Biology* 17, 1038-43



Whiten, A., Spiteri, A. et al. (2007) Transmission of multiple traditions within and between chimpanzee groups. *Current Biology* 17, 1038-43



Have apes the capacities to sustain cumulative culture?

Contents lists available at ScienceDirect

Evolution and Human Behavior

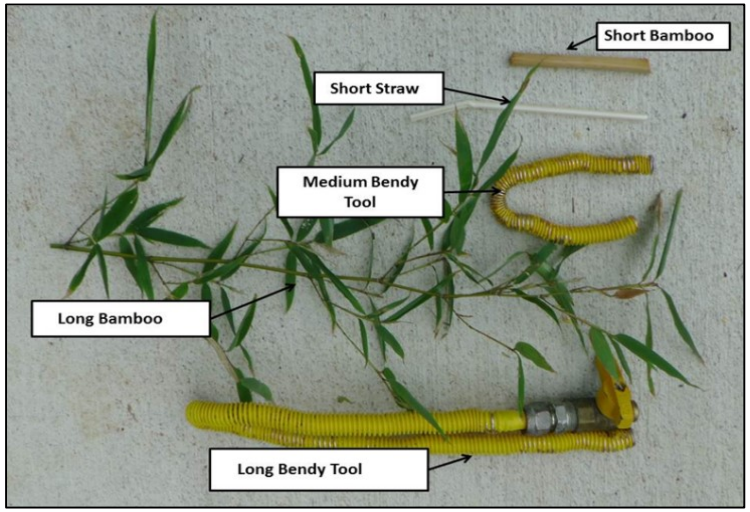
journal homepage: www.ehbonline.org

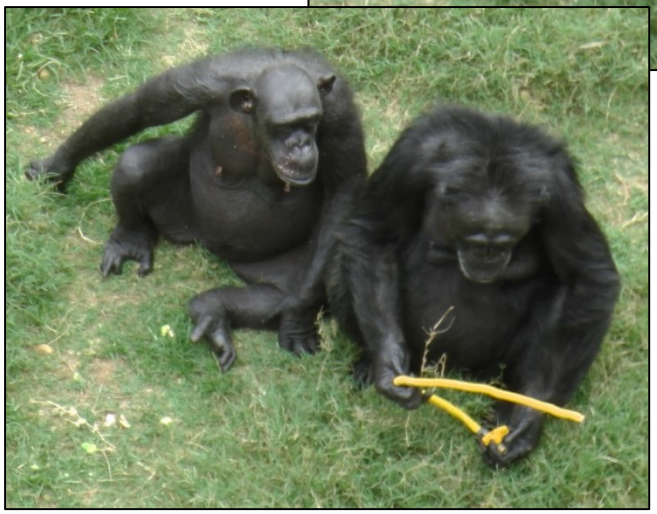
Original Article

Acquisition of a socially learned tool use sequence in chimpanzees: Implications for cumulative culture

Gillian L. Vale [a,b], Sarah J. Davis [a,b], Susan P. Lambeth [b], Steven J. Schapiro [b], Andrew Whiten [a,*]

[a] Centre for Social Learning and Cognitive Evolution, and Scottish Primate Research Group, School of Psychology & Neuroscience, University of St Andrews, United Kingdom
[b] National Center for Chimpanzee Care, Michale E. Keeling Center for Comparative Medicine and Research, The University of Texas MD Anderson Cancer Center, United States



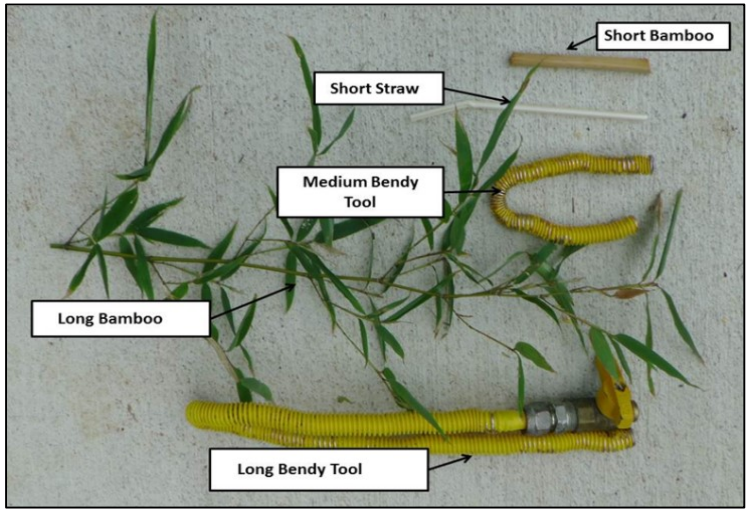


3 groups seeded with LBT expert

7/18 successfully created and used LBT
12/18 used LBT as straw
18/18 attempted using functional LBT
23 valves opened / 93 LBT uses as straw

