

Book of Abstracts

Protolang 5

Barcelona, September 26–28

Protolang 5. Barcelona, September 26–28, 2017

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Welcome address

Dear participant,

We are pleased to offer you an exciting program, made up of 3 invited presentations, 29 talks, and 20 posters. We very much look forward to 3 days of intense discussions around the topic of language evolution and its many dimensions. In addition to your own contributions, we want to thank the Universitat de Barcelona, and the Spanish Ministry of Economy and Competitiveness (project FFI2016-78034-C2-1-P) for this financial support.

Barcelona, September 26, 2017

Cedric Boeckx
Pedro Tiago Martins
Constantina Theofanopoulou
Saleh Alamri
Thomas O'Rourke

(The Protolang 5 organizers)

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Keynote Speakers

Sep 26 **Understanding the neurogenetics of spoken language: from vocal**
Day 1 **learning bats to humans**
9:30

Sonja Vernes

Max Planck Institute for Psycholinguistics
sonja.vernes@mpi.nl

Sep 26 **How communication systems are shaped by interaction and**
Day 1 **transmission**
18:30

Olga Feher

University of Warwick
o.feher@warwick.ac.uk

Sep 27 **A look through the genomic binocular: Population history,**
Day 2 **migration and adaptation in humans (and their relatives)**
9:00

Martin Kuhlwilm

Institute for Evolutionary Biology (CSIC/UPF)
martin.kuhlwilm@upf.edu

Talks

The role of asymmetric alignment in linguistic simplification

Kenny Smith^{1*}, Mark Atkinson², Simon Kirby¹ and Olga Feher¹

¹University of Edinburgh

²University of Stirling

*kenny.smith@ed.ac.uk

Human languages differ in their complexity, and those differences correlate with social structure: languages spoken in small groups exhibit more irregularity, less transparency, and greater levels of redundancy; languages spoken in larger, more complex groups tend to be simpler, more regular and more transparently compositional. Understanding the mechanism linking social structure to linguistic complexity would allow us to uncover the likely characteristics of the earliest languages.

Adult learners (who form a larger proportion of complex social groups) have difficulty in acquiring morphological complexity, and are often identified as drivers of linguistic simplification. But how do the simplifications these learners make influence the complexity of whole languages? We present two experiments using artificial language learning to test the hypothesis that alignment during interaction (the process by which speakers adapt to interlocutors) is inherently asymmetric: speakers of more complex languages adapt to the simpler language of their interlocutor. Asymmetric alignment provides a mechanism by which simplifications made by a small number of individuals can spread through a population.

In Experiment 1 we trained pairs of participants on miniature languages which featured a (potentially) variable grammatical marker, and then had them use that language to communicate with each other. One participant in each pair was trained on a relatively complex language in which multiple markers fulfilled a single grammatical function; their partner was trained on a simpler, categorical system featuring a single marker. Results were consistent with asymmetric alignment: variably-trained participants accommodated to their categorically-trained partners, who did not change their behaviour. Furthermore, these effects outlasted the interaction: variably-trained participants did not fully return to their complex pre-interaction behaviour.

In Experiment 2, we tested asymmetric alignment in morphology. One participant in each pair was trained on a paradigm featuring irregular forms, while their partner was trained only on the regular part of the paradigm. During interaction the participant trained on the more complex language accommodated to their partner, avoiding irregulars and producing over-regularizations instead; again, these simplifications persisted beyond the interaction.

These experiments show how a small number of individuals can have a disproportionate effect on the complexity of a language: simplifications spread because individuals with more complex language ‘accommodate down’ during interaction, and remain simpler afterwards. This work shows how experimental techniques can be used to test hypotheses about the link between social structure and linguistic complexity, and therefore offer insights into the likely structural features of the earliest languages.

Keywords: linguistic complexity, interaction, alignment, artificial language learning

The cultural evolution of communicative conventions: Interactions between population dynamics and cognitive biases

Sep 26
Day 1
14:30

Monica Tamariz^{1*} and Jose Segovia Martin²

¹Heriot Watt University

²The University of Edinburgh

*monicatamariz@gmail.com

Languages work because speakers in a community share a set of linguistic conventions. Several factors affect the spread of conventions in populations: some relate to the structure of the population (e.g. Lupyan and Dale, 2010); others, to cognitive biases that affect the individual's likelihood of adopting a given variant (content-, frequency- and model-based; Boyd and Richerson 1988). We investigate the effects of population dynamics and cognitive biases on variant spread. We ran computer simulations of signal spread in microsocieties of 8 agents who communicate in pairs. At round 0, each produces its own unique variant signal; in successive rounds, agents switch partners, and each agent may produce their original variant or switch to a variant produced by one of their partners (Tamariz et al., 2014). Because some variants disappear while others spread to multiple agents, the entropy of the variant set always decreases. We measured the speed of entropy decline and the net variant production of each agent.

We systematically manipulated:

- a) Initial isolation of subpopulations: members from two halves of the population are not paired with each other for the first round (low isolation), 2 rounds (medium) or 3 rounds (high).
- b) Content bias: no bias to strong preference for a variant.
- c) Coordination biases: form full (egocentric) preference for one's own variants to full (allocentric) preference for others' variants.

Results include: In high isolation populations (Fig. 1: each dot represents a population), entropy decreases more slowly (slower evolution). Differences are greatest at generation 2, when isolation differences are felt: each agent in low-isolation populations has had direct or indirect access to productions from all 8 agents; in medium, from 6; in high, from 4.

Content bias accelerates the spread of the biased variant. Moreover, this bias amplifies the differences between isolation population types.

Coordination bias also tends to slow down evolution (Fig. 2). Entropy decreases over rounds in all cases. With allocentric bias, entropy values are slightly higher; with egocentric bias, they are much higher (little evolution when agents stick to their own variants).

Furthermore, we describe simple rules explaining the effects of population dynamics on signal production.

This model reveals how complex interactions between cognitive biases and population dynamics shape the evolution of communicative variants as they spread in populations.

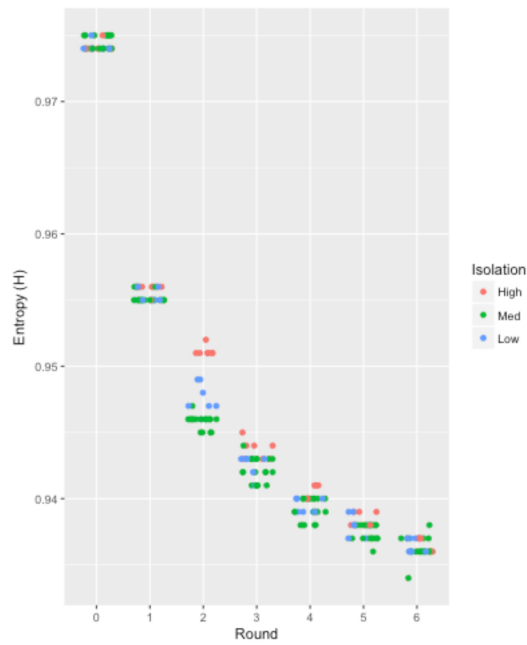


Figure 1: Subpopulation isolation

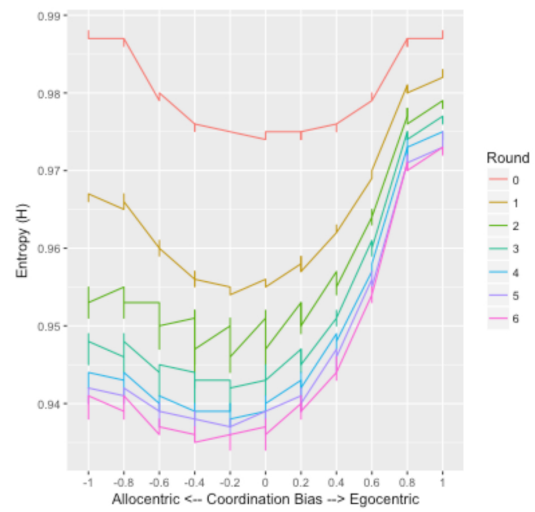


Figure 2: Coordination bias

Keywords: population structure, content bias, coordination bias, spread of variants, communication

Children vs. the cultural evolution of language – an experimental communicative iterated learning study

Sep 26
Day 1
12:30

Katarzyna Rogalska-Chodecka

Nicolaus Copernicus University

kasia.rogalska@outlook.com

The methodology of iterated learning has recently become one of the most valuable insights into the transmission of linguistic structures and the consequent evolution of the linguistic code. Basing on a simple “alien fruit” experiment originated by Kirby and his collaborators (e.g. 2008), it is possible to overcome the most commonly held accusation against evolutionary linguistics, namely that as languages do not fossilise, they cannot be studied empirically (e.g. Fitch, 2000, 262). The process of emergence and development of an experimental mini-language can be observed within just several hours. Replicating the original experiment with adults, data that point to stored-language bias in the emergent mini-language were obtained. Therefore, in order to limit the linguistic bias in the experiments with human agents, a similar experiment with children under 8 years of age was performed. Moreover, they were allowed to communicate within groups of three, to control one another if native language bias occurred. The results show that the design involving interaction and children as agents provides the best conditions for observing mini-languages evolve through the iterated learning methodology. The participants were encouraged to discuss all the options to fulfil their task correctly and were not time-limited. The evolving mini-languages were not based on or very similar to entrenched linguistic structures; consequently, hopes can be pinned on further development of the methodology with children as agents. Their linguistic bias is not as strong as in adults, and, being in the critical period for language learning, the learnability level they achieve is incomparable to that of adults.

