Models of Social Dynamics
An Introductory Module

Paul E. Smaldino
University of California, Merced

Unit 5:
Coordination and Norms

Coordination and Norms

- Problems remain even when we have solved the problem of cooperation.
- How do we best cooperate? Who are the best cooperators for *me*?
- Important considerations:
  - Shared goals
  - Common ground for communication
  - Shared intentionality and a group mindset.
  - Empathizing with others' feelings and experiences
  - Similar background, experiences, and traditions help to coordinate interests

This is <u>coordination</u>

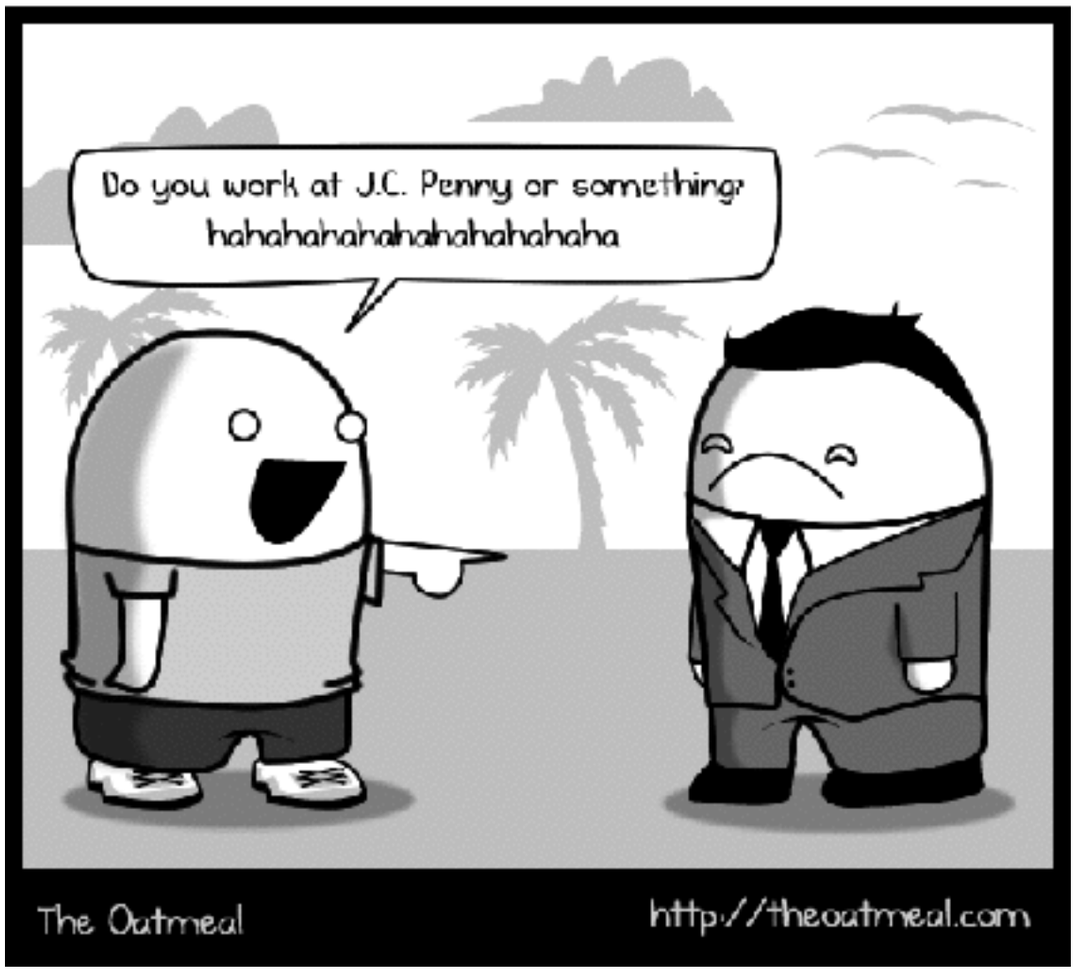
Norms: Behaviors that facilitate coordination