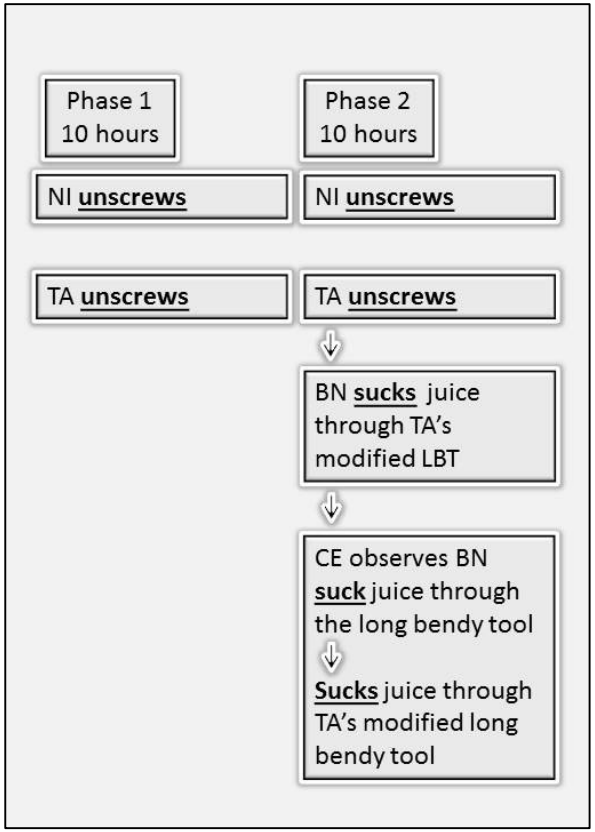
3 groups with no expert

2/25 created LBT but failed to use it
0/25 used LBT as straw
0/25 attempted using functional LBT
3 valves opened / 0 LBT uses as straw

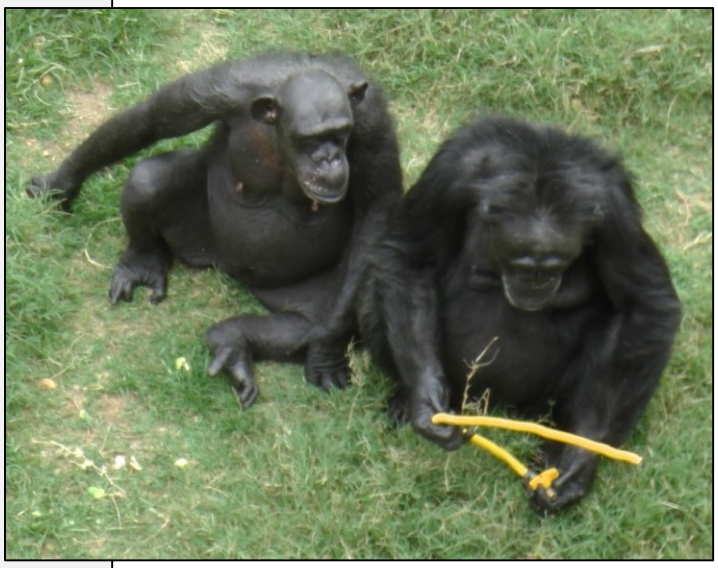


Asocial controls

LBT-only controls


Phase 1
10 hours
Phase 2
10 hours
NI unscrews
NI unscrews
TA unscrews
TA unscrews
BN sucks juice through TA's modified LBT
CE observes BN suck juice through the long bendy tool
Sucks juice through TA's modified long bendy tool

Phase 1 10 hours	Phase 2 10 hours	Phase 3 10 hours
NI **unscrews**	NI **unscrews**	BN observes NI **unscrew** x 3 ⇩ BN **unscrews** ⇩ Performs known **suck** behavior with new **unscrew** behavior
TA **unscrews**	TA **unscrews** ⇩ BN **sucks** juice through TA's modified LBT ⇩ CE observes BN **suck** juice through the long bendy tool ⇩ **Sucks** juice through TA's modified long bendy tool	NI observes BN **suck** ⇩ Performs known **unscrew** with **suck** behavior



CUMULATIVE CULTURAL CHANGE: EFFECTIVE FACTORS

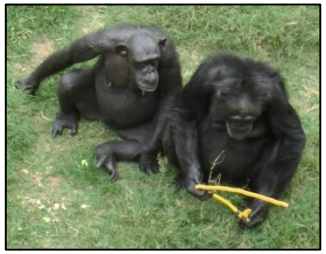
social group

asocial controls

+

opportunities for cumulative, progressive learning

high-level-only controls



partial knowledge + socially learned addition

integration ➡ novel combination = 'invention'

