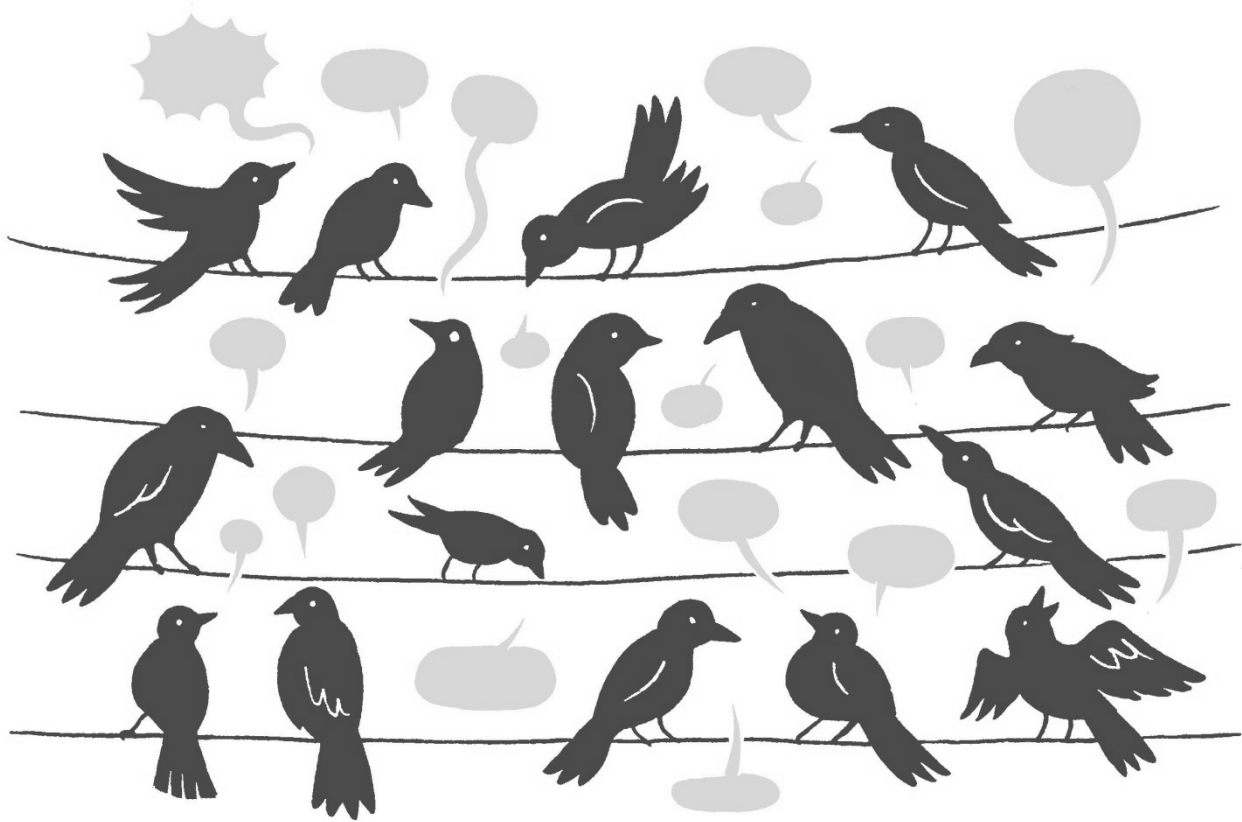


The Transmission of Songs in Birds, Humans, and Other Animals

February 17-18, 2019, Columbia University



*Conference organized by Brian Boyd (Anthropology), Pamela Smith (History),
Nori Jacoby (Neuroscience), Julia Hyland Bruno (Neuroscience)*

*Supported by the Presidential Scholars in Society and Neuroscience, the Institute for
Social and Economic Research Policy, and Barnard College*



Presidential Scholars in
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BARNARD

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RESEARCH
AND POLICY

DAY 1: Sunday, February 17, 2019 (Jerome L. Greene Science Center, L3-079)

8:45 - 9:30 am Check-in and breakfast

9:30 - 9:50 am Welcome day 1 (Organizers)

9:50 - 11:05 am What makes cultures persist over time?

