The descent of rules:
Investigating the cultural evolution & ecology of institutions

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Plan

• Institutions and their role in organizing human societies
  – Variation in space & time

• Institutions and evolution

• Testing hypotheses about institutional evolution (macro-scale)
  – Evolution of large-scale societies
  – Institutions and variation in economic growth
  – The spread of democracy

• Modelling social processes in institutional change (micro-level)

• Applications to the real-world
  – Community-based conservation in Kenya
Evolution of Institutions and Organizations

Thomas E. Currie, Peter Turchin, Jenna Bednar, Peter J. Richerson, Georg Schwesinger, Sven Steinmo, Romain Wacziarg, and John J. Wallis

In Complexity & Evolution: A New Synthesis for Economics (2016). Ernst Strungmann Forum
What do we mean by institutions?

• A working definition:
  “Systems of rules which proscribe particular roles and regulate social relations”

• Examples: Marriage, Descent & Inheritance, Law Courts, Parliaments, Banking

• Organize societies and help groups to act collectively
  – Structure interactions
  – Affect “pay-offs” to different behaviours

• Often conceptualized as being distinct from “culture”
Humans are an extremely cooperative species
Human cooperation: variable, and difficult to achieve
Good and Bad institutions

School children picking cotton in Uzbekistan
**Figure 1.** State instability decreases with increasing GDP (International Monetary Fund, 2011). The Failed State Index (Fund for Peace, 2012) is based on range of indicators including Mounting Demographic Pressures, Uneven Economic Development along Group Lines, and Suspension or Arbitrary Application of the Rule of Law and Widespread Human Rights Abuse. The straight line is the OLS regression line.
Quantitative historical analysis uncovers a single dimension of complexity that structures global variation in human social organization

Peter Turchin¹, Thomas E. Currie⁵, Harvey Whitehouse³,¹, Pieter François⁴,⁶, Kevin Feeney⁹, Daniel Mullins³,⁷, Daniel Hoyer¹, Christina Collins³, Stephanie Grohmann³, Patrick Savage³, Gavin Mendel-Gleason³, Edward Turner¹, Agathe Dupeyron¹, Enrico Cioni¹, Jenny Reddish¹, Jill Levine¹, Greine Jordan¹, Eva Brandl¹, Alice Williams³, Rudolf Cesaretti², Marta Krueger¹, Alessandro Ceccarelli⁴, Joe Figliuolo-Rosswurm⁴, Po-Ju Tuan¹, Peter Peregrine⁵, Arkadiusz Marciniak¹, Johannes Preiser-Kapeller⁵, Nikolay Kradin¹, Andrey Korotayev⁵, Alessio Palmisano¹, David Baker³, Juley Bidmead⁵, Peter Bol⁶, David Christian¹, Connie Cook⁵,⁶, Alan Covey³, Gary Feinman⁵, Árni Daniel Júlíusson³, Axel Kristinsson³, John Miksic⁶, Ruth Mostern⁷, Cameron Petrie⁸,⁹, Peter Rudiak-Gould⁹, Barend ter Haar¹⁰, Vesna Wallace⁵, Victor Mair¹, Liye Xie¹, John Baines¹¹, Elizabeth Bridges¹², Joseph Manning¹³, Bruce Lockhart¹¹, Amy Bogaard¹⁴, and Charles Spencer¹¹
Different features of socio-political organization tend to be found together in historical and archaeological societies.
Socio-political complexity: “a composite measure of the various roles, institutions, and technologies that enable the coordination of large numbers of people to act in a politically unified manner”
Descent with Modification
VARIATION
INHERITANCE
SELECTION
Institutions evolving

• Rules are transmitted down the generations (inheritance)
• Rules can be modified (variation)
  – Can be discontinuous or incremental
  – Even discontinuous change this may be the result of adoption and adaptation of existing forms from elsewhere
  – Even when institutions are planned they may not work as intended
• Stable patterns of group-level behaviour (“institutions-as-equilibria”) can be selected if there is competition between groups

• What general processes affect institutional evolution?
• Institutions currently under-developed in cultural evolutionary models

Currie et al. 2016; Currie et al. 2021
MACRO-SCALE STUDIES OF INSTITUTIONAL EVOLUTION
Types of evolutionary trends

Currie et al. 2021; Turchin, Currie et al. 2018
Has warfare driven the evolution of large-scale, complex organization?
Warfare and the Steppe frontier

(A)

Territory of the Largest State (mln km², log-scale)

-20  -15  -10  -5  0  5  10  15

Century

Chariot Warfare
Cavalry Warfare

Distance Class (x 1000 km)

0  1  2  3  4  5  6  7  8

Average Imperial Density

0
2
4
6
8
10

(B)
War, space, and the evolution of Old World complex societies

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Edited® by Charles S. Spencer, American Museum of Natural History, New York, NY, and approved August 27, 2013 (received for review May 9, 2013)

How did human societies evolve from small groups, integrated by can arise at all levels of organization (14). For example, an ar-
We need to test multiple hypotheses

**Theoretical framework(s)**

![Diagram showing H1 to H3 and P1 to P3 relationships with level of support bar]

**Strong Inference**

Certain systematic methods of scientific thinking may produce much more rapid progress than others.

John R. Platt

Scientists today tend to keep up a glib fiction that science is orderly. Except for the work of the rare genius, we are told, the lab is where the action is: a lot of things happen, but we know what to do because we understand what’s going on. This is nonsense. It is true that some things happen in the lab, but most of the action is in our heads. We need to test multiple hypotheses.