BN observes NI **unscrew** x 3
⇩
BN **unscrews**
⇩
Performs known **suck** behavior with new **unscrew** behavior

NI observes BN **suck**
⇩
Performs known **unscrew** with **suck** behavior

social learning by others

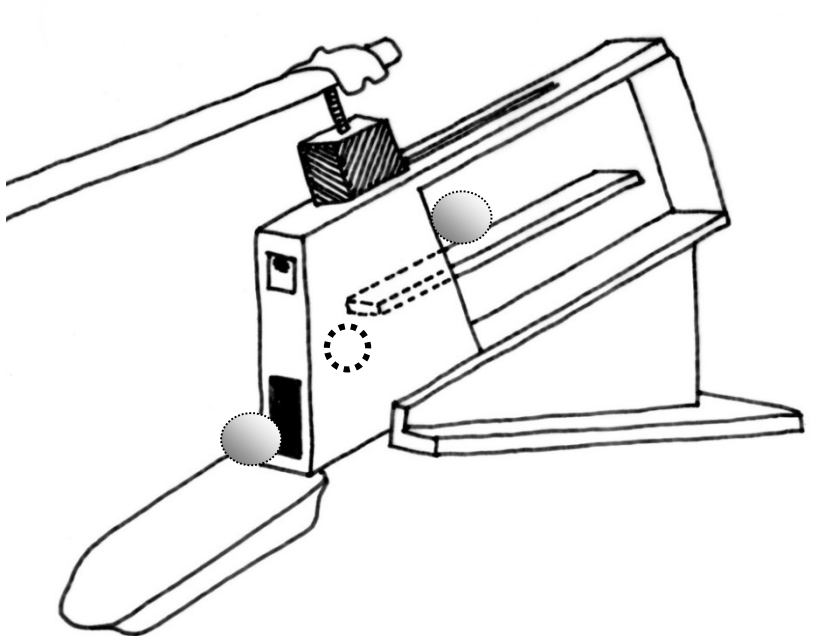
culturally transmitted 'innovation'

