

# Minds, Mechanisms and Interaction in the Evolution of Language

Thursday, September 21st

9:00-9:30

Introduction by Stephen Levinson

9:30-10:30

Plenary Talk: David Leavens

***The Referential Problem Space: Ecological Determinants of Nonverbal Reference***

Nonverbal reference is the ability to pick out a common focus of attention between two or more interactants. For decades, cognitive scientists took the view that this capability was the product of evolutionary selection, unique to the human lineage among primates, and a developmental precursor to verbal reference. Pointing is the quintessential example of nonverbal reference. Despite sporadic reports of pointing by great apes dating back more than a century, pointing has been interpreted as a developmental index of a maturing, innate capacity for the meeting of minds in our species. With the many demonstrations of pointing by great apes in experimentally controlled conditions, it is now unambiguously clear that apes in captivity do frequently point, without any explicit training, and despite not having a selective history for linguistic communication. Yet reports of pointing by wild apes are vanishingly rare. Thus, among humans' nearest living relatives, pointing emerges in some ecological contexts, but not in others, demonstrating its sensitivity to environmental input. Recently, some have argued that some kinds of pointing, but not others, implicate mental state awareness in humans as young as 12 months of age. I will critique this perspective on methodological and logical grounds. In my view, while pointing reveals a great deal about researchers' biases and theoretical commitments, it is mute as to its psychological underpinnings. Finally, I will discuss the ramifications of ape pointing as a pre-adaptation for human language.

10:30-11:00

Coffee Break

11:00-12:00

Session 1: Biases I

11:00-11:30

Piera Filippi

***Biological universals in voice modulation across terrestrial vertebrates: a comparative approach to the study of language evolution***

A central aspect of animal vocal communication is the ability to recognize emotional state or body size of signalers based on the perception of the signaler's tone of voice. I will report on recent empirical data on humans, suggesting that prosodic modulation of the voice is evolutionarily older than the emergence of segmental articulation and might have paved the way to its origins. Within this framework, I will emphasize the key role of the interactional value of voice modulation in relation to the evolution and ontogenetic development of language. Finally, implications for the study of the cognitive relationship between linguistic prosody and the ability for music, which has often been identified as the evolutionary precursor of language, will be discussed.

11:30-12:00

**Marcus Perlman**

***Laryngeal air sacs, silverback chest beating displays, and the evolution of speech***

The great apes – but not humans – all possess laryngeal air sacs, indicating that these were lost sometime over hominin evolution. Understanding why human ancestors lost their air sacs may provide clues to the evolution of speech. However, little is known about their function in extant great apes. In this talk, I explore the hypothesis that gorillas use their laryngeal air sacs to produce the staccato ‘growling’ sound of the male chest beating display, as well as other similar sounding ‘whinny’ vocalizations. These vocalizations are predominantly, but not exclusively, produced by males. I propose that great apes use their air sacs for vocalizations and displays related to size exaggeration for sex and territory. Thus, changes in social structure, mating, and sexual dimorphism, rather than evolutionary pressures directly related to the advent of speech, may have led to the obsolescence of the air sacs and their loss in hominin evolution.

12:00-13:00

**Lunch**

13:00-14:00

**Session 2: Biases II**

13:00-13:30

**Andrea Ravignani**

***The evolution of musical rhythm between biology and culture***

Musical rhythm, beyond its variety, exhibits cross-cultural similarities and statistical universals. Testing the mechanisms underlying these universals, I will show human experiments where musical rhythm is created and evolves culturally due to cognitive and motoric biases. I will also suggest how comparative animal experiments can help reconstruct early hominid musicality.

13:30-14:00

**Bill Thompson**

***Cross-linguistic Biases in Lexical Semantics***

Words carve up human experience into richly structured categories of events, objects, relationships, emotions, and ideas. Categories like these subserve human communication and interaction, but it has long been unclear how similar these categories are for speakers of different languages. Recent progress in applied machine learning and artificial intelligence has resulted in large scale machine-readable semantic networks across many languages. I'll present an analysis of typological patterns in lexical semantics, focusing on the structure and distribution of iconicity ratings and other norms across modern languages. More generally, I'll discuss how emerging methods at the intersection of machine learning and psycholinguistics can illuminate the generative process for vocabularies, or the evolution of words.

14:00-15:00

**Plenary Talk: Monica Tamariz**

***Biased and unbiased transmission in language evolution***

An overarching goal of evolutionary studies is to explain the patterns of diversity observed in a system such as life or culture. As a cultural behaviour, language is embedded in three evolutionary systems: genetic, social and ecological (Laland et al.

