Social Learning Strategies

Adaptive Transmission Biases in Social Learning

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Social Learning Strategies
(or Transmission Biases)

- Selective & Flexible use of:
  - Personal / Asocial Information (trustworthy)
  - Social Information (rapid/efficient)

- Avoids costs of:
  - Asocial learning
  - Vetting every cultural variant for its contribution to fitness

- Operating over generations => cultural adaptations & influence evolution of culture...
May be products of evolution and/or learning

Not necessarily conscious

Social learning strategies

Unbiased or random copying

Context dependent

Copy if uncertain [9,13,30,31,32,28,110]
Copy if personal information outdated
Copy if dissatisfied [110,41,42,43]
Copy if asocial learning is costly [9,25,26,27,111,112,113]

State based

Frequency dependent

Model based

Bias derived from emotional reaction (e.g., disgust [56])
Bias for social information [56,57]
Bias for memorable or attractive variants
Bias for better payoff [9,17,11,58,60,61]

Guided variation (trial-and-error learning combined with unbiased transmission)

Age-based [12,35,44]

Sex-based

[Kendal et al ’18 TICS]
Context Dependent SLSs

- State based
- Frequency dependent
- Model based
State Based Strategies

If female, copy when young

If male, copy when subordinate

Due to dispersal patterns

‘copy if dissatisfied’
State Based Strategies

Copy if pregnant

Risk averse behaviour due to predation risk

[Webster & Laland '10 PRSB]
State Based Strategies

Copy only if uncertain

Personal info. Inadequate

State Based Strategies

Copy only if uncertain

**Personal info. costly to collect**

[Webster & Laland ‘08 PRSB; Kendal et al. ‘09 PlosONE]
State Based Strategies

**Copy only if uncertain**

*Personal info. costly to use*

Unreliable

Outdated

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[van Bergen et al’04 *PRSB*]
Identifying SLSs in the wild

[van de Waal et al. 2013 Science]
Frequency Dependent Strategies

Conformity confusions!

- Frequency Dependence
  - Disproportionate tendency to copy the majority

- Peer Pressure
  - Discounting personal info. in favour of perceived community norms

Asch (1956)
Conformity

Frequency Dependent Strategies

Conformity

Unbiased Social learning

Proportion of population Demonstrating behaviour

Probability of adopting the behaviour

(Copying in proportion to what observed)
(Random copying)
Frequency Dependent Strategies

- **Collective Wisdom**
  - Copying behaviour displayed by the majority of *individuals*

[Haun et al’12 *Curr. Biol.*]
Frequency Dependent Strategies

- Conformity in wild animals?

71% of birds moving from one tradition to another switched
- conformity or copy when uncertain?
- adoption locally adaptive information
- beneficial in spatially variable environments

Model Based Strategies

- Copy according to the **identity** of the model
  - Generally ‘successful’ individuals
  - Indirect bias
Model Based Strategies

Copy older individuals

BUT
No preference for copying dominants (despite high foraging success)

[Thornton & Malapert ‘09 Anim. Behav.]
Model Based Strategies

copy dominant & expert ... & older individuals

If subordinates are the innovators [Reader & Laland ’01]

Restrict the accumulation of innovations?

Copying high rankers (older etc.) may explain why

• few innovations become arbitrary traditions [Nishida et al. ’09]

• little evidence of cumulative culture

[Model Based Strategies]

Context dependent SLSs

Maintain cultural diversity?

Despite populations sharing similar ecology & knowledgeable migrants

• Immigrants **conform** to majority technique of new group
• Immigrants **copy as uncertain & low-rank**
• **No copying of low ranked immigrants** if do display novel technique

Content Dependent SLSs

- Copy according to the **content** of the trait
  - Direct bias
    - Social information
    - Survival information
    - Emotional reactions (e.g. disgust)
    - Payoffs (value of the trait)
Payoff based Strategies

- Copy the high payoff extractive foraging option
  - Efficiency – speed of acquiring seeds
  - Efficacy – likelihood of success & costs (stinging hairs)

[Barrett et al’17 Proc. R. Soc. B]
Payoff based Strategies

- Copy the high payoff extractive foraging option

- Behavioural flexibility in the dispersing sex

[Bono et al’18 Curr. Biol.]
Payoff based Strategies

- “Copy if better” strategy
  - Change established behaviour if observed one more valuable
  - Important for cumulative culture

Role of SLSs in culture?

- Maintenance of adaptive behaviour
- Establishment of traditions/culture
Role of SLSs in culture?

- Dependent on phase of behaviour’s establishment
  - **Transmission Phase** following initial discovery
    - Direct/content bias
  - **Tradition Phase** when behaviour established/common
    - Indirect/context biases of ‘successful’ individuals or conformity

Summary: SLSs in Animal Culture

• Information sources used **selectively** according to SLSs

• **Personal information** is acquired/used **unless costly** to do so (state based biases)

• **Social information** use may be influenced by
  – The majority (**frequency dependent** SLSs and ‘peer pressure’?)
  – Identity of information source (**model based** SLSs)
  – Content of the information (**payoff based** SLSs)
  – Random copying (**unbiased** SLSs)

• SLSs are used **flexibly** and often in **combination**

• Different SLSs influential at different **transmission phases**

• SLSs can **influence cultural patterns**
  - establishment of cultural traditions & cultural diversity
  - cumulative cultural evolution
Further Reading


• AND papers on individual studies cited on slides
Boyd and Richerson (‘85) proposed 4 ‘biases in cultural transmission’
Alternate terms of Henrich & McElreath (‘03)
Translated into ‘social learning strategies’ by Laland (‘04):

1. Frequency-dependent (Context) bias e.g. ‘copy the majority’
2. Direct bias / Content bias e.g. ‘what strategies’
3. Indirect bias / Context model-based bias e.g. ‘who strategies’
4. Unbiased transmission e.g. ‘copy friends / kin’
5. Context ‘state based’ bias e.g. ‘when strategies’