Keywords: cultural evolution of language, iterated learning, experiments with children, critical period

Emergence of Grounded Compositional Action Language

Michael Spranger

Sony Computer Science Laboratories Inc.

michael.spranger@gmail.com

Evolution of compositional language versus holistic encodings has long been an important research topic in the emergence of language (De Beule and Bergen, 2006; Spranger, 2012). Models have shown that compositionality arises when the number of meanings is much larger than the size of the form space (e.g. available vocabulary or if there is a specific cost associated with utterances). Many of the models proposed rely heavily on complex symbolic machinery that have a compositional strategy implicitly coded as a strategy that can be selected but do not show how compositionality arises through general principles as a strategy itself. Similarly only few models (Vogt, 2005; Spranger, 2011; Mordatch and Abbeel, 2017) actually show how compositionality might emerge directly in sensorimotor spaces.

This talk addresses the issue of compositionality by proposing an experimental setup and experiments where agents try to achieve joint tasks (such as performing a particular action) through exchanging utterances as well as performing other acts. The environment consists of a number of agents and objects with certain continuous valued features such as shape, color and spatial position. Agents can move in the environment and can also use gaze to focus on particular objects. Actions in this environment are actions on objects such as “look-at”, “touch”, but also agent-agent interactions such as “kiss”. The setup allows to test and evaluate various algorithms and mechanisms for solving the task using an evolving language. We propose to frame this problem as a reinforcement learning problem solved by policy optimization and a particular combination of representations based on multi-layer perceptrons and long-term short term memory which are optimized end-to-end using backpropagation through time.

Our experiments show that agents develop compositional language when faced with large action spaces and restricted communication channel sizes. The same agent representation can account for multiple outcomes in different experimental setups — in some cases compositional language, in others more holistic languages evolve. We also see the emergence of non-utterance based communication such as the use of gaze for achieving the same tasks when gaze is observable and action spaces are small. These results show that powerful connectionist representations are capable of giving rise to different types of languages without explicit models of strategies and or explicit interaction scripts.

Keywords: compositionality, language emergence, connectionist models, reinforcement learning

The biological foundations of the language and music capacity: quest for uniqueness?

Sep 27
Day 2
12:30

Uwe Seifert and Rie Asano

Department of Systematic Musicology, University of Cologne
u.seifert@uni-koeln.de | rie.asano@uni-koeln.de

In his influential book *Biological Foundations of Language* (1967), Lenneberg suggested the existence of “a biological matrix with specifiable characteristics” (p. 394) for each cognitive capacity. Although Berwick and Chomsky (2016) claim—referring to Lenneberg’s work under pointing out how it has been extended (Curtiss, 2012)—that biological specificity of the language capacity is now well established, we think that current research on the music capacity indicates that the relationship between language and music capacities needs to be clarified at the cognitive as well the neural level. In our talk, we discuss the relationship between those two capacities on the basis of current theoretical as well as empirical findings. The results suggest that intriguing similarities and important differences exist at the same time on several representational levels: temporal integration, i.e. projecting domain-specific hierarchical structures onto temporally linearly ordered structures, is similar, but syntactic categories and propositional meaning in language as well as tonal hierarchy and isochronous beat in music are unique to each domain (Asano and Boeckx, 2015). To resolve that shared/distinct conundrum one possible approach is indicated by Lenneberg’s (1967) suggestion to regard language processing theoretically as “a special form of pattern recognition” (p. 393) as described by generative grammar. In accordance with this idea, music has been investigated as formal grammar (e.g. Sundberg and Lindblom, 1991; Steedman, 1984; Rohrmeier, 2011). Moreover, modern comparative research from theoretical (e.g. Hauser and Watumull, 2016), neuroscientific (e.g. Fitch et al., 2012), and evolutionary perspective (e.g. Fitch and Hauser, 2004; Rohrmeier et al., 2015) implies such a “pattern processing” point of view. However, thinking of formal systems as descriptions of internal representations or of cognitive capacities means thinking of abstract theoretical models, which means that a comparative biological framework requires linking these formalisms to mental and neural processes. Thus, we discuss the application of formal grammar theory in current empirical comparative research on the language and music capacity. In addition, to deal with the shared/distinct conundrum and bridge this gap for a comparative biological research program, we point out that a data-base system integrating empirical findings from biological research and computational cognitive models of language and music processing is needed. In particular a cognitive ontology for studying the computational properties of the language and music capacity needs to be developed (Price and Friston, 2005; Poldrack, 2006).

Keywords: music, language, comparativism, cognitive ontology

Sep 26
Day 1
17:00

Evolutionary Functions of Linguistic Politeness

Roland Mühlenbernd^{1*}, Przemysław Żywiczyński² and Sławomir Waciewicz²

¹University of Tübingen

²University of Torun

*roland.muehlenbernd@uni-tuebingen.de

One of the grand problems in language evolution research has been reconciling two major approaches to communication: the cynical approach (Krebs and Dawkins, 1984) and the cooperative approach, which involves the code model (Bühler, 1934; Jakobson, 1960a; Shannon and Weaver, 1949) as well as Gricean pragmatics (Grice, 1975; Sperber and Wilson, 1986). The second of these approaches has in-built assumptions of the cooperative character of interaction which - except under very special circumstances, such as kin selection - are not met in the Darwinian world (cf. Searcy and Nowicki, 2005). In turn, the cynical model makes predictions that are falsified by actual language use, which instead follows Gricean predictions (e.g. the default assumption being that speakers tell the truth rather than lie). As such, the cynical model – predicated on the calculation of gains and losses and formalised with game-theoretic means – has been next to useless for describing human language and is absent from the mainstream linguistic theory.

We will point to a more general explanatory principle, i.e. alignment of interests, which makes it possible to reconcile these two disparate approaches. A majority of forms of animal communication involve situations of incomplete alignment of interests between the sender and the receiver. In contrast, language has a Gricean nature and operates on the implicit assumption that the speaker's and hearer's interests are aligned. From this perspective, it is particularly interesting what happens in such cases of linguistic communication where the alignment of interests between the speaker and hearer is disrupted. We claim that precisely this is the case in several aspects of language use, such as indirect speech (Pinker et al., 2008), preference-dispreference organization of conversational turns (Wootton, 1981; Levinson, 1983; Pomerantz, 1984), or linguistic politeness (Lakoff, 1973; Leech, 1983; Brown and Levinson, 1987; Watts, 2003).

In our talk, we will focus on examples from linguistic politeness, which we propose to see as a communicative strategy for resolving or at least moderating instances of non-aligned interests between interlocutors. We will consider a range of hypotheses about the functions of linguistic politeness as well as mechanisms leading to its stability as a signalling strategy; e.g. the handicap principle (cf. van Rooy, 2003). Finally, we will present a mathematical framework defined with tools from evolutionary game theory to test hypotheses about the function of linguistic politeness and its evolutionary stability in a formal way.

Keywords: linguistic politeness, cynical approach, cooperative approach, alignment of interests, signalling theory, evolutionary game theory

Constructing a protolanguage: Language evolution and constructionalization

Sep 26
Day 1
17:30

Stefan Hartmann¹ and Michael Pleyer²

¹University of Hamburg

²University of Koblenz-Landau

stefan.hartmann@uni-hamburg.de | mpleyer@uni-koblenz.de

In recent years, a growing number of researchers have emphasized the points of convergence between Construction Grammar and research on the origins and evolution of language (e.g. Steels, 2004; Arbib, 2012; Hurford, 2014). In this paper, we argue that both the concept of a *construction*, i.e. a form-meaning pair at various levels of abstraction, and the concept of a *constructicon*, a structured, interrelated network of constructions (e.g. Hoffmann and Trousdale, 2013), can help answering the question that lies at the heart of any inquiry into the evolution of language: “What evolved?” (Hurford, 2012, 259)

Research in diachronic CxG (e.g. Traugott and Trousdale, 2013) has convincingly shown that new constructions emerge through processes of *constructionalization*. Regarding language origins, then, the key question from a constructionist perspective is: How did the first constructions come into being, and how did the capacity to make associations between and generalize over constructions emerge?

Several lines of research can help us find answers to these questions. In this paper, we review complementary evidence from two areas: Firstly, we discuss how the results of comparative research can be interpreted in the light of constructionist approaches. Drawing on the much-discussed example of ape gestures and alarm calls (cf. e.g. Scott-Phillips, 2015; Moore, 2015, among many others), we discuss whether the nature of these communicative systems can be captured in terms of an inventory of (proto-)constructions. As Johansson (2016) points out, “Construction Grammar naturally provides numerous possibilities for protolanguages”. In a similar vein, we argue that CxG lends itself particularly well to investigating non-linguistic/pre-linguistic communication systems and human language in a shared theoretical format.