Social learning processes

ENHANCEMENT
focussing attention on part of the environment

IMITATION
copying the form of an action

EMULATION
learning from the environmental results of actions

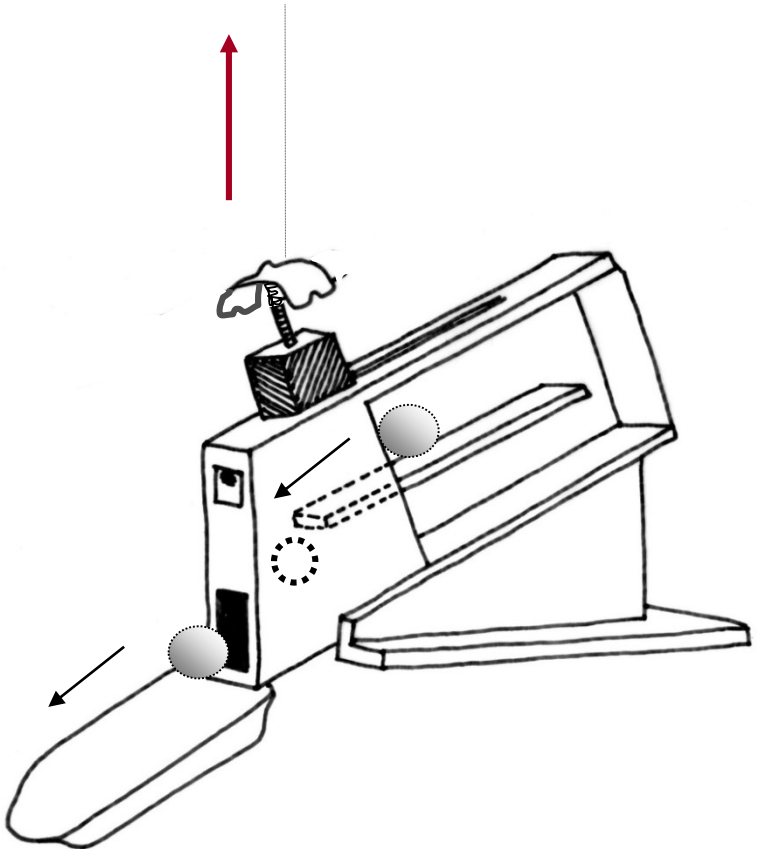


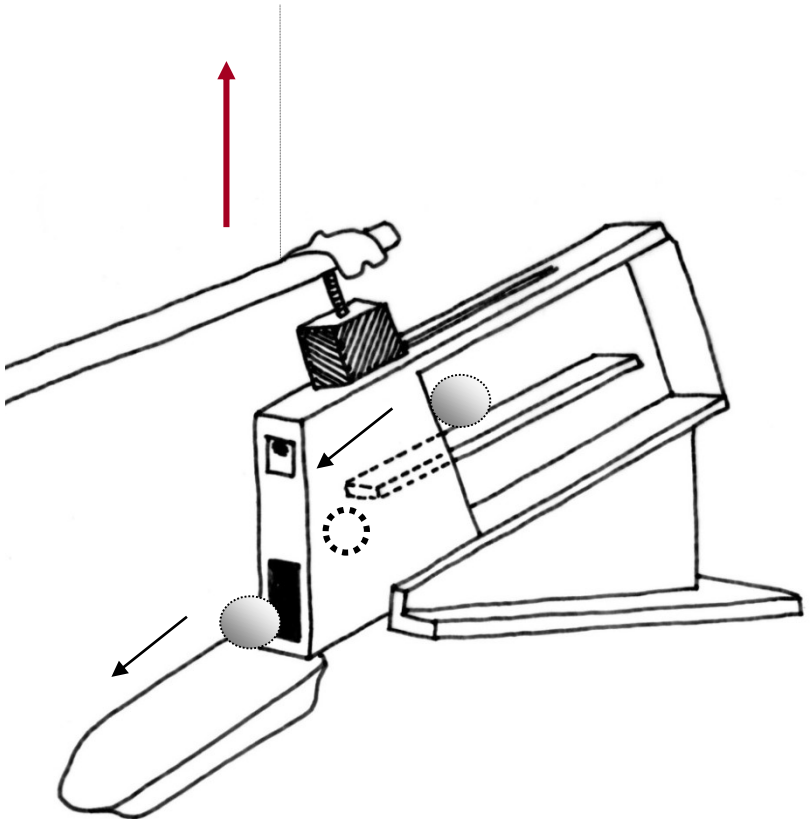
Are chimpanzees essentially emulators rather than imitators?

'WHAT IS LEARNED?' EXPERIMENTS

GHOST CONDITION STUDIES

L. Hopper et al. (2007) *Animal Behaviour* 73, 1021-32





‘HOW SOCIAL IS THE SOCIAL LEARNING?’ EXPERIMENTS

GHOST CONDITION STUDIES

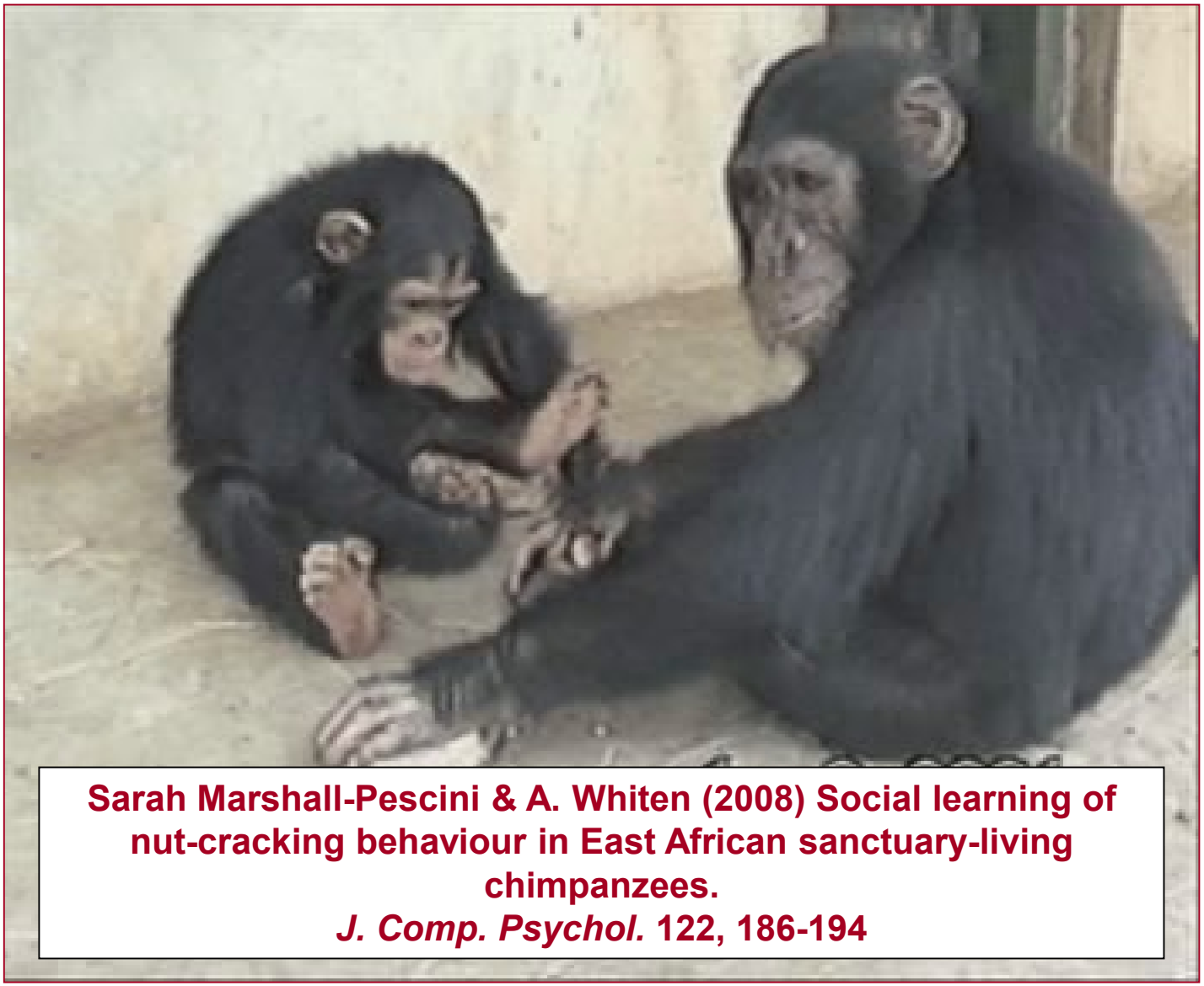
Lydia Hopper et al. (2008) *Proc. R Soc B 275, 835-840*