9:50 - 10:20 am Gary Tomlinson (Music, Yale University)

- **The emergence of cultural complexity: The case of late hominins**

10:20 - 10:50 am Ofer Tchernichovski (Psychology, Hunter College, CUNY)

- **Stability of polymorphic song culture in the zebra finch**

10:50 - 11:05 am Respondent: Nori Jacoby (Computational Auditory Perception, Max Planck Institute for Empirical Aesthetics)

11:05 - 11:30 am *Break*

11:30 am - 1:15pm The origins of languages

11:30 am - 12:00 pm Eduardo Mercado III (Psychology, University at Buffalo)

- **Song morphing by humpback whales: Cultural transmission or strategic coordination?**

12:00 - 12:30 pm James Cahill (Laboratory of Neurogenetics of Language, Rockefeller University)

- **Using comparative genomics to identify targets of natural selection in vocal learning birds**

12:30 - 1:00 pm Molly Flaherty (Psychology, Swarthmore College)

- **The emergence of grammatical structure in a new language: Marking who did what to whom in Nicaraguan Sign Language**

1:00 - 1:15 pm Respondent: E. Mara Green (Anthropology, Barnard College)

1:15 - 2:45 pm *Lunch*

2:45 - 4:00 pm Songs and signals

2:45 - 3:15 pm Julien Meyer (GIPSA-lab [Grenoble images parole signal automatique], CNRS/Grenoble INP/Université Grenoble Alpes)

- **Natural whistled and instrumental forms of speech: Transmission and insight into the music-language relation**

3:15 - 3:45 pm Andrea Ravignani (Artificial Intelligence Lab, Vrije Universiteit Brussel, Belgium; Research Department, Sealcentre Pieterburen, The Netherlands)

- **Vocal learning, chorusing seal pups, and the evolution of rhythm**

3:45 - 4:00 pm Respondent: Julia Hyland Bruno (Presidential Scholars in Society and Neuroscience, Columbia University)

4:00 - 4:25 pm *Break*

- 4:25 - 6:10 pm** **Simulating cultural transmission**
 4:25 - 4:55 pm Kenny Smith (Linguistics & English Language, University of Edinburgh)
- **How learning and interaction create, maintain, and destroy linguistic structure**
- 4:55 - 5:25 pm Jordan Suchow (Information Systems, Stevens Institute of Technology)
- **Scaling up experimental simulations of culture**
- 5:25 - 5:55 pm Gary Lupyan (Psychology, University of Wisconsin-Madison)
- **Iconicity and the origin of words**
- 5:55 - 6:10 pm Respondent: Ann Senghas (Psychology, Barnard College)

DAY 2: Monday, February 18, 2019 (Barnard Hall, Sulzberger Parlor, 3rd Floor)

- 8:15 - 9:00 am *Check-in and breakfast*
- 9:00 - 9:15 am Welcome day 2 (Organizers)
- 9:15 - 11:00 am** **Processes of cultural stasis and change**
 9:15 - 9:45 am Tom Griffiths (Psychology and Computer Science, Princeton University)
- **Modeling the effects of learning and memory on culture**
- 9:45 - 10:15 am Olga Fehér (Psychology, University of Warwick)
- **How communication systems are shaped by interaction and transmission**
- 10:15 - 10:45 am Ian Cross (Music, University of Cambridge)
- **The cultural transmission of patterns of interaction: The case of music**
- 10:45 - 11:00 am Respondent: Christopher A.B. Peacocke (Philosophy, Columbia University)
- 11:00 - 11:25 am *Break*
- 11:25 am - 1:10 pm** **Avian acoustic traditions**
 11:25 - 11:55 am Emily Doolittle (Royal Conservatoire of Scotland)
- **Thirteen ways of listening to a hermit thrush**
- 11:55 am - 12:25 pm Heather Williams (Biology, Williams College)
- **Cultural evolution in the songs of Savannah sparrows**
- 12:25 - 12:55 pm Jon T. Sakata (Biology, McGill University)
- **Motor contributions to vocal learning biases and their implications for the cultural evolution of communication**
- 12:55 - 1:10 pm Respondent: Hannah R. Chazin (Anthropology, Columbia University)
- 1:10 - 2:40 pm *Lunch*