Secondly, the cultural evolution of constructions can be studied in laboratory settings using artificial languages. In particular, the Iterated Learning paradigm, in which an artificial language is passed on from one “generation” of participants to the next, has proven influential in research on the emergence of linguistic structure (cf. Kirby et al., 2008, 2014). Iterated Learning can give clues to processes of linguistic category formation from random input (e.g. Winters et al., 2015) or the emergence of linguistic categories. Importantly, the developments to be observed in these experiments can be seen as constructionalization processes. What is more, we can, in some experiments, witness the emergence of association patterns between different emergent form-meaning pairs, i.e. the evolution of a network of constructions.

Keywords: construction grammar, non-human communication systems, artificial language learning, evolution of constraints

Sep 27
Day 2
10:00

Constraints in Budgerigar Song

Daniel C. McBride Mann^{1,2} and Marisa Hoeschele²

¹City University of New York

²University of Vienna

danmann23@gmail.com | marisa.hoeschele@univie.ac.at

The budgerigar (*Melopsittacus undulatus*), produces a complex, socially learned “warble” song which is composed of a seemingly unpredictable patterning of song elements (Brockway, 1964). The few studies that have focused on warble have found cross-population similarities in basic song units, but little evidence for broadly shared sequencing patterns (Farabaugh et al., 1992; Tu et al., 2011). It is unlikely that no species-typical patterns exist, however, since even humans seem to be constrained in language learning (though the nature of these constraints is up for considerable debate). We hope to better to understand the nature and extent of budgerigar learning flexibility by showing evidence of at least one possible phonotactic bias in budgerigar song: a strong preference for producing pulses before harmonic signals. This bias seems to be analogous to the human CV (consonant-vowel) preference for syllables (Clements, 1990).

We have gathered song data from eight individuals from two separate populations. The individual birds sang in a rich social environment (the aviary where they are housed) as well as in a sound-dampening acoustic box. We used Praat (Boersma and Weenink, 2017) to extract and analyze several acoustic parameters; particularly those associated with spectral dispersion (e.g., Weiner entropy, spectral moments, etc.) and the amplitude envelope.

We find that all of the budgerigars from both groups produce frequency modulated harmonic signals consistently, and almost exclusively, only after producing one or several short (< 5 ms) broadband pulses. Furthermore, the pulses are not nearly as common in a post-harmonic position and can also be used independent of any other sound. While more work needs to be done (e.g., further species comparisons, playback experiments, etc.) before any strong conclusions may be made, these data could show evidence for biomechanical constraints on song. For instance, the pulses may be the acoustic result of the transition from resting state to more complex phonation, a pattern that one would expect to see in other species. Interestingly, the acoustic signal is somewhat similar to human stop consonant + vowel sequences (see Fig 1); sequences that are found in almost every language (with the exception of Arrernte; Breen and Pensalfini 1999). Only recently have phonetically based mechanisms been proposed for this sound pattern (Nam et al., 2009). Further investigation and comparisons between the human and budgerigar sequences could reveal more broadly shared phonatory principles and how biomechanical constraints shape culture.

Keywords: budgerigar, comparative bioacoustics, phonotactic constraints

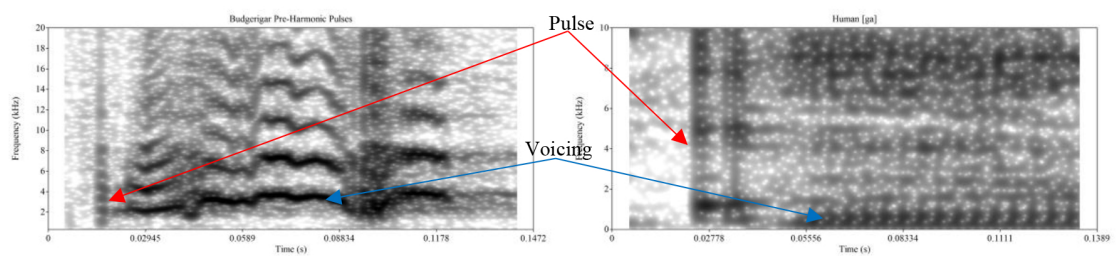


Figure 1: Budgerigar (left) and Human [ga] (right) Spectrograms

Sep 27
Day 2
11:00

The units, levels and mechanisms of language evolution: a tentative ordering

Nathalie Gontier

Centre for Philosophy of Science, Applied Evolutionary Epistemology Lab, University of Lisbon
nlgontier@fc.ul.pt

Evolutionary linguistics can learn from evolutionary biology and evolutionary epistemology, where scholars nowadays investigate a plurality of units of evolution, they recognize multilevel selection, and especially from within the extended synthesis, scholars are identifying a plurality of evolutionary mechanisms that besides natural selection can explain how evolution occurs.

We examine how a general evolutionary methodology can become abstracted from how biologists study evolution as it occurs by means of natural selection, and how this methodology can become implemented into the field of evolutionary linguistics. This methodology, which I call Applied Evolutionary Epistemology (AEE), involves a systematic search and analysis of the units (elements that evolve), levels (loci where these elements evolve), and mechanisms or processes (conditions according to which these elements evolve at certain loci) of language evolution, allocating them into ontological hierarchies, and differentiating between different kinds of evolution. We examine how existing research programs in (evolutionary) linguistics (sociolinguistics, biolinguistics, evolutionary linguistics, protolanguage theories and multimodal origin theories) have already tackled the problem of identifying the units, levels, and mechanisms of language evolution, and we provide a tentative ordering of the data.

Finally, we demonstrate how AEE not only enables an ordering, it also provides a research methodology in the form of three heuristics that enable an identification, examination, and evaluation of the data (Table 1)

Keywords: applied evolutionary epistemology, mechanisms of language evolution, extended synthesis, methodology, hierarchy theory

THE UNIT, LEVEL, AND MECHANISM HEURISTICS (READ FROM LEFT TO RIGHT AND TOP-DOWN)			
IS X A UNIT OF LE?			
?	Try to prove that x is a unit of LE (1 example suffices); Go to yes.		
Y E S	Where? Identify the level/s where x evolves	Not one level found? X is not a unit; Go to no.	
		One/multiple level/s? (Justification)	How, by which mechanism/s did x evolve? (Justification)
	Since when?	When did x first originate in time and when did x become a unit of LE?	
	How does x interact with other units?	Is x divisible into one or more sub-or super--units? If so, are they also units in LE?	
	Is x also a level and/or mechanism ?	? & yes: Go to the level and/or mechanism-heuristic.	
	How relevant is x?	Is x sufficient and/or necessary for LE or for theories thereof?	
N O	If not a unit, is x a level and/or a mechanism ?	? or Yes: Go to the level and/or mechanism-heuristic.	
		No: Is x a window of LE?	Yes: Treat x accordingly.
			No: Treat x as irrelevant for LE.
IS X A LEVEL OF LE?			
?	Try to prove that x is a level of LE (1 example suffices); Go to yes.		
Y E S	How many/what units evolve at x?	No units are identified? X is not a level; Go to no.	
		One/multiple unit/s? (Justification)	By which/How many evolutionary mechanisms did the unit evolve at x? (Test)
	What is the ontological status of x?	Is x an abstract notion that facilitates theory formation, or an existing entity?	
	Since when?	Locate the origin of x in time or indicate when it becomes necessary to invoke x as an abstract notion in LE theories.	
	How does x interact with other levels?	Is x divisible into sub-or super--levels? If so, are they also levels in LE?	
	Is x also a unit and/or mechanism ?	? & yes: Go to the unit and/or mechanism-heuristic.	
	How relevant is x?	Is x sufficient and/or necessary for LE or for theories thereof?	
N O	If not a level, is x a unit and/or mechanism ?	? or Yes: Go to the unit and/or mechanism-heuristic.	
		No: Is x a window of LE?	Yes: Treat x accordingly.
			No: Treat x as irrelevant for LE.
IS X AN EVOLUTIONARY MECHANISM OF LE?			
?	Try to prove that x is an evolutionary mechanism involved in LE; Go to yes.		
Y E S	On how many units is x active?	Not one unit: x is not an evolutionary mechanism involved in LE.	
		One/multiple unit/s. (Justification)	At how many levels is x active? (Test)
	How does x work?	What conditions need to be met for x to occur? (Requires universal heuristics of the working order of the mechanism.)	
	Since when?	Locate in time when these conditions are met regarding each unit and each level.	
	How does x interact with other mechanisms?	Is x divisible into sub-or super--mechanism/s? If so, are they also mechanisms of LE?	
	Is x also a unit and/or level ?	? & yes: Go to the unit and/or level-heuristic.	
	How relevant is x?	Is x sufficient and/or necessary for LE or for theories thereof?	
N O	If not a mechanism, is x a unit and/or level ?	? or Yes: Go to the unit and/or level-heuristic.	
		No: Is x a window of LE?	Yes: Treat x accordingly.
			No: Treat x as irrelevant for LE.