‘HOW SOCIAL IS THE SOCIAL LEARNING?’ EXPERIMENTS

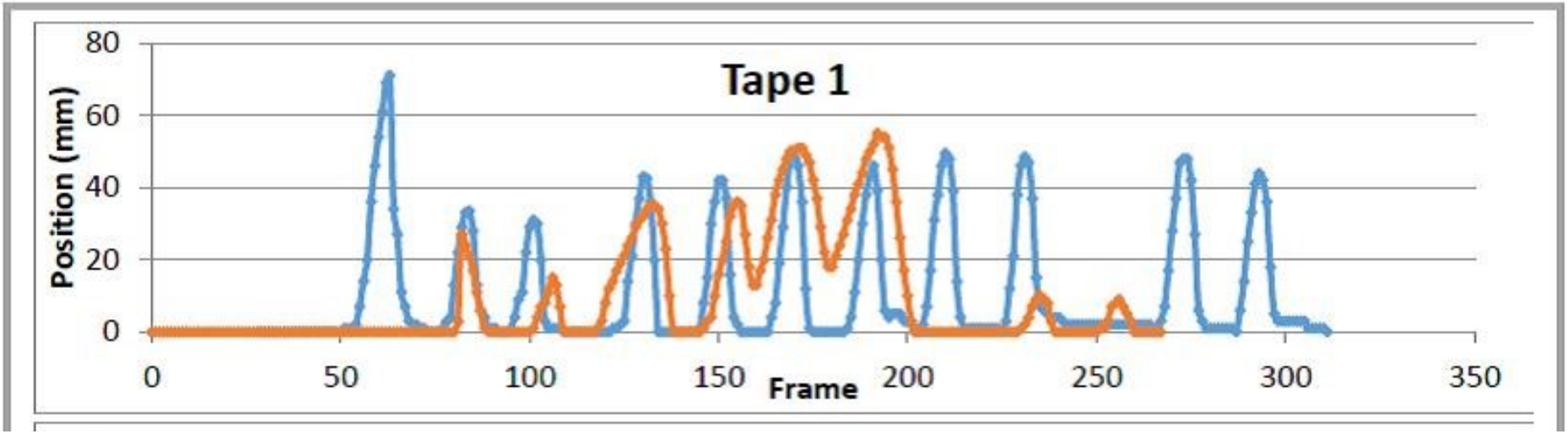
Claudio Tennie, Josep Call,
Michael Tomasello
(2010, *PLOS ONE*)

“Evidence for emulation learning in social settings using the floating peanut task”

Imitative ‘mirroring’



Sarah Marshall-Pescini & A. Whiten (2008) Social learning of nut-cracking behaviour in East African sanctuary-living chimpanzees.
J. Comp. Psychol. 122, 186-194



Delia Fuhrmann et al.
***Scientific Reports* 2014**

Synchronicity (interval comparisons)
between (p=0.001) > within (p=0.88**)**

Cross correlations (Monte Carlo)
within (p=0.02) > between

Granger causality analysis
model → observer (p=0.014)

Majority-Biased Transmission in Chimpanzees and Human Children, but Not Orangutans

