Evolution of Cultural Complexity 2018

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Book of Abstracts

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Invited Speakers

Anne Kandler

Title: Inferring processes of cultural transmission: the critical role of rare variants

Abstract: Understanding how social information is used in human populations is one of the challenges in cultural evolution. Fine-grained individual-level data, detailing who learns from whom, would be most suited to answer this question empirically but this kind of data is difficult to obtain especially in pre-modern contexts. Therefore inference procedures have often been based on population-level data in form of frequency distributions of a number of different variants of a cultural trait at a certain point in time or of time-series that describe the dynamics of the frequency change of cultural variants over time, often comprising sparse samples from the whole population. In this talk we demonstrate that there exist theoretical limits to the accuracy of the inference of underlying processes of cultural transmission from aggregated data highlighting the problem of equifinality especially in situations of sparse data. Crucially we show the importance of rare variants for inferential questions. The presence, or absence, of rare variants as well as the spread behaviour of innovations carry a stronger signature about underlying processes than the dynamic of high-frequency variants. On the example of the choice of baby names, we illustrate that the consistency between empirical data, summarized by the so-called progeny, and hypotheses about cultural evolution such as neutral evolution or novelty biases depends entirely on the completeness of the data set considered. Analyses based on only the most popular variants, as is often the case in studies of cultural evolution, can provide misleading evidence for underlying processes of cultural transmission.

Peter Turchin

Title: The Evolution of Complex Societies: Old Theories and New Data

Abstract: Over the past 10,000 years human societies evolved from "simple"—small egalitarian groups, integrated by face-to-face interactions, —to "complex"—huge anonymous societies with great differentials in wealth and power, extensive division of labor, elaborate governance structures, and sophisticated information systems. One aspect of this "major evolutionary transition" that continues to excite intense debate is the origins and evolution of the state—a politically centralized territorial polity with internally specialized administrative organization. Theories proposed by early theorists and contemporary social scientists make different predictions about causal processes driving the rise of state-level social organization. I will use Seshat: Global History Databank to empirically test predictions of several such theories. I will present results of a dynamic regression analysis that estimates how the evolution of specialized governance structures was affected by such factors as social scale (population, territorial expansion), social stratification, provision of public goods, and information systems.

Contributed Talks

Dries Daems

Title: Materialising complexity. A conceptual model of material culture, social complexity and mechanisms of change

Abstract: The genesis of complex societies has captivated scientific minds across disciplinary boundaries. In archaeology, trajectories of social complexity were traditionally considered from reductionist evolutionary perspectives focusing on fixed stages of societal development. In response, two strands of thought developed: 1) In the 1980's and 90's, archaeologists started to stress the multivocality of microscale behavioural complexity in everyday practices of social life as expressed through the entangled interaction between people and material objects; 2) Since the turn of the millennium, the waxing and waning of social complexity has increasingly come to be considered in light of resilience, sustainability, and transformation in macroscale dynamics of stability and change in complex societies. The immense potential of combining these micro- and macroscale approaches, has so far been insufficiently realized.
The present paper aims to bridge this gap by presenting a conceptual model which integrates material culture – expressed through social practices and flows of information – as micro-level building blocks for macro-scale dynamics of societal change and stability. To formalise this model, I focus on three general mechanisms of change – differentiation, specialization, and connectivity – operating within a framework of complexity as a problem-solving tool. I will look in

particular at developments in five main domains: 1) subsistence and raw material procurement; 2) technology; 3) inter-group competition; 4) socio-political structures; and 5) (economic) production. In this perspective, complex societies develop as people and social groups on various levels, domains and scales become increasingly interrelated within nested structures of functional, informational, and decision-making roles.

Thibaud Gruber and Dora Biro

Title: Efficiency as a driver of cultural evolution: from birds to primates

Abstract: While evidence for socially transmitted behaviour in a variety of species supports claims of cultural variation in wild animals, cultural evolution in animals itself remains a controversial topic, because of limited evidence for progression toward more complex behaviour. Animal "cultures" remain largely seen as perpetually re-invented by each new generation of a given population, with little progression from one variant to another across generations. We believe this view results mainly from the theoretical approach applied to cultural evolution, inspired by modern humans, which tends to blend the concept of cultural evolution with an increase in cultural complexity, the ratchet, scaffolded by high-fidelity social learning processes such as imitation or teaching. While we agree that increase in complexity has characterized much of human cultural evolution, and possibly some animal behavioural traits, we believe that complexity may not be a driver per se of cultural evolution. Rather, both animals and humans select for greater efficiency, which may in turn select for more complex behaviour as a by-product. We will analyze examples from the literature and some of our recent studies in this light: the spread of moss-sponging as an alternative to leaf-sponging in wild chimpanzees, and the cumulative learning, across artificial generations, of travel routes in homing pigeons. We argue that both examples may be considered evidence of cumulative cultural evolution, which arose through selection for greater efficiency, rather than complexity. Accordingly, efficiency rather than complexity may thus be the main driver for cumulative cultural evolution.