Table 1: The unit, level, and mechanism heuristics

Sep 27
Day 2
11:30

Narrative and Pantomime in Language Evolution

Francesco Ferretti*, Ines Adornetti*, Alessandra Chiera and Serena Nicchiarelli

Roma Tre University

*francesco.ferretti@uniroma3.it | ines.adornetti@uniroma3.it

In this work, we treat the topic of language origin in reference to two assumptions. The first assumption is conceptual and related to the idea that the distinctive feature of human language (setting it apart from other forms of animal communication) has to be traced to its inherently narrative character. The second assumption is methodological, as well as conceptual, and concerns the adoption of a cognitive approach to the study of language evolution. In adopting such an approach, we adhere to the idea of a distinction between language and thought and specifically to the idea of the primacy of thought over language. On this view, thought has ancient roots and evolved gradually over aeons of time, whereas the capacity to communicate thought is much more recent (see Corballis, 2017a).

Combining together these two assumptions, we show that narrative is the specific way in which humans represent reality (e.g. Bruner, 1991) and propose that the origin of language (whose primary, but not exclusive, function is to express thoughts) should be considered an event driven by the need to make public the individual (internal and private) narrative representations of reality. If the form of representation imposes constraints on the way we communicate our thoughts, this means that our ancestors were once faced with the requirement to invent a proper communicative medium to express the mental narratives they used to represent reality. In this regards, we propose that, at the beginning of human communication (in the absence of codified language), pantomime was the best means of expression to face the difficulty of communicating representations to others using a narrative format. Following the definition of pantomime provided by Żywicznyński et al. (2016), we highlight that the capacity of pantomime to represent and communicate relatively complex sequences of events without relying on pre-existing semiotic conventions, makes pantomime a medium of expression of human narrative representations and a medium on which language, in the form of narrative, arose. From this point of view, the narrative origin of language largely coincides with the pantomimic origin of language.

Keywords: pantomime, narrative, mental representation

Self talk and early human communication

Bart Geurts

University of Nijmegen

brtgrts@gmail.com

Sep 27

Day 2

12:00

People talk to others but also to themselves. Self talk may be overt or covert, and is associated with many higher cognitive functions, including reasoning, problem solving, planning, attention, and motivation (Winsler et al., 2009). Self talk comes naturally to us. We don't teach our children to talk to themselves, and even before they start speaking, children gesture and point for themselves. Moreover, addressing oneself seems to come naturally to other species, too: there is robust evidence showing that chimpanzees who acquired the rudiments of sign language will spontaneously sign for themselves (Bodamer et al., 1994; Jensvold, 2014).

The potential evolutionary implications of these facts are considerable. They suggest that self talk (or self signing) was an early development, which may have preceded the appearance of protolanguage, and served as the linchpin in the coevolution of human communication and higher cognition. However, before we can begin to develop such a scenario, we first need to know what self talk is, and our current understanding of that phenomenon is quite poor. I argue that this is mainly due to the fact that the received view of communication as information exchange is ill-equipped for making sense of self talk. For what might be the point of exchanging information with *oneself*? Jack urges himself to do the dishes by telling himself, "Do the dishes!" On the received view, Jack's speech act serves to convey the speaker's (i.e. Jack's) intention to do the dishes, which then leads the hearer (i.e. Jack) to believe that Jack intends to do the dishes. That doesn't seem right.

There is an alternative view on communication, developed mainly in formal pragmatics and the philosophy of language, which analyses communication in terms of commitments rather than information. On this view, Jack's self-instruction commits him, to himself, to do the dishes; which seems correct. And not only does a commitment-based approach allow us to make sense of self talk, it is also meshes well with the fact that, in humans as well as chimpanzees, communication is social interaction and usually contiguous with other forms of social interaction.

Keywords: self talk, primate communication, commitment

Sep 27
Day 2
14:30

What does language contribute to cultural evolution?

Monica Tamariz
Heriot Watt University
monica@ling.ed.ac.uk

This talk probes evolutionary relationships between language and the rest of culture by asking: What kind of culture is possible without language? In particular, are cumulative culture and symbolic culture mediated by language? Does a focus on language bias theories of cultural evolution?

We can distinguish between two cumulative processes: First, traditions become cumulatively compressible (*simple*) as an adaptation to being easy to learn and reproduce (Kirby et al., 2015). Second, if the pressure for compressibility is relaxed (e.g. through high-fidelity imitation or through externalisation of information in texts and artefacts), then *complexity* accumulates. Both processes are exemplified in nonhuman animals: cumulative simplicity, in the emergence of stable, compressible tetrominos in cultural transmission chains in baboons (Claidière et al., 2014); cumulative complexity, in the birdsong dialects that result from different motifs and their recombinations (Slater et al., 1984). Moreover, many technological artefacts and skills may evolve cumulatively without language (Tehrani and Riede, 2008).

Symbols are arbitrary associations between behaviours (e.g. rituals, words) and their conventional functions and meanings. Rituals may emerge and evolve without language, in the presence of high-fidelity transmission of behaviours: orangutans 'wash clothes' after observing humans do the same (Russon, 1996); chimpanzees do ontogenetic ritualisation (Tomasello and Call, 1997); and pre-linguistic children display behavioural patterns associated with cooking, cleaning, etc during pretend play. No functionality or language are involved in either case — the socially acquired behaviours are copied arbitrarily.

Languageless culture could therefore be cumulative and symbolic, two defining features of human culture. What, then, does language add? Arguably, it augments cumulativeness by easing cooperation and division of labour and by scaling up the scope of pedagogy and, consequently, transmission fidelity; and it extends symbolicity by enhancing individual and joint thinking and reasoning.

Regarding **cultural evolutionary theory**, however, language's role in facilitating the public manifestation and manipulation of mental representations may overly accentuate mental aspects of culture while playing down public, behavioural representations. Human culture, defined as socially transmitted knowledge, beliefs, attitudes that *reside in the brain* and influence behaviour (Boyd and Richerson, 1988) contrasts with behaviour-based definitions of non-human culture (Whiten et al., 2009). A general theory of cultural evolution should pay due attention to public cultural productions.

Keywords: cultural evolution, mental culture, public culture, cumulative culture, symbolicity

All-or-nothing theories of language tell us nothing

Pedro Tiago Martins
University of Barcelona
pmartima23@alumnes.ub.edu

Sep 27
Day 2
17:00

One position about what makes language special is that there is a Basic Property (BP) that allows humans to construct a “digitally infinite array of structured expressions”, made possible by the sudden emergence of a recursive operation, Merge (Berwick and Chomsky, 2016). While hierarchical recursion seems to be indeed a crucial piece in language, a point which we will not touch on here, within that position it is usually also assumed that, since Merge is a basic, simple property, and there is no “half recursion” (i.e. Merge is “all-or-nothing”), one must conclude there were no gradual evolutionary steps that led to it; instead, it had to be the result of a single genetic mutation or one such sudden event, with no evolutionary tinkering whatsoever (in that sense, a biological novelty). The fact that other species do not have “anything like language” is usually also taken to justify it. This renders the evolution of said BP not amenable to evolutionary study, something which the proponents of the sudden-emergence view acknowledge and even promote (Hauser et al., 2014).

We argue this position is wrong because of a number of unwarranted assumptions:

- From the formal analysis of a property one can derive the (existence of) evolutionary steps that led to it
- Properties that seem atomic or all-or-nothing at the procedural level must arise suddenly
- Properties that seem to be exhibited by only one species cannot be shed light on by studying other species’ abilities and their evolutionary history.

We will show these assumptions are incorrect by appealing to the complex nature of biological novelties (Pigliucci, 2008), how the study of other species can and has produced useful knowledge about seemingly human capacities, and approaches to recursion that counter the stagnation imposed by the sudden-emergence, all-or-nothing view, opening way for investigation within comparative cognitive biology (e.g. Martins et al., 2016).

Keywords: language evolution, evolutionary biology, comparative cognition, recursion

Sep 27
Day 2
15:30

Visualizing a human face impacts the semantic -but not the syntactic- processing of connected speech

David Hernández-Gutiérrez^{1*}, Jose Sánchez García¹, Irina Noguer¹, Javier Espuny¹, Sabela Fondevila¹, Pilar Casado^{1,2}, Laura Jimenez-Ortega^{1,2}, Werner Sommer³, Rasha Abdel Rahman³, Francisco Muñoz^{1,2} and Manuel Martín-Loeches^{1,2}

¹Center UCM-ISCIH for Evolution and Human Behaviour

²Psychobiology Department, Complutense University of Madrid

³Department of Psychology, Humboldt-Universität zu Berlin

*dhernandez1@ucm.es

Most research on the neural basis of language processing has largely used sentences in the visual modality. However, language evolved as an articulatory/auditory adaptation. Actually, this modality predominates in social contexts (interpersonal communication), along with the visualization of the speaker's face. Conversely, the human face is a notably capturing stimulus to our brain. Indeed, the use of more ecologically valid contexts in language research seems necessary. The present study aims at filling this gap by evaluating the semantic and syntactic processing of connected speech while seeing the speaker's face. In one experiment we studied semantic processing by using sentences that made or not sense. We did this by analyzing the N400 component of the event-related potentials (ERPs). Considering language as inherently social, we hypothesized that semantic processing might be modulated by the presence or absence of the interlocutor's face. Accordingly, in the experimental condition, we presented a picture of the speaker's face concurrent to the auditory presentation of sentences. In the control condition, a scrambled-face picture was presented. A second experiment approached the effects of the presence/absence of the interlocutor's face on auditory morphosyntactic processing. Previous evidence has demonstrated that semantic information may impact syntax, therefore the visualization of faces (semantic information) might modulate the LAN and P600 syntactic effects of the ERPs. Regarding the semantic experiment, our results showed a significant interaction of semantic correctness by face visualization between 350-450 ms. This was depicted in a larger N400 effect to semantic anomalies in the presence of faces as compared to control stimuli, although behavioural measures did not differ between conditions. In turn, no significant interaction was found in the syntactic experiment. Hence, the LAN and P600 amplitudes were not modulated by the type of visual stimuli. Accordingly, seeing the speaker's face may posit an influence on the semantic processing of connected speech. The amount of cognitive resources invested in the N400 effect is boosted just by perceiving the speaker's face. By contrast, syntactic processing seems opaque to the presence of this social cue, in line with some proposals on the primarily encapsulated nature of this language domain. Overall, our results evince the importance of using ecologically valid contexts in language research.