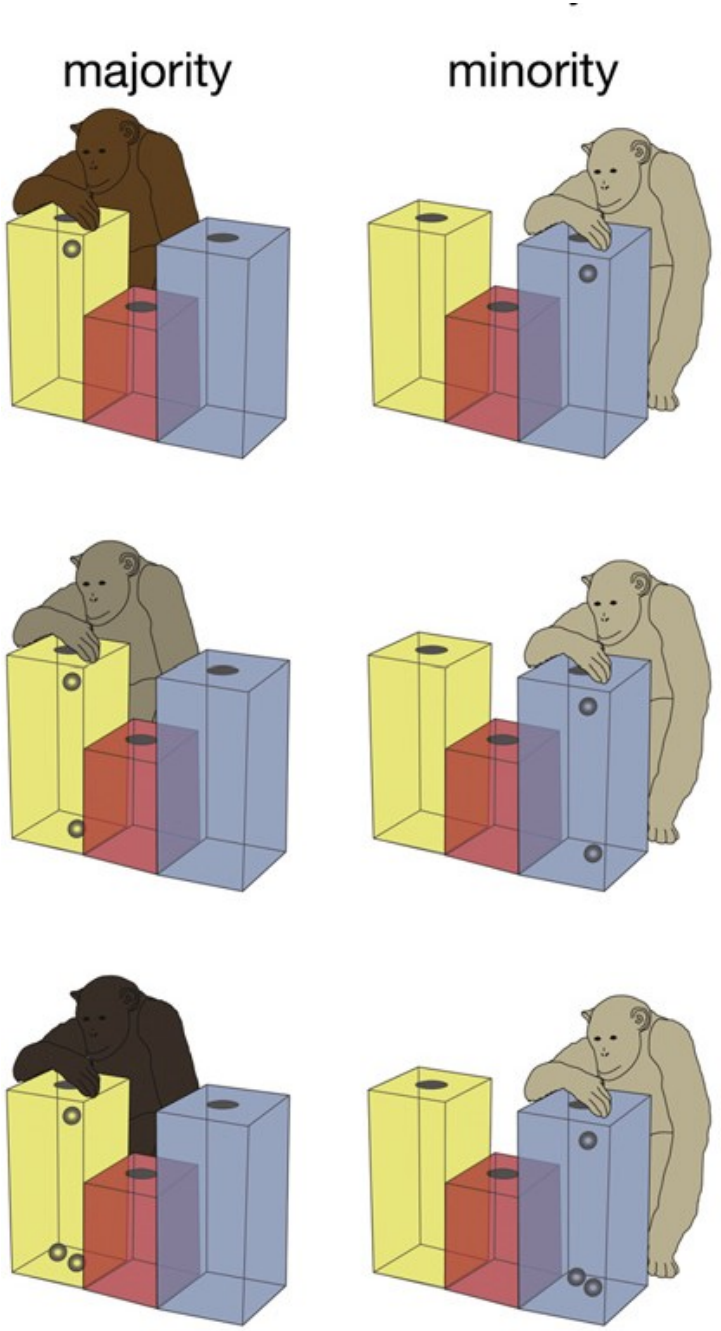
Daniel B.M. Haun, Yvonne Rekers & Michael Tomasello

Current Biology 2013

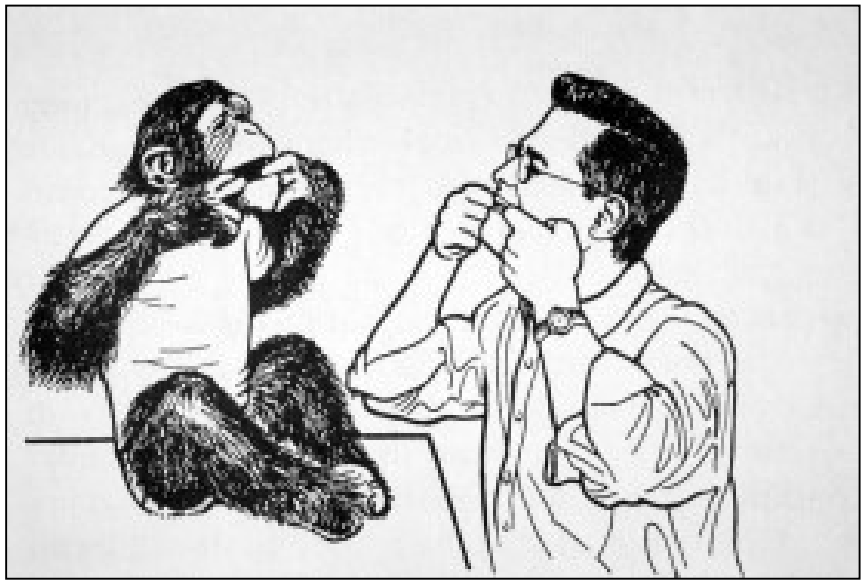
Conformity and over-imitation: an integrative review of variant forms of hyper-reliance on social learning.