2000). Focusing on the social level, I will give a view of how cultural evolutionary theory explains the extraordinary stability and variation of language. I separate two components of transmission that are often conflated in the literature. First, unbiased, high-fidelity transmission (inheritance) mechanisms such as imitation, overimitation (Whiten et al. 2016) and pedagogy (Kline 2015) achieve continuity, which is manifested in long lineages of linguistic elements, such as words and speech sounds (e.g. Pagel 2009). Second, biased transmission (selection) mechanisms that can be classed as guided variation, or content-, model- and frequency-based biases (Richerson & Boyd 2005) result in the patterns of diversity observed in world languages. In the second part of the talk I will look at the contribution of each of those two processes in iterated learning experiments and their results --compressible, expressive systems-- to chart what we know about the cultural transmission of language and to identify questions that still need to be addressed.

15:00-15:30

**Coffee Break**

15:30-17:30

**Session 3: Mechanisms of Transmission**

15:30-16:00

**Kevin Stadler**

***Cultural evolution mechanisms obscure the mapping from individual biases to cross-cultural distributions***

Many recent experimental results in the domain of language have shown how individual biases map neatly onto the cross-cultural distribution of linguistic traits such as basic sentence word order patterns. While the match between the micro- and macro-levels is striking, these biases are intriguingly not reflected in the dynamic processes through which conventions spread across speech communities: longitudinal sociolinguistic studies show time and time again that innovations are selected based on arbitrary social grounds that are completely orthogonal to the supposedly adaptive character of the innovations. In this talk I will try to shed light on the individual-to-population-level link by studying a modification of the Wright-Fisher model from population genetics augmented by a mechanism particular to cultural evolution, namely individuals' ability to track and amplify trends. I demonstrate how the addition of such a 'regulatory trait' can radically alter the relative contribution of innovation and selection biases, thus complicating the matter of inferring any such biases from patterns observed in cross-cultural samples.

16:00-16:30

**Alan Nielsen**

***Modelling the typological realisation of cognitive biases***

Humans are not unbiased learners: features of their perceptuocognitive organisation produce an inclination to prefer certain associations. For example, most people associate high pitched sounds with small, bright, or spiky objects. How do biases like these shape the words of a language? Recent typological evidence has established numerous cross-linguistic regularities (Blasi et al., 2016): for example, words meaning 'nose' contain a higher-than-expected proportion of nasal sounds, and individuals have shown to be biased towards this type of mapping. Nonetheless, only one third of the languages surveyed have nasals in their words for nose – why is this the case? Why isn't the alignment between bias and language structure perfect? Here we

present computational simulations of this dynamic in populations of pervasively biased Bayesian learners transmitting a vocabulary culturally. These simulations allow us to explore the implications for making inferences from typology to cognition, and vice versa. We show that the transmission of cultural traits among learners with multiple, potentially overlapping, biases leads to locally optimal solutions where languages differ: despite their agents sharing biases, no individual language can satisfy all biases at a given time.

16:30-17:00

Hannah Little

***Biases born from modality affect the emergence of linguistic structure***

What did structure in language originally look like? In this talk, I consider how linguistic modality (speech or sign) affects the emergence of structure in language. I argue, with evidence from experimental studies, that modality affects whether combinatorial (phonological) or compositional (syntactic) structure emerged first. If a modality allows for many thousands of holistic signals (as is possible using the manual modality), then a system is likely to adopt compositional structure first, as in emerging signed languages. If, on the other hand, a modality is a lot more restrictive in the number of distinct signals it can produce, then combinatorial structure will become necessary a lot more quickly to aid discrimination. I will briefly link this to the abilities of animals and structure in animal communication systems. The flexibility of the modality the animals (or humans) are using to communicate must be considered before attributing structure to cognitive abilities.

17:00-17:30

Yasamin Motamedi

***The cultural evolution of language: evidence from artificial sign language learning***

The vast time-scale of language evolution in natural languages, as well as the difficulty in obtaining constrained and comparable data sets have led to the development of experimental paradigms that attempt to address questions concerning language evolution in a controlled and manipulable way (Kirby et al., 2015; Fay et al., 2010). Taking motivations from natural language data, experimental research has sought to understand the cultural mechanisms that drive language evolution, namely interaction between language users and transmission of a language to new users. I present an expansion of previous experimental paradigms that attempt to further understand the roles that interaction and transmission play in the evolution of systematic linguistic structure. This nascent experimental framework, artificial sign language learning, aims to bridge the gap between the laboratory and linguistic field research by providing a manipulable comparison to some of the only currently emerging linguistic systems: emerging sign languages. I present a set of artificial sign language learning experiments that assesses the roles of interaction and transmission in novel sign systems, and how these mechanisms facilitate the systematisation of both simple and complex linguistic constructions.