2:40 - 3:55 pm	<u>Learning across generations</u>
2:40 - 3:10 pm	Tessa Verhoef (Leiden Institute of Advanced Computer Science, Leiden University) <ul style="list-style-type: none"> • Cultural transmission and the emergence of structure in whistle sounds
3:10 - 3:40 pm	Adeline Mueller (Music, Mount Holyoke College) <ul style="list-style-type: none"> • Who's teaching whom?: Rehearsing familial devotion in late eighteenth-century German songs for parents and children
3:40 - 3:55 pm	Respondent: Ana María Ochoa Gautier (Music, Columbia University)
3:55 - 4:20 pm	<i>Break</i>
4:20 - 6:05 pm	<u>Aesthetics in cultural transmission</u>
4:20 - 4:50 pm	Richard Prum (Ornithology, Ecology & Evolutionary Biology, Yale University) <ul style="list-style-type: none"> • Genetic and culture mechanisms of aesthetic evolution
4:50 - 5:20 pm	Rachel Mundy (Music, Rutgers University-Newark) <ul style="list-style-type: none"> • Hearing scores, seeing songs, and making animal knowledge
5:20 - 5:50 pm	David Rothenberg (Philosophy and Music, New Jersey Institute of Technology) <ul style="list-style-type: none"> • Nightingales in Berlin: Humans and birds transmitting songs in a sonic city
5:50 - 6:05 pm	Respondent: Brian Boyd (Anthropology, Columbia University)
6:05 - 6:30 pm	Panel discussion
6:30 - 8:00 pm	<i>Reception</i>

JAMES CAHILL

Using comparative genomics to identify targets of natural selection in vocal learning birds

Vocal learning, the ability to mimic sounds from conspecifics and the environment, is a key component of speech shared between humans and a limited number of non-human groups including: oscine songbirds, parrots and hummingbirds, each thought to have evolved the trait independently. These species exhibit substantial vocal learning related convergence, suggesting the existence of shared underlying molecular pathways. The Jarvis lab is exploring multiple avenues of study: gene expression, epigenetics, comparative genomics and improved genome sequencing to identify the key mechanisms underlying vocal learning in birds and mammals. I will discuss these approaches generally as well as provide a more focused discussion of my work identifying accelerated DNA sequence evolution, a marker of positive selection, in avian vocal learning lineages.

IAN CROSS

The cultural transmission of patterns of interaction: The case of music

This presentation will suggest that music is most informatively explored, and best understood, as an interactive, communicative medium rather than as an aurally consumable commodity. It explores the properties of music and language as interactive media, discussing the ways in which they have been considered to be distinct capacities. It reviews the theoretical and empirical literature on human interaction, drawing on this to frame and to elaborate the idea of a relational dimension to communication that underpins both music and speech. It proposes that music and speech are functionally- and culturally-differentiable components of the human communicative toolkit, and shows how research has increasingly demonstrated significant overlaps between the two in respect of the neural, cognitive and behavioural resources upon which they draw. I shall thus be arguing that music is not cleanly dissociable from speech, that it is best identified in terms of its social functionality, and that its transmission is thus best understood together with that of speech in terms of the transmission of particular configurations of communicative resources.

EMILY DOOLITTLE

Thirteen ways of listening to a hermit thrush

The hermit thrush (*Catharus guttatus*) is a small North American songbird widely celebrated for its “musical” song. In this talk I’ll be examining the history of how people from a variety of fields, including poetry, musicology, musical composition, nature writing, and biology have heard, understood, and represented this song. Each approach offers valuable perspectives, but it is through combining approaches that we can understand hermit thrush song most deeply.

OLGA FEHÉR

How communication systems are shaped by interaction and transmission

Communication systems have been created and are constantly shaped by their users. This is not only true to human language, which is uniquely complex and expressive among the communication systems of the animal world, but also to other socially learned systems, such as birdsong. The processes of individual learning, social interaction and cross-generational cultural transmission mediate the relationship between the cognitive makeup of users and the structural features of communication systems. I study these processes in a comparative framework using atypical languages and songs, and observing how learners respond as they acquire abnormal input and use it to communicate. While learning, interaction and transmission all amplify learners’ biases, leading

to the emergence of species-typical features, each seem to favour different aspects of the system, exerting sometimes opposing forces on the way these features evolve.