Andrew Whiten

Advances in the Study of Behavior 2019



Social learning processes



IMITATION IN A HOME-RAISED CHIMPANZEE[1]

KEITH J. HAYES AND CATHERINE HAYES
Yerkes Laboratories of Primate Biology

J. Comp. Physiol. Psychol. 1952

SUMMARY

The imitative ability of a three-year-old chimpanzee, who has been raised in a human environment, was found in a variety of situations to be very similar to that of three-year-old human children.

IMITATION
copying the form of an action

recognition of 'copying'

CAN YOUNG CHIMPANZEES (PAN TROGLODYTES) IMITATE ARBITRARY ACTIONS? HAYES & HAYES (1952) REVISITED

by

DEBORAH M. CUSTANCE[1,2]), ANDREW WHITEN[1]) and KIM A. BARD[3,4])

Behaviour, 1995

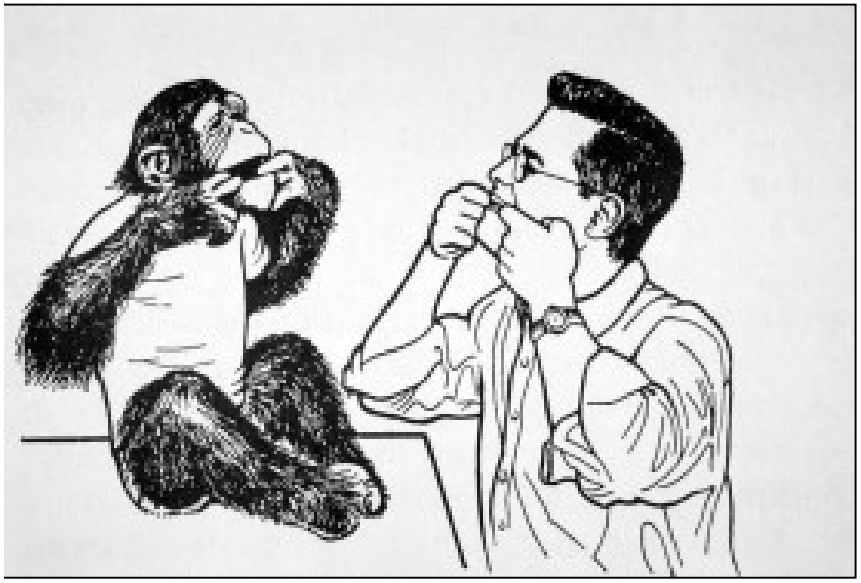


TABLE 1

Matching Acts Identified in the Do-As-I-Do Experiment

Touch in sight	Shoulder	**	Single hand	Open hand	**
	Elbow	**		Wiggle fingers	**
	Stomach	***		Wave stiffly	**
	Thigh	*		Arch fingers	**
	Foot	**			
Touch out of sight	Back of head	***	Facial	Protrude lips	*
	Top of head	**		Lip smack	***
	Nose	***		Teeth chatter	**
	Ear	*		Puff cheeks	*
Symm. hand	Clap	**	Face-head	Mouth pop	**
	All digit touch	***		Lip wobble	**
	Interlink fingers	***		Pull mouth sides	*
	Roll fists	**		Look up	**
	Peekaboo	**		Look right	*
Asymm. hand	Clap back of hand	***	Whole body	Jump	**
	Clap two digits	*		Flap arms	**
	Grab thumb	***		Hug self	***
				Foot to foot	**

Note. Descriptions given here are intended to convey the range of action presented. Comprehensive descriptions are offered in Custance et al. (1995).

Table includes all actions identified at least once:

* Identified for at least one subject, one coder's second guess.

** Identified for one subject by at least one coder.

*** Identified for both subjects by at least one coder.

In C. Heyes and Galef 1996

CAN YOUNG CHIMPANZEES (PAN TROGLODYTES) IMITATE ARBITRARY ACTIONS? HAYES & HAYES (1952) REVISITED

by

DEBORAH M. CUSTANCE[1,2], ANDREW WHITEN[1] and KIM A. BARD[3,4]

Behaviour, 1995

Social learning processes

www.nature.com/scientificreports

SCIENTIFIC REPORTS

OPEN

Tool transfers are a form of teaching among chimpanzees

Stephanie Musgrave[1], David Morgan[2,3], Elizabeth Lonsdorf[4], Roger Mundry[5] & Crickette Sanz[1,3]

PNAS 2019

Teaching varies with task complexity in wild chimpanzees

Stephanie Musgrave[a,1], Elizabeth Lonsdorf[b,c], David Morgan[d], Madison Prestipino[c], Laura Bernstein-Kurtycz[e,f], Roger Mundry[g], and Crickette Sanz[h,i,j]

Social learning processes – what do apes share?