Keywords: syntax, semantics, auditory processing, face processing, N400

Labeled trees as the computational step bridging animal cognition to the language faculty and its neural grounding

Sep 27
Day 2
16:00

Tomás Goucha*, Emiliano Zaccarella and Angela D. Friederici

Max Planck Institute for Human Cognitive and Brain Sciences

*goucha@cbs.mpg.de

Considering the combinatorial faculty underlying language, our framework focuses on the labeling of linguistic structures. We pursue the idea that labels express the asymmetric nature of linguistic structures (Goucha et al., 2017). Words are combined into phrases independently of meaning, according to their respective categories, which establish a relation of dominance between each other. We argue, this is the fundamental step to build hierarchical structures.

We first discuss the computational differences between humans and non-human primates (NHPs) and the neural substrates supporting them. The use of the combinatorial faculty in communication shows the fundamental difference between sequence processing in NHPs and hierarchical representations in humans. In both animal communication and in artificial grammar experiments performed in NHPs, we only observe associative processing based on local transitions or superficial patterns (Sonnweber et al., 2015). The respective sequences do not seem to require labels (Wilson et al., 2017) because the elements within the sequence do not establish relations of dominance among each other. Overall, the literature shows no strong evidence of abstract hierarchical rules in NHP processing.

Neuroimaging allows us to compare the corresponding neural substrates in humans and NHPs, hence identifying homologies in sequence processing, as well as the non-shared, uniquely human brain structure and function underlying hierarchical processing. Anatomically, there are well-established phylogenetic differences in the prefrontal cortex and perisylvian white matter pathways. We particularly pinpoint the cortical expansion in Broca's area and the strengthening of the arcuate fascicle, opposed to the already well-developed ventral stream in (Rilling, 2014), also observed in functional connectivity (Neubert et al., 2014). We contend that these two processing streams can be distinguished on a computational basis, with the dorsal stream supporting rule-based hierarchical processing. Within this pathway, we propose that Broca's area uses the categorical information of words to label their combination, giving rise to an asymmetrical hierarchical structure. The posterior temporal cortex, in turn, provides grammatical relationships at the interface between syntax and meaning, as seen in verb argument structure, since this region is always involved as soon as semantic information is present (Zaccarella et al., 2017; Goucha and Friederici, 2015). We underline the need for empirical testing of elementary linguistic structures backing up this hypothesis.

We finally propose an empirical framework to test our computational hypothesis, which goes beyond the current work on NHPs focused on sequence processing, which is mainly informative concerning speech processing. Instead, we suggest testing in categorical combination, which fundamentally requires labeling, in order to isolate the fundamental properties and neural correlates of the human faculty for language.

Keywords: labeling, asymmetry, rule learning, sequence processing, arcuate fascicle

Sep 27
Day 2
15:00

Subitizing and the Nature of Protolanguage

Andrew Feeney

Northumbria University
andrew.feeney@northumbria.ac.uk

There have been many posited species since the split with our last common ancestor with chimpanzees; however it is the appearance of *Homo erectus* around 1.9 mya that is accompanied by the first irrefutable evidence for cognitive and behavioural adaptations that figure prominently as precursors to modern human capacities. The period prior to this is associated with a comparatively large number of genetic changes, particularly in HAR 1 influencing brain lateralisation, organisation and connectivity (Kamm et al., 2013). One consequence of these changes was the doubling in size of the brain to 800cc (Holloway and Post, 1982). Also of significance are several behavioural adaptations suggesting greater cooperation (Beyene et al., 2013; Lynch and Granger, 2008).

While there is vast cross-linguistic diversity at every level of language (Evans and Levinson, 2009), one universal appears to be a clause consisting of a predicate with a limited number of core arguments. Dixon (2016) assigns 8 essential universal roles to language of which the first 5 (involving the communication of basic types of information) are all functions that are attested, if only to a very limited extent, in other animal groups, certainly in primates. We can therefore assume that these functional categories underpinned the very earliest protolanguage of simple concatenated symbols.

Hurford (2003) posits the existence of prelinguistic predicate structure shared by all higher animals: $\text{PREDICATE}(x)$ in which (x) is a variable, and PREDICATE specifies some property(s) of that object. It is claimed that this aspect of cognition is parasitic on the ancient visual capacity to accurately report up to four objects in a scene without counting: subitizing (Dehaene, 2011). Subitizing is attested in human infants from the age of 10 months (e.g. Feigenson and Carey, 2005) and in rhesus macaque monkeys (e.g. Hauser and Carey, 2003) (whether subjects with grammatical Specific Language Impairment are correlated with impaired ability to subitize is currently under investigation). I argue that clausal structure emerged in protolanguage during the early days of *H. erectus* for the external representation of thought grounded in subitization.

However, the next million years are characterised by almost total stasis (Jay Gould and Eldredge, 1993). Earliest *Homo* was far more cooperative than its ancestors, enabling the utilisation of a protolanguage, but this communicative system did not develop properties such as unbounded productivity until the cognitive capacities behind it evolved to generate structured thought that was no longer constrained by the limits of subitizing.

Keywords: subitizing, argument structure, hominin cognition

Polysemy as a vocabulary learning bias

Bernardino Casas*, Neus Català, Antoni Hernández-Fernández, Ramon Ferrer-I-Cancho* and Jaume Baixeries*

BarcelonaTech

*bcasas@cs.upc.edu | rferrericanch@cs.upc.edu | jbaixer@cs.upc.edu

Sep 26
Day 1
11:00

Child language is often regarded as an example of protolanguage (Bickerton, 2007; Jackendoff, 1999), and is shaped by many learning biases (Saxton, 2010). Therefore these biases can be indicative of constraints that human language had to meet at its very origin. Here we investigate polysemy, the capacity of a word to have multiple meanings, as a potential bias in vocabulary learning.

In previous research (Casas et al., 2016), a positive correlation between the age of a child and the mean polysemy of its speech has been found in English based on transcripts of conversations involving children and adults. Here we investigate the relationship between the polysemy of a word and its age of acquisition (AoA) in English and Spanish. We determine the AoA with the help of the MacArthur-Bates Communicative Development Inventories (CDIs) following standards in language acquisition research (Hills et al., 2010).

We define the estimated age of acquisition (EAoA) of a word as function of a threshold. The EAoA of a word is the first month where the percentage of children that have acquired this word is above the threshold. We consider thresholds between 10% and 90% by increments of 10%, yielding 9 thresholds.

We find that the polysemy of words tends to decrease as EAoA increases in English while it shows a slight tendency to increase as EAoA decreases in Spanish.

Our results suggest that polysemy plays a role in the preferences that children have for words in the CDIs. We discuss the extent to which these results can be generalized to words that do not belong to the CDIs with the help of further statistical analyses.

Keywords: language acquisition, vocabulary learning, learning biases, polysemy bias

Sep 28
Day 3
10:00

An experimental study of multimodal communication and early language emergence

Vinicius Macuch Silva,^{1,2*} Seán G. Roberts², Judith Holler² and Asli Özyürek^{1,2}

¹Max Planck Institute for Psycholinguistics

²Radboud University Nijmegen

*vini.macuch@gmail.com

One of the central questions in the linguistic evolutionary literature revolves around the role of modality in the historical onset of human language. Accounts of early language emergence are usually divided into speech- or gesture-first (see Kanero, 2014). However, most recent models of language origins acknowledge the importance of both the visual and the vocal modality (e.g. Kendon, 2009; Levinson and Holler, 2014; McNeill, 2012), postulating a tight co-dependence between the two during the emergence of language. Empirically, however, little experimental research has explicitly tackled the issue of multimodality in language emergence, with studies generally focusing either on speech and the affordances of the vocal modality or on gesture and the affordances of the manual modality, with very few exceptions (Fay et al., 2013, 2014). Here, we use a paradigm that tests the actual natural affordances of both the vocal and the visual modality, given novel stimuli which do not bias only one modality by default. Participants were asked to communicate about abstract sounds and images for which no conventional labels exist. We show that participants spontaneously create novel referential conventions based on unconventionalized non-linguistic signals. Moreover, our findings show that multimodal signaling is actually more advantageous in terms of communicative effectiveness and efficiency than unimodal visual or acoustic signaling alone, at least in some scenarios of referential communication about unconventionalized abstract meanings. Ultimately, our findings provide empirical support for accounts of language evolution that suggest that both the vocal and the visual modality might have played an important role in the early bootstrapping of human language.