MOLLY FLAHERTY

The emergence of grammatical structure in a new language: Marking who did what to whom in Nicaraguan Sign Language

In this talk, I will discuss the emergence of linguistic structure in one of the youngest languages known to science: Nicaraguan Sign Language. I will begin by discussing how syntactic structure grows in homesign (manual communication systems created by isolated deaf individuals) and NSL by tracking the emergence of devices to mark who did what to whom (argument structure). I find that the emergence of argument structure marking is neither instantaneous nor monolithic: some devices can be created by individual learners: homesigners and NSL signers of all generations employ these devices. Other markers show up only later with the addition of the language community and iterated transmission/learning of the language system. Using the example of NSL, I will discuss how the shape of this new language, and indeed all language, derives from human learning, transmission, and use.

TOM GRIFFITHS

Modeling the effects of learning and memory on culture

As information passes from person to person it changes form—some things are lost, other things are added. Using mathematical models of human learning and memory, we can try to characterize the changes that result from the process of cultural transmission. I will summarize results from modeling the impact of learning and memory on simple transmission chains and on processes such as technological innovation. These mathematical analyses suggest that the biases that are characteristic of human learning and memory should have a significant impact on the objects produced by cultural transmission and can constrain technological innovation to those technologies that we find least counter-intuitive.

GARY LUPYAN

Iconicity and the origin of words

It has been taken as self-evident that knowing what a word sounds like offers little hint to its meaning. New research has upended this dogma, revealing languages to have an abundance of iconic, or motivated, relationships between forms and meanings. I will present several experiments showing the surprising ability of people to invent vocalizations that are understandable by others, and the ways that vocalizations transform as they are passed down from person to person. Recognizing the iconic potential of spoken language, and the apparent benefit of iconicity, raises the question of why languages are not even more iconic. I will offer a speculative answer to this question which touches on the cognitive function of natural language.

EDUARDO MERCADO III

Song morphing by humpback whales: Cultural transmission or strategic coordination?

Singing humpback whales collectively and progressively change the sounds and patterns within their songs throughout their lives. The dynamic modifications that humpback whales make to their songs are often cited as an impressive example of cultural transmission through vocal learning in a non-human. Some qualities of song change challenge this interpretation, however, including: (1) singers

often temporally warp patterns they have used for more than a year; (2) complex sound patterns recur across years and populations; (3) every five to six years, song structure rapidly destabilizes and then gradually becomes more stable again; (4) acoustically isolated subpopulations singing similar songs morph their songs in similar ways. These anomalies suggest that singing humpback whales may be modulating song features to avoid mutual interference rather than copying novel song features to compete for mates.

JULIEN MEYER

Natural whistled and instrumental forms of speech: Transmission and insight into the music-language relation

Human language, in its acoustic form, has the flexibility to be emitted in very different ways according to the contexts of communication. Spoken, whispered, sung, shouted are the most common and universal ones. At the same time, around the world, several languages are also expressed through other special and complementary natural speech registers which are particularly adapted to long distance communication by transforming speech into either modulated whistles (whistled speech) or drummed series of beats (drummed speech). Several cultures also developed ways to sing lyrics directly with musical instruments, without the use of the human voice. The transmission of these fascinating and often endangered traditional speech forms will be here explored based on examples taken from my fieldwork experience and some behavioral tests. We will also see that, taken together, these special speech forms provide an original insight into the long discussed music-language relation.