Platt 1964, Strong Inference
• Previous study focused on warfare as a selective force

• Other factors may also affect evolution including generation of variation
  – Agriculture thought to provide the kind of resource base that facilitates large, complex societies
  – Examined 2 factors: duration of agriculture, and potential productivity
- Distance from the Steppe
- Duration of agriculture
- Potential agricultural productivity
- Rugged terrain
Table 2 GLS spatial models with different predictor variables ranked according to how well they fit the data based on mean ΔAIC values from across the 20 sub-samples of data.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Intercept</th>
<th>Duration of agriculture</th>
<th>Agricultural productivity</th>
<th>Elevation (std)</th>
<th>Distance from steppe</th>
<th>Steppe × agriculture</th>
<th>Mean ΔAIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-0.15 (0.01)</td>
<td>0.24 (0.04)</td>
<td></td>
<td>0.00 (0.01)</td>
<td>0.47 (0.02)</td>
<td>0.15 (0.02)</td>
<td>0.23</td>
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<tr>
<td>2</td>
<td>-0.15 (0.01)</td>
<td>0.24 (0.04)</td>
<td></td>
<td>0.00 (0.01)</td>
<td>0.46 (0.02)</td>
<td>0.15 (0.02)</td>
<td>1.85</td>
</tr>
<tr>
<td>3</td>
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<td>0.32 (0.04)</td>
<td></td>
<td>0.00 (0.01)</td>
<td>0.38 (0.02)</td>
<td>0.15 (0.02)</td>
<td>6.56</td>
</tr>
<tr>
<td>4</td>
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<td>0.32 (0.04)</td>
<td></td>
<td>0.00 (0.01)</td>
<td>0.38 (0.02)</td>
<td>0.15 (0.02)</td>
<td>8.10</td>
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<tr>
<td>5</td>
<td>-0.19 (0.02)</td>
<td>0.37 (0.05)</td>
<td></td>
<td>0.00 (0.01)</td>
<td>0.49 (0.02)</td>
<td>0.15 (0.02)</td>
<td>26.08</td>
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<tr>
<td>6</td>
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<td></td>
<td>0.00 (0.01)</td>
<td>0.49 (0.02)</td>
<td>0.15 (0.02)</td>
<td>33.76</td>
</tr>
<tr>
<td>7</td>
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<td></td>
<td>0.00 (0.01)</td>
<td>0.49 (0.02)</td>
<td>0.15 (0.02)</td>
<td>58.78</td>
</tr>
<tr>
<td>8</td>
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<td></td>
<td>0.00 (0.01)</td>
<td>0.49 (0.02)</td>
<td>0.15 (0.02)</td>
<td>59.22</td>
</tr>
<tr>
<td>9</td>
<td>-0.28 (0.02)</td>
<td></td>
<td></td>
<td>0.00 (0.01)</td>
<td>0.49 (0.02)</td>
<td>0.15 (0.02)</td>
<td>59.85</td>
</tr>
</tbody>
</table>

Standardised coefficients (β) are presented to indicate the relative strength of each predictor. The best-fitting model contains duration of agriculture and distance from the steppe, and the interaction between these two variables. Only one other model falls within 2 mean AIC units of the best-fitting model and this also includes small effects of agricultural productivity and elevation.
Main historical pathways in the cultural evolution of institutions supporting economic performance

Flitton & Currie (under review)
Modern democratic institutions spread faster to countries more closely related to the USA

Currie et al. (2021) – data taken from Polity V database
MICRO-LEVEL MODELS OF INSTITUTIONAL CHANGE
How institutions work

The Tragedy of the Commons
Garrett Hardin (December 13, 1968)

**Table 4.2**: Payoff table for the prisoner’s dilemma.

<table>
<thead>
<tr>
<th></th>
<th>Player A</th>
<th>Player B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cooperate</td>
<td>Cooperate</td>
</tr>
<tr>
<td></td>
<td>Cooperate</td>
<td>Defect</td>
</tr>
<tr>
<td></td>
<td>Defect</td>
<td>Cooperate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Defect</td>
</tr>
</tbody>
</table>

material pay-offs

individual preferences over outcomes of the economic game form

the economic game form
How institutions work

- Institutional rules can enable collective action by:
  - Structuring interactions to reduce chances of defection
  - Changing pay-offs e.g. punishment

Powers et al. 2016, Phil Trans Roy Soc B
Political game  Economic game

Punishment cost value

Proportion of agent type

Final budget

Currie, Campenni et al. (2021)
Leadership & punishment, foresight, and mode of selection – Gavrilets & Shrestha 2021

Leadership & decision-making – Perret, Hart, and Powers 2020
Applying an evolutionary approach to address real-world challenges

Conservancies

“A wildlife conservancy is land managed by an individual landowner, a body or corporate group of owners or a community for purposes of wildlife conservation and other compatible land uses to better livelihoods.”

Recognised under the Wildlife Act of 2013

Offer improved land and resource rights and access to incentives
Walker, Ontiri, Campenni, Perret, Currie (in prep)
Summary

• Cultural evolutionary theory provides a synthetic framework to study institutional change
  – Generates hypotheses that can be empirically tested

• Competition between groups appears to have driven the evolution of large scale societies

• Cultural evolutionary history has shaped the distribution of institutions and economic performance we see in the modern world

• We need to further develop modelling of micro-level of institutional change

• This framework can have important applications for addressing real-world cooperative challenges
Funding

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