Keywords: language emergence, sensorimotor modality, multimodality, experimental semiotics, multimodal communication, referential communication

Informational bottlenecks lead to co-evolution of categories and systematicity in an emergent communication system

Sep 28
Day 3
10:30

Jonas Nölle^{1*}, Marlene Staib^{2*}, Riccardo Fusaroli³ and Kristian Tylén^{2,3}

¹Centre for Language Evolution, The University of Edinburgh

²Center for Semiotics, Aarhus University

³The Interacting Minds Centre, Aarhus University

*j.nolle@sms.ed.ac.uk | mvs@cc.au.dk

In recent years, it has been suggested that languages are characterized by not only arbitrary, but also non-arbitrary relationships between form and meaning, such as iconicity and systematicity (Dingemanse et al., 2015a). We argue that iconicity and systematicity are not just facets of the same phenomenon, but serve orthogonal functions in the scaffolding of an efficient communication system. Iconicity is usually associated with learning and bootstrapping (Imai and Kita, 2014), while systematicity has been shown to emerge in the lab in settings where iconicity is less afforded (Little et al., 2017; Verhoef et al., 2016; Galantucci et al., 2010; Selten and Warglien, 2007) or when participants have to communicate about words belonging to preexisting linguistic categories (Theisen et al., 2010). Building on this work, we conducted a study that investigated different pressures for systematicity in a silent gesture referential game, which highly afforded iconicity: Dyads had to communicate pictures of stylized characters possessing various salient idiosyncratic features (e.g., moustache, glasses) as well as categorical traits (e.g., female, soldier). In other words, the stimuli allowed for both iconic and systematic gestures to represent their meaning.

In experiment 1, we found that, although iconicity was strongly preferred (as afforded by the stimuli/medium), systematicity could emerge and was modulated by the saliency of the trait, that is, traits that were more frequent and discriminative in the given context were more likely to become systematized. Overall, there was a tendency to decrease systematicity towards the end of the experiment, as dyads became more efficient and used fewer gestures.

In experiment 2, we used a 2x2 design, where we manipulated both openness of the environment (an expanding meaning space vs. constant meanings across trials) and displacement of the communicative context (whether the stimuli were available during the communication phase or not).

Our results indicate that displacement increased the tendency to systematize overall, while the openness of the environment affected the temporal development of systematicity. Similar to experiment 1, systematicity decreased in later trials in closed environments, whereas open environments led to constant increase in systematicity until the end of the experiment.

Taken together, our findings suggest that informational bottlenecks (linked to finite working memory and central processing resources) can motivate systematicity to emerge on the interaction level. This suggests that besides cognitive biases acting over transmission (Kirby et al., 2008), semiotic structure can also emerge under external pressures in communication.

Keywords: systematicity, iconicity, displacement, silent gesture, experimental semiotics, working memory

Sep 28
Day 3
11:30

How to create sound symbolism: Cross-linguistic and experimental evidence for establishing active sound symbolic effects

Niklas Johansson
Lund University
niklas.johansson@ling.lu.se

During the current resurgence of interest in iconicity and sound symbolism, most studies have been small in scope, and larger-scale studies that have been conducted (Wichmann et al., 2010; Blasi et al., 2016) have not captured many phonetic distinctions important for sound symbolism, e.g. voicing (Ohala, 1994; Johansson, *ress*).

The present study attempts to amend these issues by focusing on how sound symbolism operates through a more thorough examination of the phonetic and semantic features involved, both cross-linguistically and experimentally. 344 concepts with universal tendencies in 245 language families were investigated and the phonemes of the linguistic forms were systematically grouped according to various phonetic parameters to pinpoint the features responsible for each sound symbolic association. Of the 142 statistically significant sound-meaning associations, several concepts (KNEE, MOTHER) were equally phonetically deviant as onomatopoeic concepts (TO SNEEZE). Also, several clusterings of concepts with similar semantic features were found, e.g. relative distance to speaker, largeness/evenness-smallness/edginess, body part terms and kinship attributes.

A number of the confirmed sound symbolic concepts were then investigated through iterated learning experiments (Kirby et al., 2015) in which naïve participants were audially presented with a phonetically diverse word and asked to repeat it, which was then played for the next participant in the same chain. Depending on the chain, the participants either received no information about the meaning of the word, or that it meant e.g. BIG or SMALL, which created a meaning-bias for their ability to repeat the word. The results revealed that the share of high frequency sounds gradually increased in the SMALL-condition, and after 15 generations the average share of high frequency sounds had a ratio of 3:1 when compared to the low frequency sounds. This indicates that SMALL is more sound symbolically salient than BIG, which is further corroborated by the cross-linguistic results showing more phonetic features associated with SMALL, and that marking only one pole of semantic oppositional pairs is topologically common (De Villiers and De Villiers, 1978).

These findings show considerable cross-linguistic sound symbolic effects on basic vocabulary which form complex semantic networks, and that sound symbolism operates actively in language since similar effects can be recreated through experiments. This is also in line with claims that sound symbolism acts as bootstrapping mechanism for early stages of human language (Imai and Kita, 2014) and could therefore aid in establishing how fundamental parts of the mental lexicon are arranged.

Keywords: iconicity, sound symbolism, iterated learning, cross-linguistic, basic vocabulary

The Sensory Theory of Protolanguage Emergence

Christine Cuskley
University of Edinburgh
ccuskley@gmail.com

Sep 28
Day 3
12:00

Interest in sound symbolism and non-arbitrariness — especially in the context of the evolution of language — has grown considerably in the last decade. Accordingly, a good deal of work has been done which explores the cognitive constraints which may underlie sound symbolism in terms of both learning (e.g. Monaghan et al., 2012) and perceptual biases (e.g. Cuskley et al., 2017). Likewise, a large body of work has examined sound symbolism present in modern natural languages (e.g. Monaghan et al., 2014). However, the role of sound symbolism in language evolution is often vaguely assumed: iconic words helped us learn to use linguistic symbols. But the *specific* role of sound symbolism in protolanguage — and how this relates to its role in modern language — is addressed only rarely (e.g., see Imai and Kita, 2014).

This talk will aim to fill in that detail, providing a synthesis of why sound symbolism likely played an important role in protolanguage, what a sound symbolic protolanguage may have looked like, and how (and why) it would have transitioned to the more arbitrary modern languages we observe today. This will be presented in a unified *sensory theory of protolanguage* (STP), leveraging the considerable evidence for cognitive perceptual biases and sound symbolism in natural language. The STP provides a detailed perspective by addressing the nature of a sound symbolic protolanguage system in detail, and reconciling a sound symbolic protolanguage with other important issues in the protolanguage literature such as the synthetic/analytic debate. The talk will situate the STP in light of the growing body of empirical evidence presented surrounding sound symbolism. Beyond providing a more detailed language evolution framework for ongoing work in sound symbolism, the STP provides the schema necessary for extending into computational models which can more fully explore the role of sound symbolism in language evolution.

Keywords: sound symbolism, non-arbitrariness, lexicon, perception

Sep 28
Day 3
12:30

The Role of Linguistic Frame Knowledge in the Evolution of Human Cognition and Culture: What Pretend Play Can Tell Us

Michael Pleyer¹ and Stefan Hartmann²

¹University of Koblenz-Landau ²University of Hamburg
mpleyer@uni-koblenz.de | stefan.hartmann@uni-hamburg.de

The capacity to act according to collectively shared conventions can be seen as one of the most important foundations for human cognition and culture (Tomasello, 2014). Crucially, this capacity for collective intentionality is tied to internalised knowledge of role elements involved in cultural activities such as, e.g., commerce, hunting, or appropriate behaviour within social hierarchies. These connected networks of knowledge have been described as frames (e.g. Ziem, 2014). Frame and role knowledge, which seems to be a uniquely human feature (Tomasello et al., 2005), is mediated through linguistic interaction. From this point of view, both language and knowledge about roles systematised and schematized in frames are the evolutionary foundation of collective intentionality. But which mechanisms lead to the development of frame knowledge underlying our understanding of roles and collective cultural conventionalisations and institutions?

One mechanism active in ontogeny certainly is that of explicit teaching, which seems to be uniquely human (Csibra and Gergely, 2009). Another important mechanism is that of pretend play. Whereas play is found in many social species and has been hypothesized to play an important role in the development of skills and knowledge, pretend play seems to be a uniquely human capacity (Palagi, 2011). It has been considered “the first form of true collective intentionality in ontogeny” (Rakoczy, 2006), as it is fundamentally social and cooperative in nature and children enact and internalise roles and culturally stereotyped forms of behaviour (Trawick-Smith, 1998). Moreover, this particular aspect of pretend play seems to be culturally universal (Gaskins, 2013). Therefore, we argue that from an evolutionary perspective, pretend play and the linguistic capacities mediating it can be seen as one of the crucial breeding grounds for the acquisition of frame knowledge. In this way, pretend play can be described as the cradle of the human capacity for collective intentionality and understanding of roles, both simple and culturally complex.