wearing a SUIT TO WORK on the

East Coast

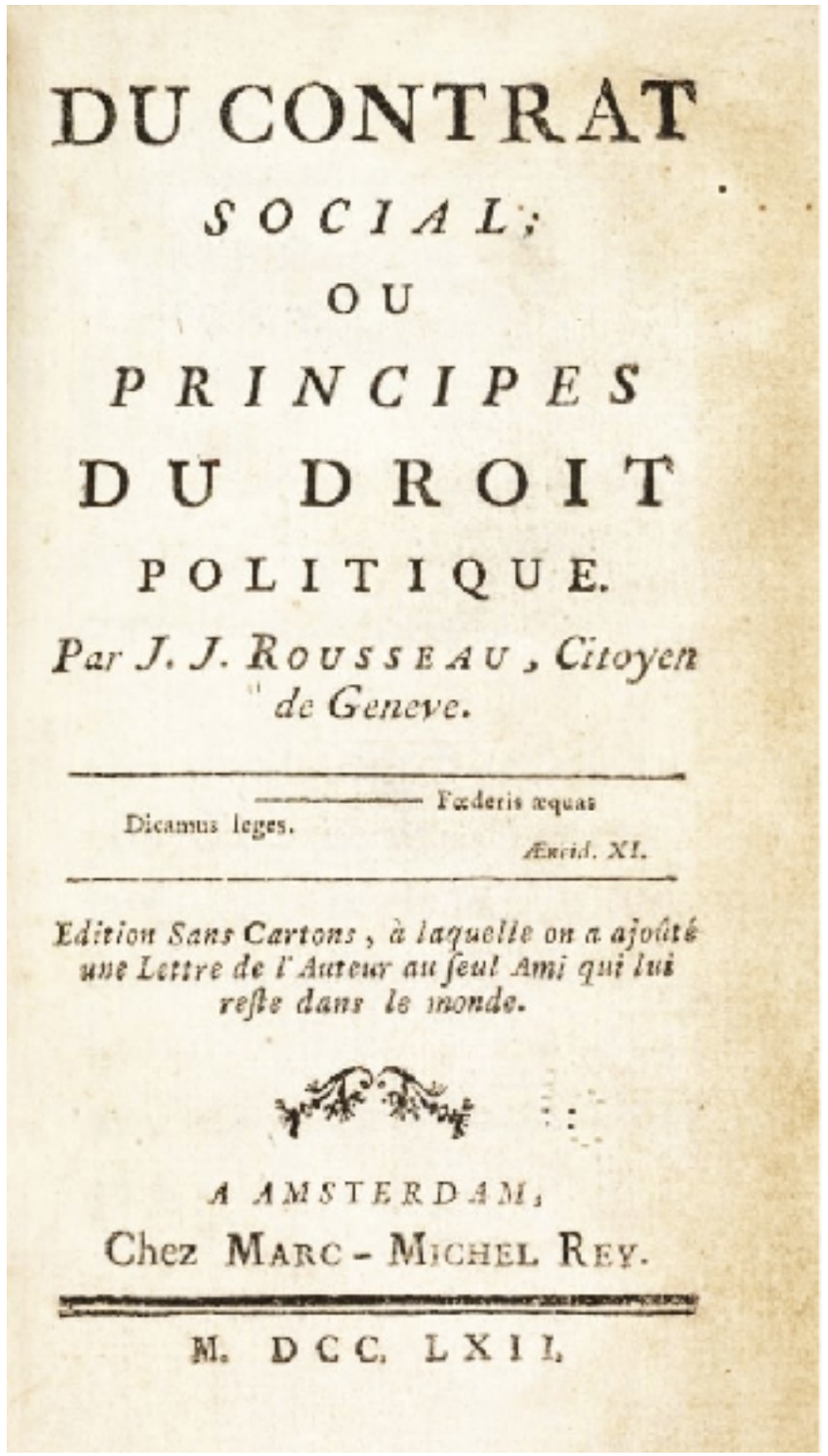
wearing a SUIT TO WORK on the

West Coast



Prosocial norms

- Rules against murder and assault encourage civil order, and make us feel relatively secure.
- Property rights allow encourage productive effort and innovation.
- Well-managed taxation provides roads, schools, and other public goods.
- Product standards, building codes, and rules of professional conduct allow more efficient commerce and protect citizens from harm.
- Norms governing the filling of political offices reduce the chances of a civil war over political disputes (hopefully)


DU CONTRAT
SOCIAL;
OU
PRINCIPES
DU DROIT
POLITIQUE.
Par J. J. ROUSSEAU, Citoyen de Geneve.
Fœderis æquas
Dicamus leges.
Æneid. XI.
Edition Sans Cartons, à laquelle on a ajoûté une Lettre de l'Auteur au seul Ami qui lui reſte dans le monde.
A AMSTERDAM,
Chez MARC-MICHEL REY.
M. DCC. LXII.

How do norms spread?

- Cultural evolutionary framework
- Assume individuals have many interactions, and accumulate payoffs from them.
- They then update their behaviors using success-biased copying.
- Simplest case: two norms compete, and neither has any intrinsic advantage over the other

Coordination game with symmetric payoffs

Player 1 \ Player 2	Norm 1	Norm 2
Norm 1	$1+\delta$	1
Norm 2	1	$1+\delta$

$\delta \geq 0$

payoff is to Player 1

Calculating payoffs

- Assume **many** interactions with random individuals in a population of size *N*.

- Let n_1 be the number of agents who use norm 1, and n_2 be the number of agents who use norm 2, so $n_2 = N - n_1$.