17:30-18:30

Borrel and Poster Session

Friday, September 22nd

9:00-10:00

Plenary Talk: Jennie Pyers

***Social-cognitive forces in the emergence of language: perspectives from an emerging sign language***

A central question of language emergence asks what are the circumstances that affect how members of a community build a communication system and shape its change over time. The emergence of a sign language in Nicaragua allows us to uniquely consider the effects of the changing cognitive abilities of the community on the trajectory of linguistic change in Nicaraguan Sign Language (NSL). The deaf creators of NSL had no exposure to another language, and thus had experienced years of language deprivation before their circumstances afforded an opportunity to build a shared, accessible communication system with others. The early language deprivation as well as the limitations of the initial form of NSL had cognitive consequences for the first cohort of creators of NSL: reasoning about number, space, and theory of mind lagged far behind age-typical performance. Yet as NSL grew more complex, a new cohort of child learners began to surpass their elders in these cognitive abilities as a direct result of key changes in the language. Here, I extend this previous work by considering how the changing cognitive abilities of new cohorts of NSL signers in turn shaped the emergence of NSL. Specifically, I bring together several findings to identify how differences in the social-cognitive abilities of older and younger signers systematically align with structural changes in NSL over time. I argue that our understanding of language emergence must include the cognitive skills of both the language creators and the language learners.

10:00-10:30

Coffee Break

10:30-12:30

Session 4: Interaction

10:30-11:00

Sean Roberts

***Language adapts to interaction***

In Croft's model of language evolution, phrases are replicators and the individual speaker is a 'vehicle' which causes the replicator to replicate (Croft, 2000). However, this omits an intermediate level: turns at talk in interaction. The interactional sequence in which a form is used can be a better predictor of selection than the form's frequency (Buyn et al, in prep). Repair sequences can be loci of selection (e.g. Micklos, 2016) and can lead to better communication (Mills & Redeker, 2016; Macuch Silva et al., 2017). Individuals often do not innovate effective solutions in communication (Verhoef et al., 2015; Sulik & Lupyan, 2016) but are better at recognising and adopting them (Tamariz et al., 2017). Therefore, I'll argue that conversational sequences are also vehicles and that cultural evolution proceeds by random innovation at the individual level and biased selection at the interactional level.

11:00-11:30

Ashley Micklos

***Considering the effects of interaction on language evolution: Repair as a mechanism for conventionalization***

When approaching questions of language evolution, it is crucial to keep in mind the natural ecology of language and communication: among individuals interacting face-to-face. There are a variety of foundational features that underpin communication in interaction, one of which is repair. Repair is a strategy in which misalignment is negotiated and resolved: a critical aspect to achieving form-meaning matches in an evolutionary context. Here we consider how repair is performed in experimental paradigms of language evolution, and what the consequences are for using it in terms of communicative success and efficiency. We will consider different modalities used in studies of language evolution - including vocalizations, gesture, drawings, and text - to determine the affordances that each modality provides for doing repair. Detailing the effects of different repair strategies on the emerging communication systems, we can observe which repair initiation-solution matchings might be most effective in establishing conventions.

11:30-12:00

Connie de Vos

***Turn-timing in sign language emergence***

Social interaction is the primary ecological niche for languages to evolve and to emerge. Looking at such settings in sign language emergence enables us to study the selection pressures involved in vivo. Spontaneous conversation is remarkably rapid across typologically diverse spoken languages as well as the Sign Language of the Netherlands (NGT) with most turns timed ~200ms after the prior (Stivers et al. 2009; de Vos et al. 2015). This study investigates whether the time pressure of turn-taking remains constant across language emergence by looking at the three most recent generations of the emerging sign language Kata Kolok (KK). Initial analyses indicate that NGT (Mean = 307, Mode = 227, N= 210) and KK (Mean = 261, Mode = 230, N =22) are strikingly similar in terms of turn-timing when all generations are grouped together. Further analyses are focused on comparing the different generations of KK signers to age-matched NGT signers to identify intergenerational, rather than age-related differences.

12:00-12:30

Justin Sulik

***Creativity and copying: the division of labor in cultural evolution***

Humans are a creative species. When we don't share a language with someone, we can often create a novel gesture to get our point across, and when we encounter a surprising fact, we can often create a plausible explanation of that fact. However, we are also a cultural species. Instead of creating something new, we can often simply copy a successful strategy from someone else. Indeed, a main benefit of having culture is that we don't need to constantly reinvent the wheel (or communicative signal, or explanation). I show experimentally that people are relatively consistent when evaluating cultural products like words or explanations, but that there is greater variation in people's ability to generate the same products. I identify some of the cognitive mechanisms that distinguish cultural innovators, and show that a division of

cognitive labor is required for the cultural evolution of informative signals or satisfying explanations.

**12:30-14:00**

**Lunch**

**14:00-15:00**

**Break-out Discussion Sessions**

**15:00-15:30**

**Coffee**

**15:30-16:30**

**Break-out Discussion Sessions**

**16:30-17:00**

**Closing**