In this talk we will present evidence for the hypothesis that pretend play represents an important context for the acquisition of systematic frame knowledge and the development of collective intentionality. We will do so by offering a corpus-based case study of frame knowledge linguistically mediated and established in pretend play situations in the context of language acquisition. We will show that pretend play can be seen as an important part of the evolutionary picture how language and the linguistic construction of collective intentionality got off the ground.

Keywords: pretend play, linguistic frames, ontogenetic development

All you need is love...or what?

Sverker Johansson

Dalarna University

sja@du.se

Sep 28

Day 3

14:30

Language is essentially always present in groups of modern humans. Even in the exceptional groups that for some reason are formed without language, language will invariably emerge in short order. Examples of language emergence in recent times include deaf communities in e.g. Nicaragua and Israel. Such newly-formed languages converge within a few generations towards the same general form and features as mainstream human languages.

Language is essentially never present in groups of non-human primates. Even in the exceptional groups that are heavily exposed to language and explicitly trained in language use, progress in language acquisition is invariably modest at best. Language never emerges spontaneously in non-human groups.

What's special with humans? It is sometimes argued that "all you need is merge" (e.g. Berwick, 2011), that a small genetic change provided a language-ready brain and the rest is history. This saltational view of language evolution is wrong for many reasons (e.g. Tallerman, 2014), but I would add here another one.

A language-ready brain is not an all-or-nothing affair, nor is it sufficient for language emergence. The results of language training in apes are modest, but not nil. Apes do learn to connect symbols with referents and use them communicatively. One may quibble about whether to call this "language", and it is far from full human language, notably lacking in syntax. But it does show the presence of some language-relevant abilities in apes, and it is a functional communication tool at some protolinguistic level.

But if ape brains are protolanguage-ready, why doesn't protolanguage emerge in the wild among apes, as it does among humans? Clearly, some extra-linguistic key factor is lacking. A language-ready brain is not all you need for language emergence. In a group of hypothetical creatures with a human language faculty (narrow sense) but otherwise ape-like in psychology and behavior, language would not emerge.

Human prosociality and shared intentionality are likely key ingredients in language emergence (e.g. Tomasello, 2008), but are not the whole story. In this talk, I will explore the minimal extra-linguistic requirements for protolanguage emergence to get off the ground in protohumans.

Keywords: language emergence, ape language, prosociality

Sep 28
Day 3
15:00

The Role of Mindreading for Social Learning in Early Infancy

Emiliano Loria

Consortium FINO, University of Torino
emilianoloria@gmail.com

In 2006 Gergely Csibra and György Gergely (2006; 2009; 2013) proposed a new type of social cognitive learning mechanism, called “natural pedagogy”. According to them, i) human infants show very early sensitivity to communicative and ostensive cues that indicate teaching contexts; and ii) infants tend to interpret certain actions (gaze shift, pointing, motherese) occurring in these communicative contexts as referential cues to identify the referents about which new information will be provided (Farroni et al., 2002). Gergely and Csibra argue that the infant interprets the ostensive-communicative cues addressed to her as indicating that the other (the adult) is about to manifest for the infant some significant aspect of cultural knowledge that will be new and relevant for her and that, therefore, should be fast learned (Sperber and Wilson, 1986). Natural pedagogy triggers several biases, one in particular is here analyzed, the assumption of universality that predicts the equivalence of others’ minds. In other words, infants interpret the content of ostensive manifestations to infer the new information about the relevant properties of the referent object and ascribe them to others. Gergely and Csibra (Csibra and Gergely, 2006; Gergely, 2007; Gergely et al., 2007) denied any commitment between mindreading and natural pedagogy, because a) infants do not encode the perspectives of other agents as person-specific sources of knowledge, and b) infants learn about the object, rather than the agent’s disposition towards that object. I propose that the knowledge-attribution to others competence is the signal of a cognitive functional cooperation between a primary form of mindreading and the natural pedagogy mechanism. By the notion of mindreading I suggest to take a constructivist perspective that may reveal how during the ontogenetic development the slow maturation of several competences occurs and builds the full system. Some of these competences start to emerge very early in infancy, primarily under the form of ascription of false beliefs to others (Tirassa et al., 2006; Carruthers, 2013, 2016; Jacob, 2016; Kovács et al., 2010; Kovács, 2016). Dora Kampis et al. (2013). proposed that early theory of mind processes lack the binding of belief content to the belief holder, and the assumption of universality occurs also in not pedagogical conditions. Therefore, I argue that natural pedagogy mechanism incorporates, as its component, the ToM competence already available, even if it is limited to simple domains like ascription of true or false belief about the location of an object. I suggest that the natural pedagogy mechanism applies this competence in the ostensive communicative context in order to ascribe to others knowledge content for the benefit of a social learning as fast, frugal and efficient as possible.

Keywords: ostensive communication, referential expectation, natural pedagogy, assumption of universality, mindreading

Posters

Ramon Ferrer-I-Cancho
Universitat Politecnica de Catalunya
ramon.ferrericancho@gmail.com

Vocabulary learning by children can be characterized by many biases. When encountering a new word, children as well as adults, are biased towards assuming that it means something totally different from the words that they already know (Markman and Wachtel, 1988; Merriman et al., 1989; Clark, 1993). The 1st mathematical proof of the optimality of this bias has been presented recently (Ferrer-i Cancho, 2017). First, we will show that this bias is a particular case of the maximization of mutual information between words and meanings. Second, we will review the optimality in the context of a more general information theoretic framework where mutual information maximization competes with other information theoretic principles. The bias turns out to be a prediction of modern information theory. We will also show the relationship between information theoretic principles and the principles of contrast and mutual exclusivity.

Keywords: child language, vocabulary learning biases, principle of contrast, mutual exclusivity, information theory

Understanding the presentation of a trophy implies the understanding of a syntactic structure

Sep 27
Day 2
17:30

Till Nikolaus von Heiseler
Free University of Berlin
formatlabor.net@googlemail.com

The analysis of the traits that distinguish language from animal communication is fundamental in any study of the origin of language. Traditionally, the power of language to express unlimited propositions with finite means was regarded as its unique quality (Chomsky, 1991). The key element of any linguistic structure is the verb that combines the arguments (such as agent, patient, instrument) depending on its valency. Verbs refer to actions. It has therefore been suggested that language is adapted to share past or future events (Corballis, 2013).

Peirce classifies signs according to the way they denote their objects: by pointing ad (index), by similarity (icon), and by convention (symbol). However, there is an essential distinction: while the difference between an icon and a symbol is only gradual, the difference between an icon and a symbol on one hand and an index on the other is discrete.

While the index corresponds to a whole statement, icons and symbols can form syntactic elements of a sentence. Animals live in a world of indexes (which refer to the here and now) while people live in a symbolic world (including mental time traveling). How could this gap be bridged? Is a constellation, in which an index refers to a past action or is part of the syntactic structure possible? Tracks (e.g. of an animal) refer to a past action, but they are not part of a syntactic structure. In contrast, the presentation of a trophy — e.g. of hunting or war — has a syntactic structure. The presenter is the agent, the trophy symbolizes the patient, and the verb kill is implied in the state of the patient. Generally, the patient is symbolized by its dead body or parts of it. However, the presentation of a trophy possesses a syntactic structure only if this presentation is understood. In our talk, we will explore if there is any evidence the structural similarity between trophy presentation and linguistic syntax is homologous or convergent. This is to say, if both emerged by having merely the same function — presenting a past action — or if the presentation of an index of a deed could be in any way the precursor of language. Both possibilities could shed new light on early language use.

Keywords: Narration, Trophy, Syntax, Index, Icon, Symbol

Sep 27
Day 2
17:30

Can Evolution Help Us Understand What Mind Is and Why Does it Develop?

Olga Vasileva

Simon Fraser University
ovasilev@sfu.ca

What is mind? How and why does mind develop in evolution? In my talk, I argue that addressing these questions is of prime importance for achieving any significant advancement in psychological and anthropological sciences. Moreover, recent advancements in various disciplines provide unique insights into the question of the evolution of cognition and urge for developing a unified framework that can explain the findings.

Data from genetic, comparative and developmental research suggests that majority of the evolutionary attention and pressure is concerned with the nervous system. It is now known that a large proportion of the total genome is expressed in the brain (up to 80%) (Lein et al., 2007); that g-intelligence increases over the course of evolution, despite seemingly not providing direct fitness benefits (Burkart et al., 2016); that in rodents the ability for anticipation correlates with abilities in other cognitive domains and is mediated by specific genetic variants (Poletaeva and Zorina, 2015). Moreover, studies in avian brain and intelligence suggest the cognition has emerged and progressed in evolution more than once, as avian brain contains structures functionally homologues to the mammalian neocortex (Jarvis et al., 2005) and that abilities for analogical reasoning are present not only in primates (Thompson and Oden, 2000), but corvids as well (Smirnova et al., 2015).