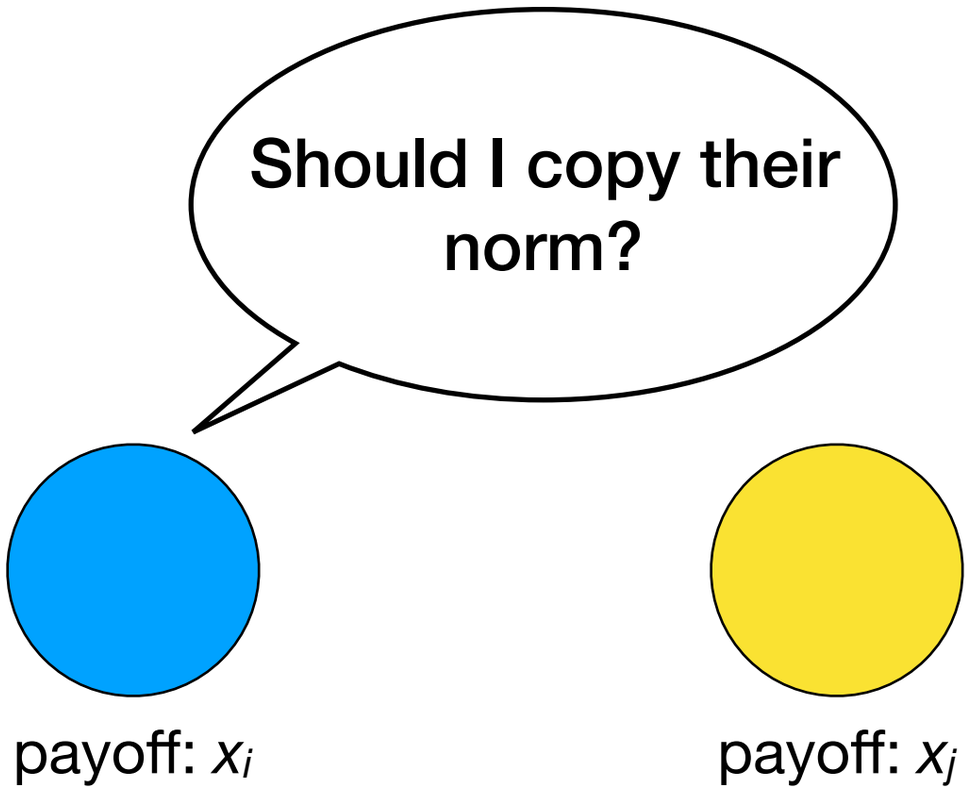
- The payoff to an agent who uses norm 1 is:

$$V_1 = \frac{n_1 - 1}{N - 1}(1 + \delta) + \frac{n_2}{N - 1}(1)$$

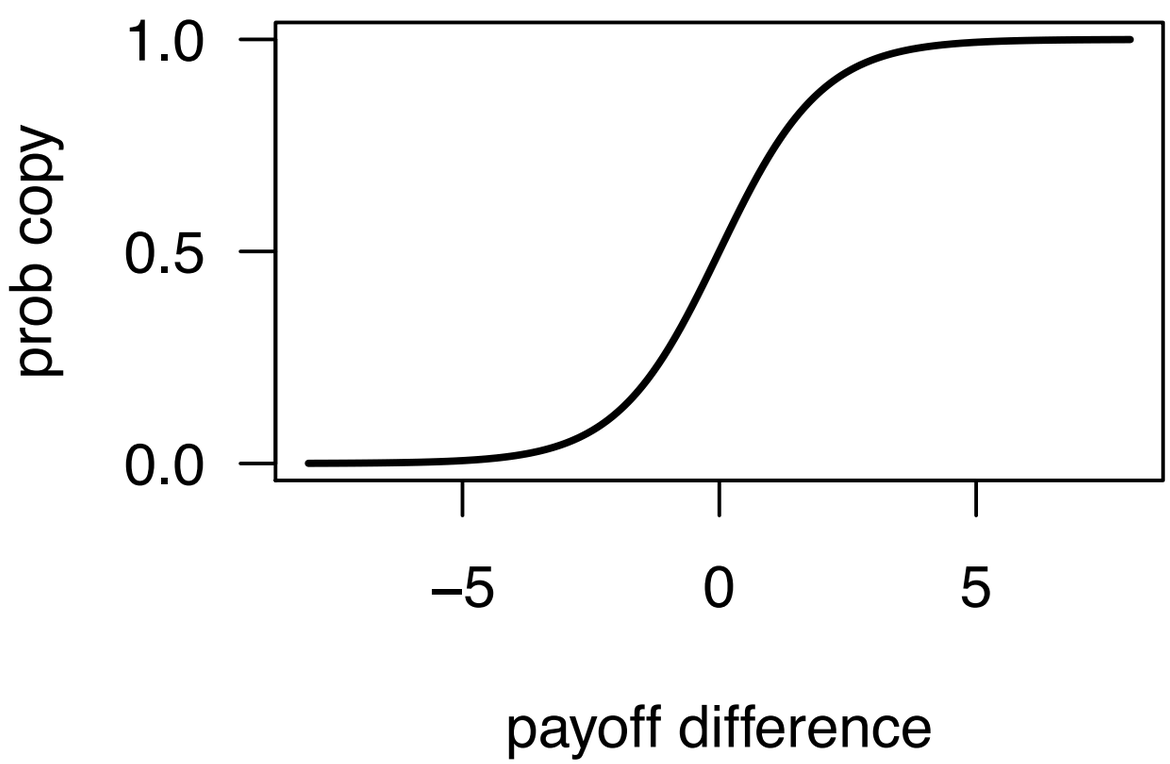
which reduces to

$$V_1 = 1 + \frac{n_1 - 1}{N - 1}\delta$$

Probabilistic copying



$$\Pr(i \textbf{ copy } j) = \frac{1}{1 + \exp[-\alpha(x_j - x_i)}$$



coordination with symmetric payoffs

CODE: coordination_simple.nlogo

Group-beneficial norms

Player 1 \ Player 2	Norm 1	Norm 2
Norm 1	$1+\delta+g$	$1-h$
Norm 2	$1+g$	1

$$\delta, g, h \geq 0$$

coordination with asymmetric payoffs

CODE: coordination_asymmetric.nlogo

When does the prosocial norm spread?

- Assume large population so $\boldsymbol{N \approx N - 1}$. Let $\boldsymbol{p}$ be the proportion using norm 1, so the proportion using norm 2 is $\boldsymbol{1 - p}$.

- The expected payoff to a norm 1 agent is:

$$V_1 = p(1 + \delta + g) + (1 - p)(1 - h)$$

- The expected payoff to a norm 2 agent is:

$$V_2 = p(1 + g) + (1 - p)(1)$$

Norm 1 spreads when $V_1 > V_2$

$$V_1 = p(1 + \delta + g) + (1 - p)(1 - h)$$

$$V_2 = p(1 + g) + (1 - p)(1)$$

Solve for ***p****, the threshold frequency, when:

$$p(1 + \delta + g) + (1 - p)(1 - h) > p(1 + g) + (1 - p)$$

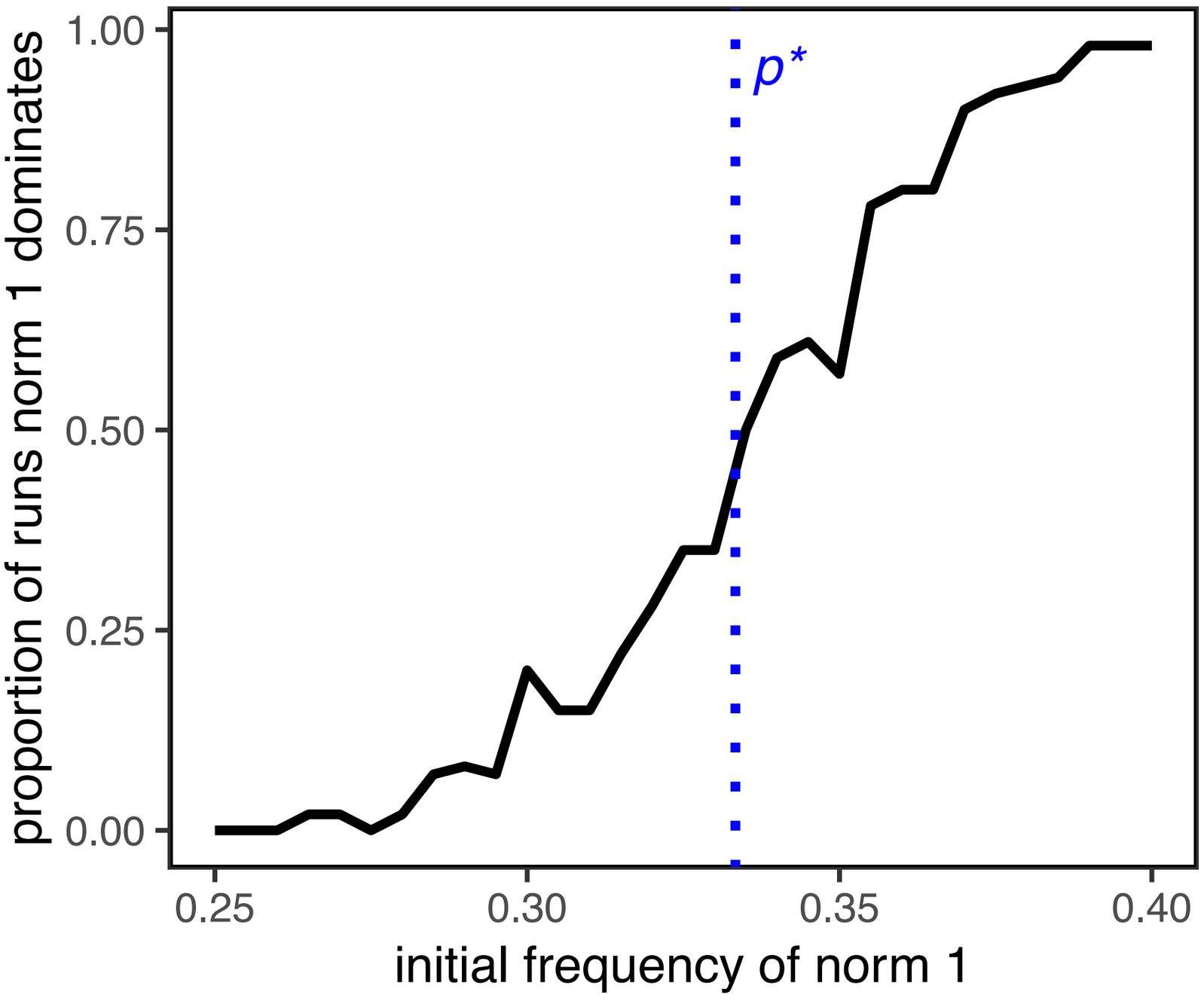
$$p\delta + (1 - p)(-h) > 0$$

$$p\delta + ph > h$$

$$p > p^* = \frac{h}{\delta + h}$$

For $g = 1$, $h = 0.5$, we calculate $p^* = .5/1.5 = 0.333$

100 simulations for each value of p



$$p^* = \frac{h}{\delta + h}$$

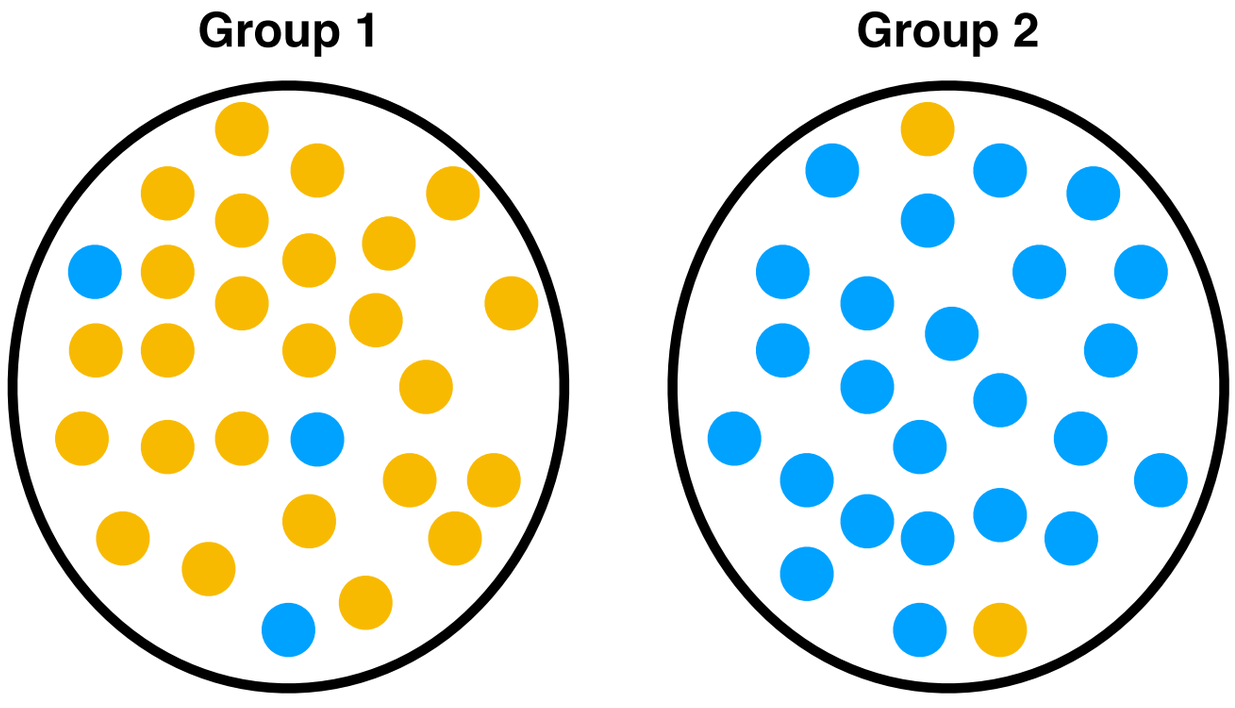
- Group-beneficial norms cannot spread if too rare initially.

- Paradox: how can groups improve their practices?

- A possible solution: inter-group competition?