ADELIN MUELLER

Who's teaching whom?: Rehearsing familial devotion in late eighteenth-century German songs for parents and children

With the rise of educational and parenting reform movements in late eighteenth-century Germany came a burgeoning market in print media aimed at families, educators, and children. Poems, plays, dialogues, riddles, songs, stories, and non-fiction content—often anthologized in periodicals or annual digests—helped promote norms around filial virtue, productivity, and obedience. But the “disciplining” going on in this literature was as much emotional as it was moral. Unlike earlier traditions of didactic theater, printed children’s fiction introduced more and more melodramatic plots: abandonment and reunion, poverty and death featured prominently, allowing for tenderness and affection to be role-played in the family drawing room (Wild 1987). The songs that accompanied or illustrated such moments of extreme joy or pathos constituted, for the first time, a shared repertoire between young and old, one that might even find parents and children singing together at the same time, or trading verses one after the other as in strophic songs. Duets for brothers and sisters or parents and children—with such prescriptive titles as “Brotherly Harmony” and “Exhortation to Two Children”—thus habituated mothers and fathers to the new culture of sentimental, devoted parenthood, while at the same time new printed collections of lullabies intervened in the earliest and most intimate musical exchanges between parents and infants (Dettmar 2002, Gramit 2002). In exploring songs for family members to sing together, I seek to uncover the reciprocal learning implied in text, music, and the act of performance itself, as adults and children alike rehearsed the insular, emotionally bonded elementary family.

RACHEL MUNDY

Hearing scores, seeing songs, and making animal knowledge

How do the songs of animals help us think broadly about evidence? In this talk I examine the way that graphs and musical notation were used in two divergent traditions of evidence throughout the twentieth century: the study of human song cultures, and the study of animal songs. By turning to the historical role of sound visualization technologies in the music hall and the laboratory, I will suggest that the creation of musical knowledge today is tied to a much broader history of constructing scientific data through notions of difference, particularly notions of species difference. Although the touchstone of my talk is a particular case of musical “vivisection” in Berlin of the 1920s, I want to raise much broader questions about musical and scientific traditions of knowledge-making, and the voices and bodies of animals that lie between them.

RICHARD PRUM

Genetic and culture mechanisms of aesthetic evolution

Aesthetic evolution is an emergent consequence of sensory perception, cognitive evaluation, and choice. The results of aesthetic evolution are components of the phenotype that do not function mechanically or physically in the environment. Rather they function through the perceptions and cognitive evaluations of other individuals. Consequently, aesthetic evolution inevitably involves *coevolution* of the signal and the receiver—the display and the preference for it. Aesthetic evolution may proceed by natural or sexual selection, but it always involves the action of sexual, social, or ecological preferences. In a few lineages of animals, aesthetic evolution proceeds by a combination of genetic and cultural mechanisms. Although non-human cultures sometimes involve non-aesthetic elements (e.g. tool construction in New Caledonian Crows), the most elaborate and diverse examples involve the evolution by aesthetic sexual selection. Investigation and analysis of cultural evolution in bird song and whale song should be informed by the fundamentally aesthetic nature of these modes of communication.

ANDREA RAVIGNANI

Vocal learning, chorusing seal pups, and the evolution of rhythm

Musical rhythm, beyond its variety, exhibits cross-cultural similarities and statistical universals. Testing the mechanisms underlying these universals, I will show human experiments where rhythm is created and evolves culturally due to cognitive and motoric biases. Musical behaviors can also be found in other species. I will suggest how comparative animal experiments can help reconstruct early hominid musicality. In particular, I will present ongoing work on rhythm and vocal learning in seal pups.

DAVID ROTHENBERG

Nightingales in Berlin: Humans and birds transmitting songs in a sonic city

In this talk David Rothenberg will explain his rationale for making music live with birds, and how this project crosses the disciplines of music and birdsong neuroscience. Why do nightingales sing so much and so intensely? Is this an example of the aesthetic selection suggested by Darwin, ignored for a century, and resuscitated by Richard Prum?

JON T. SAKATA

Motor contributions to vocal learning biases and their implications for the cultural evolution of communication

Songbirds like the zebra finch are an excellent model system to reveal mechanisms underlying vocal learning, including biases and constraints on vocal learning. Given that the cultural evolution of behaviors such as communication relies on learning mechanisms and that biological processes shape the nature and trajectory of cultural evolution, songbirds are also a powerful model system to elucidate biological mechanisms that influence the cultural evolution of vocal communication. I will discuss our experiments investigating how vocal motor systems can bias song learning and, thus, the cultural evolution of song. I will summarize our experiments demonstrating: (1) that zebra finches learn to produce biased vocal patterns in response to hearing unbiased and random patterns of inputs and (2) that predispositions in vocal patterning could contribute to this learning bias. These findings complement studies in humans revealing motor contributions to speech and music production and processing.

