A short introduction to cumulative cultural evolution (CCE)

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Introduction to cumulative cultural evolution

Part 1: Definition and historical background
Part 2: Evidence for CCE in non-human animals
Part 3: The origin of CCE
PART 1: DEFINITION AND HISTORICAL BACKGROUND

Gould, 1980
What is cumulative cultural evolution?

“If I have seen further it is by standing on the shoulders of Giants.”

Isaac Newton, 1676

“To be ignorant of what occurred before you were born is to remain for ever a child. For what is the value of a human life, unless it is woven into the life of our ancestors by the records of history?”

Marcus Tullius Cicero, 106-43 BC
Cumulative cultural evolution

Definition: *Cumulative cultural evolution is the gradual accumulation of cultural modifications.*

Tomasello, 1993, 1996

“*the accumulation of knowledge and skills over generations*”

Caldwell & Millen 2008

Technological evolution

Basalla, 1988
1. Medieval times (15th century): “Do not spit into the basin when you wash your hands, but beside it”

2. 16th century: “Turn away when spitting, lest your saliva fall on someone. If anything purulent falls on the ground, it should be trodden upon, lest it nauseate someone.”

3. 17th century: “Formerly it was permitted to spit on the ground before people of rank, and was sufficient to put one’s foot on the sputum. Today that is an indecency”.

4. 18th century: “When you are with well-born people, and when you are in places that are kept clean, it is polite to spit into your handkerchief while turning slightly aside”

5. 19th century: “Spitting is at all times a disgusting habit. I need say nothing more than – never indulge in it”

Nichols 2002
Summary part 1

1. Cumulative cultural evolution is the gradual accumulation of cultural modifications.

2. Culture is made of:
   - Ideas (e.g. norms)
   - Behaviours (e.g. telling stories)
   - Objects (e.g. paintings)

3. In humans, CCE is widespread
Is CCE also common in non-human animals?

Boyd and Richerson (1996), *Why culture is common, but cultural evolution is rare.*

“There are only a few well documented cases in which cultural change accumulates over many generations leading to the evolution of behaviors that no individual could invent—the only well documented examples are song dialects in birds, perhaps some behaviors in chimpanzees, and, of course many aspects of human behavior”
PART 2: EVIDENCE OF CCE IN NON-HUMAN ANIMALS
Where shall we look for CCE in animals?

• Chimpanzee nut cracking

• Evidence of nut cracking for thousands of years at the same site*

• Yet, no evidence of change

* Mercader, Panger, & Boesch (2002); Mercader et al. (2007)
Cultural evolution of humpback whale songs

See lecture 5 by Rendell

Garland, et al. (2011)
See lecture 6 by Aplin and 10 by Whiten
Evolution of songs in songbirds

Feher et al. 2009
Cumulative improvement of flight route

Sasaki & Biro, 2017
Cumulative improvement of flight route

Sasaki & Biro, 2017
Summary part 2

1. Animal culture is widespread and can be stable through time

2. However, it does not seem to evolve in the same way human culture does, despite intense research

3. The few suggestions of CCE in animals are not where we might expect (not technology, not apes)
PART 3: THE ORIGIN OF CCE
Tomasello (1993): The ratchet effect

1. Once a new modification is introduced it can easily be passed on to other individuals

2. Faithful transmission prevents the loss of modifications and therefore produce cultural accumulation

3. Eventually, what is socially transmitted goes beyond what a single individual could invent on their own

4. Tennie et al. (2009). "Ratcheting up the ratchet" further extend the notion with the zone of latent solutions (ZLS)
See Vale study in lecture 10 by Whiten

Dean et al. 2012
Why is human social learning faithful?

- Tomasello et al’s 1993: *Cultural learning*

- Humans share with other animals many social learning mechanisms

- Humans are unique in their capacity to take the perspective of others

- Perspective taking allows *faithful* cultural transmission
Cultural transmission in baboons

Claïdière et al. 2014
Increase in success

Claidière et al. 2014

Transmission trials

50 matched random trials

Claidière et al. 2014
Emergence of structures

Cladière et al. 2014
Lineage specificity

Cladière et al. 2014
What about fidelity?

We found:

- Increase in score
- Emergence of structures
- Lineage specificity

... with very low fidelity. Initially 37% of grids were reproduced without errors in the 1st generation.

Fidelity also increased sharply to reach 72% in the last generation.

=> These results suggest that Hi-Fi can be the *result* of CCE, not necessarily it’s *source*. 
Do not copy task!

Touch anything but the four green squares

Claidière et al. 2018
Structure: alternating patterns

Cladière et al. 2018
What is the origin of CCE?

My opinion is that it comes back to the question of the evolution of language.

1. Social hypothesis: evolution of social intelligence
   Cumulative cultural evolution evolved through the complexification of social life and social cognition

2. Ecological hypothesis: evolution of technologies
   Cumulative cultural evolution evolved as a response to a challenging environment
Two distinct evolutionary scenarios

Social hypothesis:
- Environment created selection for
- Increasingly complex social life
- Unique set of socio-cognitive abilities
- Increased communication (language)
- Gave rise to CCE

Ecological hypothesis:
- Environment created selection for
- Increased reliance on tools and technologies
- More tolerance, coordination, cooperation
- Developed social learning mechanisms
- Gave rise to CCE
Summary part 3: Where does CCE come from?

1. We don’t know!
2. But CCE can emerge with a variety of social learning mechanisms
3. CCE does not require high-fidelity cultural transmission
THANK YOU!

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