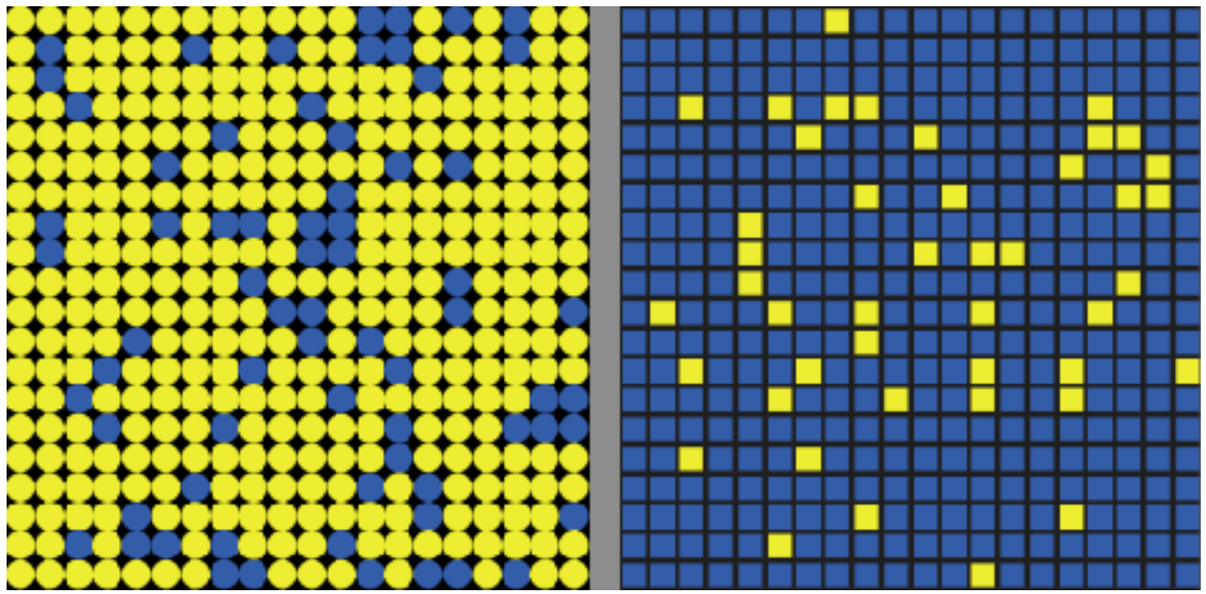
Group-beneficial norms in a structured population

- Multiple groups exist
- Individuals continue to interact with group members
- However, individuals sometimes observe norms and related payoffs of <u>outgroup</u> members



Group-beneficial norms in a structured population

- Multiple groups exist
- Individuals continue to interact with group members
- However, individuals sometimes observe norms and related payoffs of <u>outgroup</u> members



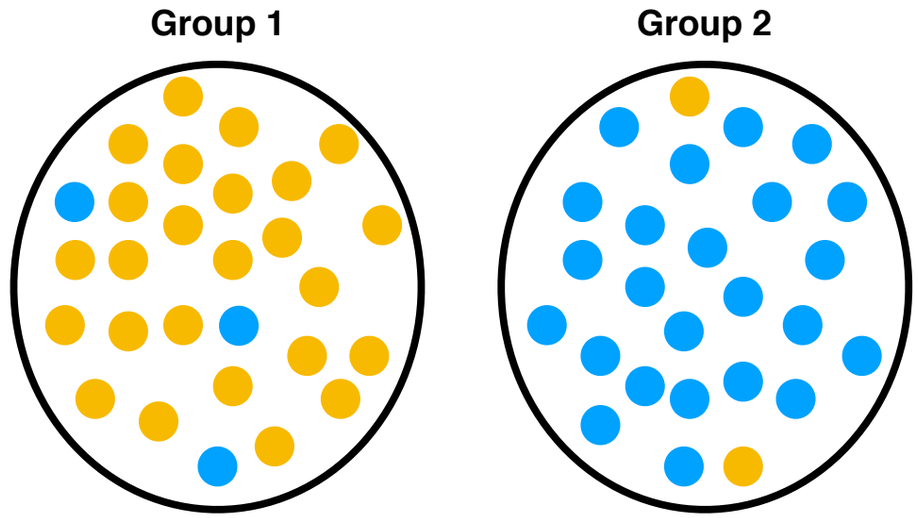
coordination with asymmetric payoffs and group structure

CODE: coordination_2groups.nlogo

Strong assumptions of the model

- Individuals are willing to consider another's success as a reason to copy them, even if they are successful in a different social context/group.
  - Probably reasonable

- Both norms and payoffs are easily observable.
  - Not always the case!