KENNY SMITH

How learning and interaction create, maintain, and destroy linguistic structure

Human languages are culturally-transmitted systems, which persist in populations via a repeated cycle of learning and use, where learners learn from linguistic data which represents the communicative behaviour of other individuals who learnt their language in the same way. Languages evolve as a result of this cycle of learning and use, and are therefore the product of a potentially complex interplay between the biases of human language learners, the communicative functions which language serves, and the ways in which languages are transmitted in populations. In this talk I will present a series of experiments, based around artificial language learning, dyadic interaction and iterated learning paradigms, which allow us to explore the relationship between learning and use in shaping linguistic structure. I'll summarise some of our older work showing how and when linguistic structure is created through this process, then present some recent work using these techniques to test hypotheses about the mechanisms linking population demographics and linguistic complexity, in particular exploring why it might be the case that languages spoken in larger populations are relatively simple.

JORDAN SUCHOW

Scaling up experimental simulations of culture

As experiments in the behavioral and social sciences move from brick-and-mortar laboratories to the web, new opportunities emerge in the design of experiments. One such opportunity is to go beyond the transmission chain to simulate more complex evolutionary dynamics of culture. Another such opportunity is to interpolate between human- and agent-based simulations of culture by studying "bionic" agents where some, but not all decision making is offloaded to a human participant. In this talk, I discuss these opportunities and the development of crowdsourcing technologies to realize them.

OFER TCHERNICHOVSKI, SOPHIE EISENBERG-EDIDIN, AND ERICH D. JARVIS

Stability of polymorphic song culture in the zebra finch

Zebra finch song syllables are highly stereotyped within a bird and highly diverse across birds, even within a colony. This diversity persists despite a fairly accurate imitation of song syllables from one

generation to the next. Even if the imitation of syllable types were random, 'genetic drift' should have pruned variability in each generation. Further, some syllable types are copied much more often than others, which should have resulted in a rapid collapse of song repertoire across generations. Here, we generated a song library database of a colony of about 1300 birds at the Rockefeller University Field Research Center, which we mined to analyze song imitation statistics across generations. We found that the mechanism that maintains polymorphism in song culture is a stabilizing, negative frequency dependent, selection of song features during imitation.

GARY TOMLINSON

The emergence of cultural complexity: The case of late hominins

This talk will present a model of the distinctive mechanisms by which modern human capacities emerged over the last 200,000 years or so. The mechanisms involve the accumulation of cultural archives, their systematization, and the consequences of these in forming novel dynamics of biocultural niche construction. These distinctive features, in specifying exceptional conditions of possibility for the evolution of late hominin sociality, help to formulate meaningful versions of the question of how far beyond humans we might expect to find similar evolutionary dynamics at work.

TESSA VERHOEF

Cultural transmission and the emergence of structure in whistle sounds

I will discuss data from an experiment in which artificial whistled languages (produced with slide whistles) were transmitted in the lab. A set of whistled signals needed to be memorized and recalled and the reproductions of one participant were used as the input set for the next. After ten transmissions, combinatorial structure spontaneously emerged in the sets of whistles. The set of basic sound primitives was reduced and these primitives were more extensively reused and combined in a predictable way, yielding a more compressible system. Such an efficient combinatorial structure is one of the basic features of linguistic systems, but is also present in artistic systems such as music and dance. To explore whether cultural transmission can also explain universal patterns in music, we take a new look at this data in the context of the evolution of melodic structure.

HEATHER WILLIAMS

Cultural evolution in the songs of Savannah sparrows

Young Savannah sparrow males learn their songs from adults, and in doing so may introduce innovations or recombine elements copied from several singers. Within a population, some song elements are consistent over time, some vary between individuals, and others change across generations. Frequency-biased copying as well as drift and cultural selection underlie these changes to a socially learned behavior, and new features may build on previous changes to form a cumulative song culture.