Fidelity adequate to sustain traditions long-term

Some degree of cumulative culture

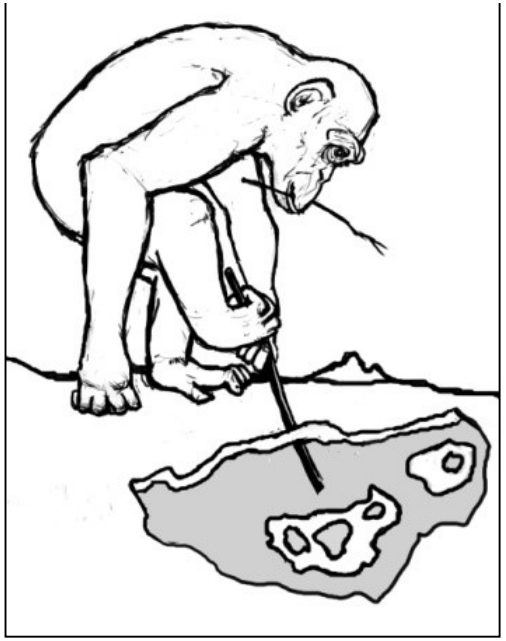
‘Portfolio’ of learning processes including enhancement, emulation and imitation

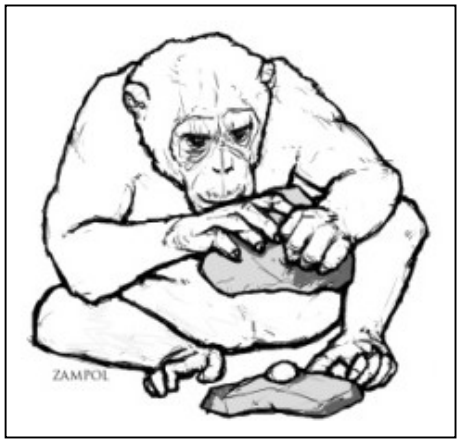
Social learning biases including conformity and others

Recognition of what it is to imitate

Teaching at the level of tolerant ‘scaffolding’

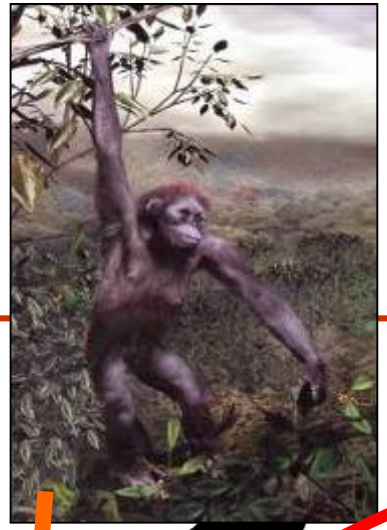
Shared cultural contents – tool use extensive in chimpanzee material culture

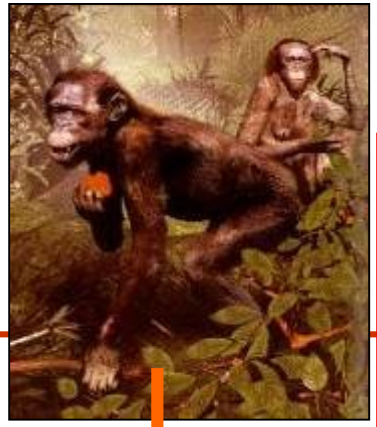




- Nut hammer, anvil
- Pestle pound
- Lever
- Club
- Stab weapon
- Termite puncture w stick
- Termite fish w stem
- Ant dip wand
- Fly-whisk
- Marrow-pick
- Leaf sponge
- Leaf napkin clean
- Leaf dab wound
- Leaf seat
- Leaf-clip courtship

A Whiten, Schick and Toth
The evolution and cultural transmission of percussive technology: integrating evidence from paleoanthropology and primatology. *J Human Evolution 2009*





Population level patterning

Multiple Diverse Traditions

Communities have unique traditions arrays

Traditions may be long lasting

Traditions may evolve like a branching tree

Traditions may evolve cumulatively

Transmission

Fidelity adequate to sustain traditions long-term

Some degree of cumulative culture

‘Portfolio’ of learning processes including enhancement, emulation and imitation

Social learning biases including conformity and others

Recognition of what it is to imitate

Teaching at the level of tolerant ‘scaffolding’


ORIGIN
OF
SPECIES
DARWIN