Group Beneficial Norms Can Spread Rapidly in a Structured Population

ROBERT BOYD*† AND PETER J. RICHERSON‡

*Department of Anthropology, University of California, Los Angeles, CA 90095, USA and
‡Department of Environmental Science and Policy, University of California, Davis, CA 95616, USA

(*Received on* 20 *April* 2001, *Accepted in revised form on* 5 *December* 2001)

Group beneficial norms are common in human societies. The persistence of such norms is consistent with evolutionary game theory, but existing models do not provide a plausible explanation for why they are common. We show that when a model of imitation used to derive replicator dynamics in isolated populations is generalized to allow for population structure, group beneficial norms can spread rapidly under plausible conditions. We also show that this mechanism allows recombination of different group beneficial norms arising in different populations.

Further directions

Cultural group selection

Cultural group selection, coevolutionary processes and large-scale cooperation

Joseph Henrich*

Department of Anthropology, Emory University, Geosciences Building

Received 17 January 2001; received in revised form 10 February 2

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B

Phil. Trans. R. Soc. B (2010) 36
doi:10.1098/rs

Transmission coupling mechanisms: cultural group selection

Robert Boyd[1],* and Peter J. Richerson[2]

[1]*Department of Anthropology, University of California, Los Angeles, CA 90095, USA*
[2]*School of Environmental Science and Policy, University of California, Davis, CA 95616, US*

The application of phylogenetic methods to cultural variation raises questions about how cu adaption works and how it is coupled to cultural transmission. Cultural group selection particular interest in this context because it depends on the same kinds of mechanisms tha to tree-like patterns of cultural variation. Here, we review ideas about cultural group sele relevant to cultural phylogenetics. We discuss why group selection among multiple equilib not subject to the usual criticisms directed at group selection, why multiple equilibria common phenomena, and why selection among multiple equilibria is not likely to be an impo force in genetic evolution. We also discuss three forms of group competition and the processe cause populations to shift from one equilibrium to another and create a mutation-like process group level.

Keywords: cultural transmission; multi-level selection; cultural adaptation

BEHAVIORAL AND BRAIN SCIENCES (2016), Page 1 of 68
doi:10.1017/S0140525X1400106X, e30

Cultural group selection plays an essential role in explaining human cooperation: A sketch of the evidence

Peter Richerson
Department of Environmental Science and Policy, University of California–Davis, Davis, CA 95616
pjricherson@ucdavis.edu
www.des.ucdavis.edu/faculty/richerson/richerson.htm

Ryan Baldini
Graduate Group in Ecology, University of California–Davis, Davis, CA 95616
ryanbaldini@gmail.com https://sites.google.com/site/ryanbaldini/

Adrian V. Bell
Department of Anthropology, University of Utah, Salt Lake City, UT 84112
av.bell@gmail.com http://adrianbell.wordpress.com/

Kathryn Demps
Department of Anthropology, Boise State University, Boise, ID 83725
kathryndemps@boisestate.edu
http://sspa.boisestate.edu/anthropology/faculty-and-staff/kathryn-demps/

Karl Frost
Graduate Group in Ecology, University of California–Davis, Davis, CA 95616
kjfrost@ucdavis.edu https://sites.google.com/site/karljosephfrost/

Emily K. Newton
Department of Psychology, Dominican University of California, San Rafael, CA 94901
emily.newton@dominican.edu http://emilyknewton.weebly.com/

Nicole Naar
Department of Anthropology, University of California–Davis, Davis, CA 95616
nsnaar@ucdavis.edu

Lesley Newson
Department of Environmental Science and Policy, University of California–Davis, Davis, CA 95616
lgnewson@ucdavis.edu lesleynewson@gmail.edu
https://www.researchgate.net/profile/Lesley_Newson/

Cody Ross
Santa Fe Institute, Santa Fe, NM 87501
cross@ucdavis.edu
http://scholar.google.com/citations?user=xSugEskAAAAJ

Paul E. Smaldino
Department of Anthropology, University of California–Davis, Davis, CA 95616
paul.smaldino@gmail.com http://www.smaldino.com/

Further directions

Signals and markers

JOB MARKET SIGNALING *

MICHAEL SPENCE

1. INTRODUCTION

The term "market signaling" is not exactly a part of the v
defined, technical vocabulary of the economist. As a part of
preamble, therefore, I feel I owe the reader a word of explana
about the title. I find it difficult, however, to give a coherent
comprehensive explanation of the meaning of the term abstra
from the contents of the essay. In fact, it is part of my purpos
outline a model in which signaling is implicitly defined and to
plain why one can, and perhaps should, be interested in it.
might accurately characterize my problem as a signaling one,
that of the reader, who is faced with an investment decision u
uncertainty, as that of interpreting signals.

