

Abstract

FROM PSYCHOLOGY TO PHYLOGENY: BRIDGING LEVELS OF ANALYSIS
IN CULTURAL EVOLUTION

by

MASON PATRICK YOUNGBLOOD

Advisor: Professor David Lahti

Cultural evolution, or change in the socially learned behavior of a population over time, is a fascinating phenomenon that is widespread in humans and present in some non-human animals. In this dissertation, I present an array of cultural evolutionary studies that bridge pattern and process in a wide range of research models including music, extremism, and birdsong. The first chapter is an introduction to the field of cultural evolution, including a bibliometric analysis of its structure. The second and third chapters are studies on the cultural dynamics of music sampling traditions in hip-hop and electronic music communities and far-right extremism in the United States, using social network analysis and epidemiological modeling, respectively. The fourth and fifth chapters are studies on how cultural transmission biases influence population-level changes in music sampling traditions and house finch song, using a combination of agent-based modeling and machine learning. The sixth chapter is a technical report on computerized birdfeeders that were used to remotely collect data on the social network structure of a wild house finch population. Lastly, the seventh chapter applies a novel phylogenetic method based on dynamic community detection to reconstruct the cultural evolution of electronic music.

Chapter 1 The science of cultural evolution is unified in its application of evolutionary logic to socially transmitted behavior, but diverse in methodologies and assumptions.

Qualitative reviews have encouraged integration by illuminating points of divergence and fostering interaction. This effort would be greatly enhanced by quantitative data on patterns of collaboration and idea sharing in the literature. In the present study, we apply a novel combination of network, cluster, and bibliometric analyses to an extensive dataset of publications on cultural evolution, in order to represent the structure of the field and evaluate the level of disciplinary integration. We first construct a co-authorship network and identify subdisciplines. We then use bibliometric analyses to describe each subdiscipline and investigate trends in collaboration and productivity. Lastly, we assess the topographical distance and degree of citation sharing between subdisciplines, as well as the diversity of subject categories within subdisciplines. Our results reveal an increase in productivity and collaboration over time, albeit a higher inequality in author productivity than expected. Our structural approach reveals research subcommunities with differential levels of integration, citation sharing, and subject diversity. These findings confirm the emergence of a vigorous interdisciplinary field, and indicate ways to foster integration and synthesis in cultural evolution.

Chapter 2 Music sampling is a common practice among hip-hop and electronic producers that has played a critical role in the development of particular subgenres. Artists preferentially sample drum breaks, and previous studies have suggested that these may be culturally transmitted. With the advent of digital sampling technologies and social media the modes of cultural transmission may have shifted, and music communities may have become decoupled from geography. The aim of the current study was to determine whether drum breaks are culturally transmitted through musical collaboration networks, and to identify the factors driving the evolution of these networks. Using network-based diffusion analysis we found strong evidence for the cultural transmission of drum breaks via collaboration between artists, and identified several demographic variables that bias transmission. Ad-

ditionally, using network evolution methods we found evidence that the structure of the collaboration network is no longer biased by geographic proximity after the year 2000, and that gender disparity has relaxed over the same period. Despite the delocalization of communities by the internet, collaboration remains a key transmission mode of music sampling traditions. The results of this study provide valuable insight into how demographic biases shape cultural transmission in complex networks, and how the evolution of these networks has shifted in the digital age.

Chapter 3 Increasing levels of far-right extremist violence have generated public concern about the spread of radicalization in the United States. Previous research suggests that radicalized individuals are destabilized by various environmental (or endemic) factors, exposed to extremist ideology, and subsequently reinforced by members of their community. As such, the spread of radicalization may proceed through a social contagion process, in which extremist ideologies behave like complex contagions that require multiple exposures for adoption. In this study, I applied an epidemiological method called two-component spatio-temporal intensity modeling to data from 416 far-right extremists exposed in the United States between 2005 and 2017. The results indicate that patterns of far-right radicalization in the United States are consistent with a complex contagion process, in which reinforcement is required for transmission. Both social media usage and group membership enhance the spread of extremist ideology, suggesting that online and physical organizing remain primary recruitment tools of the far-right movement. In addition, I identified several endemic factors, such as poverty, that increase the probability of radicalization in particular regions. Future research should investigate how specific interventions, such as online counter-narratives to battle propaganda, may be effectively implemented to mitigate the spread of far-right extremism in the United States.