Jelena Grujic, Miljana Radivojevic and Marko Porcic

Title: The concept of archaeological cultures – an inside from complex networks approach

Abstract: The concept of archaeological culture is one of the most challenging yet most enduring concepts in prehistoric archaeology. Recently we applied an innovative method based on complex networks analysis to identify community structures in the archaeological record and investigate pathways to an independent evaluation of archaeological cultures that produced and traded copper in the Balkans, from c. 6200 to c. 3200 BC. Used only trace element data of 410 copper-based objects from 79 archaeological sites as the independent

variable for detecting the most densely interconnected sets of archaeological sites we uncovered modular structures that exhibit strong spatial and temporal significance within each observed time slice across c. 3,000 years. Here we build upon our previous study and apply an improved modelling approach to empirically determine if traditionally defined archaeological cultures of the Balkan Neolithic and Chalcolithic (6200-3200 BC) represent meaningful entities from the perspective of the most densely connected copper supply networks and if an agreement between obtained modular structures and archaeological data is plausible. Furthermore, we improve our previous method by conducting cluster analysis of the bipartite network instead of its projection, as in our previous study. Finally, we present a reinforced model of human interaction and cooperation that can be evaluated independently of established archaeological systematics, and can find wide application on any quantitative data from archaeological and historical record.

Elizabeth Hobson, Dan Mønster and Simon Dedeo

Title: Detecting the Basis of Sociocultural Complexity in Animals and Humans

Abstract: The extreme social and cultural complexity of human groups is a fundamental feature that differentiates human sociality from animals, but despite long-standing interest, the evolution of sociocultural complexity in both humans and animals is still poorly understood. Most studies use a bottom-up measure, where social complexity is contained within the number, type, or strength of pairwise relationships in groups. However, this perspective loses a lot of the complexity of sociocultural structures. Rather than using a bottom-up measure, which focuses exclusively on the structure of local social interactions, we describe a novel integrated feedback loop as a way to bridge between local and global properties of sociality, where individual actions both create the group's social world and can then be influenced by these social structures. We show how these methods can lead to new understanding of sociocultural complexity in the context of within-group conflict. We apply these methods to observational studies of over 85 species of animals as they choose who to fight with and to experimental studies of humans as they synthesize social information and formulate conflict strategies within a networked computer game. This approach provides new potential for broad comparative analyses to better understand the evolution of complex sociocultural traits.

Francois Lafond

Title: The evolution of classification systems as indicator of cultural evolution

Abstract: It has long been recognized by anthropologists and sociologists that classification systems reflect prevalent institutions and cognitive organizations. In this talk, I will describe my preliminary attempts at bringing a complex system twist to this strand of research – using a data driven approach

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to understand empirical patterns, and describing classification systems as stochastically evolving networks where simple rules of evolution lead to empirically realistic classification trees. I will present a few case studies of technological and economic classification systems, and in particular the US patent classification system, which evolved for almost two centuries [1], and in which items are reclassified when the classification system is updated [2]. I will discuss opportunities and challenges associated with using this data to understand and predict long-run innovation.

[1] Lafond, F. and Kim, D. (2017) Long-run dynamics of the U.S. patent classification system, https://arxiv.org/abs/1703.02104

[2] Verendel, V., Lafond, F. and Farmer, J.D. (2018), The origins of new technological domains, in progress, to be presented at the CCS 2018.

Dion O'Neale, Caleb Gemmell, Thegn Ladefoged, Alex Jorgensen, Hayley Glover, Christopher Stevenson and Mark McCoy

Title: Constructing socio-political networks from obsidian artefacts in pre-European Aotearoa/New Zealand

Abstract: The Polynesian colonists who settled New Zealand some 700 years ago, brought with them cultural conceptions of chiefdom based on genealogical affiliation (whakapapa) and territory (mana whenua). It has been suggested that the initial settlers lived in relatively autonomous villages, and that over centuries these grew to form geographically larger social units (hapū), which eventually coalesced into tribal groups known as iwi. We have used archaeological records to construct networks of obsidian movements in pre-European Aotearoa New Zealand, and to investigate factors that may have influenced how iwi groups gathered resources, be they geographic, economic, or social.
We create a bipartite network of obsidian source locations and the archaelogical study sites where the artefacts were ultimately found. Analysis of the spatial and temporal aspects of the source-site bipartite network is used to provide insight into the movement and interactions of the groups who were collecting, transporting, and using the obsidian. The bipartite networks allow us to test various hypotheses that might explain the unique distribution of obsidian throughout the Northland and Auckland regions of Aotearoa/New Zealand. Using tools such as similarity measures and community detection we identify those regions with similar patterns of obsidian sourcing which we use to infer social networks in pre-European Aotearoa/New Zealand.

