reconciling crowd contagion and cultural evolutionary models

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Outcomes of Behavioral Transmission

contagion

WTO protests Seattle 1999

Sunni Awakening 2006
cultural evolution
outline

• crowd contagion and SIR model

• social learning as an evolutionary system

• social learning in crowd contexts
SIR contagion process

Phase transitions – wave propagation

\[ R_0 = \frac{\alpha}{\beta} S > 1 \]

Transmission rate
Recovery rate
social learning process

learner ➔ pool of models ➔ model selection ➔ deploy

• behavioral variation
• differential payoffs
• inheritance mechanism
social learning constraints

sample pool

selection bias
variable velocity crowds

fear $\rightarrow c_i(t)$

speed $\rightarrow \dot{x}_i(t) = c_i(t)$

learning $\rightarrow \dot{c}_i(t)$

INTUITION
1. velocity impacts model pools
2. faster $\rightarrow$ smaller pools
3. learning biases less important as pool size $\rightarrow 0$
variable velocity crowds

Brownian motion
number of observed models declines with agent speed
content diverges from true values for smaller model pools
crowd conformist transmission

$$\dot{c}_i(t) = \gamma [\bar{c}_i(t) - c_i(t)]$$

density of agents with fear $c$

$$\frac{\partial f(c, x, t)}{\partial t} + \nabla \cdot [\vec{v} f(c, x, t)] = \frac{\partial}{\partial c} \left[ \gamma (c - \bar{c}(x, t)) f(c, x, t) \right].$$
spreading fear

increased conformity

discrete

speed limits conformity

continuous

slow, trailing wave

fast, forward wave

event

space

space
conclusions

• physical dynamics of crowds may indeed constrain standard social learning processes
• social transmission impaired for faster agents by the physics of the system
• fear/anxiety overrides social transmission