Shared Norms and the Evolution of Ethnic Markers[1]

RICHARD MCELREATH, ROBERT BOYD, AND PETER J. RICHERSON
Department of Anthropology, University of California, Los Angeles, Calif. 90095, U.S.A., and Center for Adaptive Behavior and Cognition, Max Planck Institute for Human Development, Lentzeallee 94, 14195 Berlin, Germany (mcelreath@mpib.berlin.mpg.de) (McElreath)/*Department of Anthropology, University of California, Los Angeles, Calif. 90095, U.S.A.* (Boyd)/*Department of Environmental Science and Policy, University of California, Davis, Calif. 95616, U.S.A.* (Richerson). 15 III 02

Unlike other primates, human populations are often divided into ethnic groups that have self-ascribed membership and are marked by seemingly arbitrary traits such as distinctive styles of dress or speech (Barth 1969, 1981). The modern understanding that ethnic identities are flexible and ethnic boundaries porous makes the origin and existence of such groups problematic because

Further directions

Noisy signals and intragroup variation

The Evolution of Covert Signaling

Paul E. Smaldino[1], Thomas J. Flamson[2] & Richard McElreath[3]

Human sociality depends upon the benefits of mutual aid and extensive communication. However, diverse norms and preferences complicate mutual aid, and ambiguity in meaning hinders communication. Here we demonstrate that these two problems can work together to enhance cooperation through the
signaling is the transmis
obscured when perceive
while also avoiding the a
the empirical literature h
humor, there is to date n
to assess when a covert
covert signals. Covert sig
cooperative assortment
and to get along with dis
theories of signaling and
human cultural complex

The signal-burying game can explain why we obscure positive traits and good deeds

Moshe Hoffman[1,3*], Christian Hilbe[2,3*] and Martin A. Nowak[1*]

People sometimes make their admirable deeds and accomplishments hard to spot, such as by giving anonymously or avoiding bragging. Such 'buried' signals are hard to reconcile with standard models of signalling or indirect reciprocity, which motivate costly pro-social behaviour by reputational gains. To explain these phenomena, we design a simple game theory model, which we call the signal-burying game. This game has the feature that senders can bury their signal by deliberately reducing the probability of the signal being observed. If the signal is observed, however, it is identified as having been buried. We show under which conditions buried signals can be maintained, using static equilibrium concepts and calculations of the evolutionary dynamics. We apply our analysis to shed light on a number of otherwise puzzling social phenomena, including modesty, anonymous donations, subtlety in art and fashion, and overeagerness.

Further directions

Language and conventions

The Emergence of a 'Language' in an Evolving Population of Neural Networks

ANGELO CANGELOSI & DOMENICO PARISI

(Received for pu

The evolutio priately to si signals in th are produced signals may advantage is neural netwo function. Sig mushrooms, Language pr product of th

Cultural evolution of categorization

Pablo Andrés Contreras Kallens[a,b], Rick Dale[c], Paul E. Smaldino[a,*]

[a] Cognitive and Information Sciences, University of California, Merced, USA
[b] Department of Psychology, Cornell University, USA
[c] Department of Communication, University of California, Los Angeles, USA

June 2018; accepted 13 August 2018
nber 2018

mplications for the rest of the cognitive system. In humans, anations at the population level. In this paper, we discuss the in by delineating key properties of categories in need of evo- ratory studies of category evolution, including their major rstanding the cultural evolution of categorization.

PNAS PNAS

Cultural route to the emergence of linguistic categories

Andrea Puglisi*, Andrea Baronchelli†, and Vittorio Loreto*‡§

*Istituto Nazionale per la Fisica della Materia–Consiglio Nazionale delle Ricerche (SMC) and Dipartimento di Fisica, "Sapienza" Università di Roma, Piazzale A. Moro 2, 00185 Roma, Italy; †Departament de Física i Enginyeria Nuclear, Universitat Politècnica de Catalunya, Campus Nord, Mòdul B4, 08034 Barcelona, Spain; and ‡Fondazione ISI, Viale S. Severo 65, 10133 Torino, Italy

Communicated by Giorgio Parisi, University of Rome, Rome, Italy, March 14, 2008 (received for review January 19, 2007)

Categories provide a coarse-grained description of the world. A fundamental question is whether categories simply mirror an underlying structure of nature or instead come from the complex interactions of human beings among themselves and with the environment. Here, we address this question by modeling a population of individuals who co-evolve their own system of symbols and meanings by playing elementary language games. The central result is the emergence of a hierarchical category structure made of two distinct levels: a basic layer, responsible for fine discrimination of the environment, and a shared linguistic layer that groups together perceptions to guarantee communicative success. Remarkably, the number of linguistic categories turns out to be finite and small, as observed in natural languages.

internal form-meaning association tables; i.e., their "mind." The individuals play elementary language games (26, 27) the rules of which constitute the only knowledge initially shared by the population. They are also capable of perceiving analogical stimuli and communicating with each others (6, 7).

The Category Game Model

Our model involves a population of N individuals (or players), committed in the categorization of a single analogical perceptual channel, each stimulus being represented as a real-valued number ranging in the interval [0, 1].

Modeling Categories. Here, we identify categorization as a partition of the interval [0, 1) in discrete subintervals, from now onwards

Next up:

Sociopolitical cycles