Iza Romanowska, Simon Carrignon and Tom Brughmans

Title: When culture meets economy: modelling cultural complexity in an economic setting

Abstract: When culture meets economy: modelling cultural complexity in an economic setting Imagine going to a market to buy a new plate. The seller offers you a wide selection of locally made or imported ceramics, some cheaper, some more expensive. But which one to choose? Here we present a model of economic preference designed to investigate how simple customer preferences can shape centuries long term economic and cultural trends. By applying a number of standard cultural evolution algorithms (conformity bias, prestige bias, neutral etc.) to a baseline economic model (utility maximisation or 'sell high, buy low') we investigate how cultural behavioural scenarios can lead to different patterns in economic data. Does a complete dominance of one type of good signify a strong preference of the buyers or can this pattern arise from other types of cultural bias? Can a high level of variability in terms of products be equated with more complex behavioural patterns? Our goal is to provide a benchmark for a more informed interpretation of cultural assemblages, such as pottery found at archaeological sites, and to understand what kind of processes might have driven the apparent changes in cultural complexity over centuries long time spans. To showcase the utility of these abstract cultural/economic models we provide a case study centred on Jerash, a medium sized Roman town in present-day Jordan, where recent excavations revealed that the local pottery dominates the archaeological record for a period of six centuries. The results of our agent-based model indicate that this pattern could have arisen only within a narrow band of conditions giving us an unprecedented window into the lives and decisions of ancient inhabitants of Jerash.

Clemens Schmid

Title: A computational Cultural Transmission model of Bronze age burial rites in Central, Northern and North-western Europe

Abstract: European Bronze age archaeology traditionally focusses on two major dimensions to categorise burials – although there's an immense variability of attendant phenomena within this spectrum: Flat graves versus burial mounds and cremation versus inhumation. These traits are an indispensable ingredient for common narratives of sociocultural interaction in the Bronze age.

This complex system of ideological affiliation and exchange can be described in the terms of Cultural Evolution theory. Burial rites are extraordinary cultural traits: Following Dunnels[1] distinction between function and style based on relevance for selection, they can be handled as neutral variants. As demonstrated by Neiman[2], drift and intergroup transmission as opposed to natural selection should therefore be the decisive processes for their expansion. On the other hand funerals touch upon personal loss and profound religious beliefs: They are not short-lived fashion and most probably well interlinked with other – many archaeologically inaccessible – traits.

This paper will present the results of my currently ongoing master thesis. To study the diffusion of burial rites, I employ the dataset RADON-B[3] which contains more then two thousand Bronze age ^{14}C dates of graves from Central, Northern and North-western Europe. Based on this information I construct regional time series that document how rituals change. For a better understanding of the real-world phenomena I implement a computational model in R and C++. It simulates the expansion of ideas in an artificial population graph and provides an environment to explore the effects of parameters like group size or the degree of intergroup idea transmission.

[1] Dunnell, Robert C., 'Style and Function: A Fundamental Dichotomy', American Antiquity, 43 (1978), 192–202 https://doi.org/10.2307/279244

[2] Neiman, Fraser D., 'Stylistic Variation in Evolutionary Perspective: Inferences from Decorative Diversity and Interassemblage Distance in Illinois Woodland Ceramic Assemblages', American Antiquity, 60 (1995), 7–36 https://doi.org/10.2307/282074

[3] Kneisel, Jutta, Martin Hinz, and Christoph Rinne, 'Radon-B', 2013 http://radon-b.ufg.uni-kiel.de.

Kaarel Sikk, Geoffrey Caruso and Aivar Kriiska

Title: Conceptual framework of assessing the influence of cultural complexity to settlement pattern formation

Abstract: Settlement patterns are one of the main products of prehistorial archaeological research and are used as spatial projections of past societies. In current paper we study how geographical locational data can reveal information about cultural complexity. The formation of the patterns is influenced by multiple factors from human-environment interactions to complex processes within society.
We analyse the forces behind formation of settlement patterns from an agent based modelling perspective. For the purpose we construct a spatial discrete choice model and formulate it using random utility theory. We argue that agent decisions in the models can be decomposed into different rulesets. Those rules are mostly determined by attraction to natural affordances and sociocultural behaviours.
Paleoecological and geological data can be used to extract information about human attraction to natural affordances. Analysing the resulting empirical data can reveal the significance of environment as determining settlement choice which we argue is declining with growing cultural complexity.

Christopher Watts

Title: Simulating institutional innovation and the collapse of complex societies

Abstract: In this presentation we discuss early-stage work on testing, via agent-based simulations, Joseph Tainter's (1988) theory of the collapse of complex societies. Tainter argued that ancient societies solved resourcing problems by becoming more complex, that is, by increasing in the number and diversity of people, places, goods, practices, hierarchy, roles and rules. Performing and reproducing the increased complexity, however, costs resources, especially energy, leading to future problems, requiring further innovation. When the returns to complexity turn negative, the alternative solution is a dramatic simplification, or collapse. This theory has since received interest from researchers into the sustainability of contemporary resource use. To study the complexification-and-collapse phenomena, we propose simulating agents who use resources, make institutional judgments as part of governance systems for resource use, and can collectively innovate in their innovations. We discuss the empirical support for complexity and collapse in the context of ancient societies, the motivation for a focus on institutions, previous simulation models of innovation, emergent organisation and resource use from which we may learn, and some of the technical challenges we anticipate in developing the new model.