Chapter 4 One of the fundamental questions of cultural evolutionary research is how individual-level processes scale up to generate population-level patterns. Previous studies in music have revealed that frequency-based bias (e.g. conformity and novelty) drives large-scale cultural diversity in different ways across domains and levels of analysis. Music sampling is an ideal research model for this process because samples are known to be culturally transmitted between collaborating artists, and sampling events are reliably documented in online databases. The aim of the current study was to determine whether frequency-based bias has played a role in the cultural transmission of music sampling traditions, using a longitudinal dataset of sampling events across three decades. Firstly, we assessed whether turn-over rates of popular samples differ from those expected under neutral evolution. Next, we used agent-based simulations in an approximate Bayesian computation framework to infer what level of frequency-based bias likely generated the observed data. Despite anecdotal evidence of novelty bias, we found that sampling patterns at the population-level are most consistent with conformity bias. We conclude with a discussion of how counter-dominance signaling may reconcile individual cases of novelty bias with population-level conformity.

Chapter 5 In this study, we used a longitudinal dataset of house finch (*Haemorrhous mexicanus*) song recordings spanning four decades in the introduced eastern range to assess how individual-level cultural transmission mechanisms drive population-level changes in birdsong. First, we developed an agent-based model (available as a new R package called *TransmissionBias*) that simulates the cultural transmission of house finch song given different parameters related to transmission biases, or biases in social learning that modify the probability of adoption of particular cultural variants. Next, we used approximate Bayesian computation and machine learning to estimate what parameter values likely generated the temporal changes in diversity in our observed data. We found evidence that strong content bias, likely targeted towards syllable complexity, plays a central role in the cultural evolution

of house finch song in western Long Island. Frequency and demonstrator biases appear to be neutral or absent. Additionally, we estimated that house finch song is transmitted with extremely high fidelity. Future studies should use our simulation framework to better understand how cultural transmission and population declines influence song diversity in wild populations.

Chapter 6 Radio-frequency identification (RFID) is an increasingly popular wireless technology that allows researchers to monitor wild bird populations from fixed locations in the field. I have developed an RFID-equipped birdfeeder based on the Raspberry Pi Zero W, a low-cost single-board computer, that collects continuous visitation data from birds marked with passive integrated transponder (PIT) tags. Each birdfeeder has a perch antenna connected to an RFID-reader board on a Raspberry Pi powered by a portable battery. When a tagged bird lands on the perch to eat from the feeder, its unique code is stored with the date and time on the Raspberry Pi. These birdfeeders require only basic soldering and coding skills to assemble, and can easily be outfitted with additional hardware like video cameras and microphones. I outline the process of assembling the hardware and setting up the operating system for the birdfeeders. Then, I describe an example implementation of the birdfeeders to track house finches (*Haemorrhous mexicanus*) on the campus of Queens College in New York City.

Chapter 7 Cultural phylogenies, or “trees” of culture, are typically built using methods from biology that use similarities and differences in artifacts to infer the historical relationships between the populations that produced them. While these methods have yielded important insights, particularly in linguistics, researchers continue to debate the extent to which cultural phylogenies are tree-like or reticulated due to high levels of horizontal transmission. In this study, we propose a novel method for phylogenetic reconstruction using

dynamic community detection that explicitly accounts for transmission between lineages. We used data from 1,498,483 collaborative relationships between electronic music artists to construct a cultural phylogeny based on observed population structure. The results suggest that, although vertical transmission appears to be dominant, horizontal transmission is common and populations never become fully isolated from one another. In addition, we found evidence that electronic music diversity has increased between 1975 and 1999. The method used in this study is available as a new R package called *DynCommPhylo*. Future studies should apply this method to other cultural systems such as academic publishing and film, as well as biological systems where high resolution reproductive data is available, to assess how levels of reticulation in evolution vary across domains.