I suggest that these findings can only be understood within a framework addressing both the evolution of the nervous system, and the evolutionary progression of complex cognition and behavior. In my talk, I will propose such a framework, and review the aforementioned findings from a given perspective. The framework defines mind as an ability for mental representation of the environment. Consequently, cognitive evolution is conceptualised as a special form of adaptation, and that is, an increasing amplification and flexibility of the mental representation abilities. Importantly, this representation is species-specific and contingent upon phylogenetic and ontogenetic constraints of a given species.

The talk will outline how major trends in neurological (increased functional specialization and plasticity, functional cephalization, development of associative cortices) and parallel cognitive (analogical reasoning, behavioral flexibility, insight and extrapolation) evolution are explained by the proposed framework. I suggest these trends are indicative of the evolutionary development of the mind and can be best explained by the developing ability for mental representation of the environment. I will conclude my talk by discussing the implications of the framework for studies in comparative cognition and human evolution.

Keywords: cognition, evolution, comparative cognition, behavior evolution

Spatial deixis back in context: a new experimental paradigm for the study of demonstrative reference

Sep 27
Day 2
17:30

Roberta Rocca¹ and Juan Olvido Perea Garcia²

¹School for Communication and Culture, Aarhus University

²Interacting Minds Centre, Aarhus University

roberta.rocca@cc.au.dk | juan@interacting-minds.net

Spatial deixis is a fundamental building block of the flexible referentiality characterizing human communication. Words like *this* and *that* allow interlocutors to establish joint attention on intended referents in the physical space of interaction, which stands at the core of the emergence of complex cultural phenomena. However, despite its fundamental role in human communication and prominence in development (Diessel, 2006), current experimental literature on spatial deixis is still scarce and displays huge internal disagreement. In this talk, we deal with demonstratives as a specific kind of deictic reference. We will propose a new experimental approach which allows an investigation of deixis as an intrinsically collaborative, multimodal and situated process.

It is usually claimed that all languages encode a basic dyadic distinction between so-called *proximal* and *distal* demonstratives, the use of either form depending uniquely on the distance between speaker and referent (Coventry et al., 2014). However, recent studies point at a more complex picture, with social and perceptual factors playing a crucial role (Bonfiglioli et al., 2009; Peeters et al., 2015). In this talk, we will first review state-of-the-art experimental approaches to the study of spatial deixis. Then, we will present a series of experiments addressing the influence of perceptual and social factors in the use of demonstrative forms. We do so by embedding our participants in an interactive setting that aims to mimic naturalistic communication.

More specifically, our studies aimed at investigating:

- The effect of the distance of intended referents relative to the speaker and relative to competing referents on the choice of demonstrative forms;
- Whether the presence and the role (*collaborative* vs *complementary*) of an addressee modifies the distribution of likelihood of either form relative to the location of intended referents.

In our studies, participants are asked to refer to target objects lighting up on a horizontal screen via pointing gesture + demonstrative. Confederates perform a complementary (naming objects) or a collaborative task (note down the pointed location). Maps of likelihood to use distal/proximal demonstratives in lateral and sagittal coordinates of referents are compared across experimental conditions.

The advantage of such paradigm lies in its flexible adaptability to different languages and variables at stake. Moreover, it allows a more naturalistic approach to the study of deixis as a multimodal phenomenon (Tylén et al., 2010), as opposed to previous paradigms which rule out the interactive and perceptually rich context of reference in human communication.

Keywords: reference, deixis, spatial cognition, interaction, multimodality, context, experimental methods

Population growth and typological shifting in expanding languages

David Sanchez-Molina^{1*} and Mikel Fernandez Georges

¹BarcelonaTech

*david.sanchez-molina@upc.edu

Head-directionality parameter is an important typological feature. It is related with the position of nucleus or head inside a syntagma or syntax phrase. For example, there are OV-languages (here V is the head and is final) and VO-languages (here head V is initial); similarly, for Prepositional/Postpositional Phrases some languages use prepositions (head-initial feature) and other use postpositions (head-final feature). Among all languages in the world, we observe a balanced distribution in the *head-directionality parameter*: about one-half of the languages of the World shows *head-initial* preference, and the other half shows *head-final* features. Available evidence suggests that both possibilities are equally observable among the languages of the world.

In this paper, we present geographic and phylogenetic evidences suggesting that this evenly-balanced distribution in the *head-directionality* is a relatively-recent development, different from prevalent conditions in the Paleolithic. The majority of the languages with head-initial features belong to a recently arisen *linguistic genera*, in particular, they arose in 7 very specific areas on the Earth, and their current distribution can be explained by the way they spread, as it is observed in the map below (Fig. 1). This map shows in red the *linguistic genera* with prepositions (head-initial feature) and in blue the genera with postpositions (head-final feature), (ambiguous or intermediate situations are indicated in yellow, gray indicates unknown data or recent expansion cleaning out old linguistic genera). A striking coincidence is that the 7 areas where we found typological shift are precisely areas with a high genus-diversity and high population density due to the adoption of highly-productive economical innovation *head-directionality parameters* (e.g. beginning of the agriculture).

In addition, we note that the expansion of the number of speakers of a language, frequently involves language shifts (transfer, replacement or assimilation) and addition of new speakers seems to have an effect on the language structure at phonological, morphological and syntax levels. Moreover, some language families, whose expansion started on incipient agricultural Neolithic areas, where other additional families were also present, show a "typical warming syndrome" consisting in reducing morphological complexity and dominant shifting to certain typologies (head initial syntax).

This study provides evidence, using data from about 2000 languages from different databases, showing that the number of speakers has a statistically significant effect on grammar features. Specifically, a shift towards head initial syntax is observed.

The graph below (Fig. 2) shows the observed typologies (dark blue color represents high preponderance of head-final features, red color represents high preponderance of head-initial features). In the X-axis the population of the genus is indicated ("< 10 thousand" to "> 10 million" of speakers). We can observe that the typology is shifting to head-initial features for languages with more speakers.

Keywords: typological changes, language and population, language spreading, linguistic families

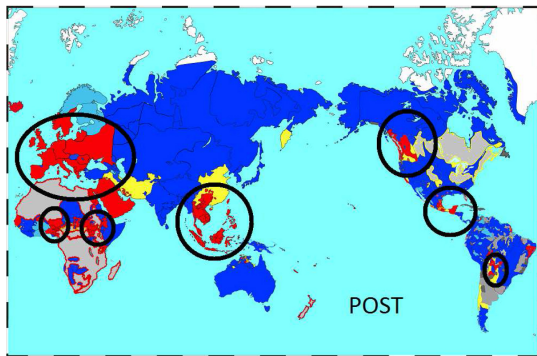


Figure 1: Linguistic genera

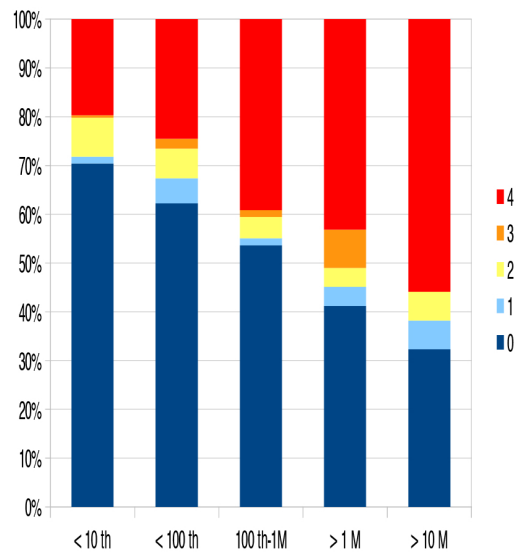


Figure 2: Observed typologies

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Sclera size index does not predict perceived trustworthiness: first empirical steps towards a reassessment of the functions of an overexposed sclera

Juan Olvido Perea García^{1*}, Przemysław Żywicznyński² and Sławomir Waciewicz²

¹Interacting Minds Centre, Aarhus University

²Nicolaus Copernicus University

*juan.olvido@gmail.com

Hypotheses about the peculiar morphology of the human eye can have profound implications in the fields of comparative and evolutionary psychology, which are relevant for disciplines like language evolution or interaction studies. We briefly review literature on human eyes in social cognition, stemming from a study in comparative morphology published twenty years ago. We take the first steps towards testing hypotheses regarding the origins of our particular eye morphology. Some, like the cooperative eye hypothesis, are well established but remain untested. We test a closely related hypothesis that we dub “*honest eye hypothesis*” by looking for a correlation between perceived trustworthiness (in faces from the *Chicago Face Database*) and an index of the exposed sclera size (SSI). We discuss our results in terms of experimental methodology and rationale motivating the hypothesis. Lastly, we propose new methods to further investigate a topic with far-reaching implications for our understanding of human evolution.

Keywords: morphology of the human eye, scleral de-pigmentation, exposed sclera size index (SSI), the cooperative eye hypothesis, the honest eye hypothesis, trustworthiness

The emergence of politeness — from implication to stable system

Sep 27
Day 2
17:30

Tobias Gretenkort

Aarhus University

tobiasgretenkort@gmail.com

The vast controversial literature on politeness can be roughly divided into a universalist and a culture-specific tendency. We diagnose the reason for this opposition to lie in the base assumption of linear causality. Theories based on an individual scope are bound to result in a universalist framework, while those with a collective scope will be more sensitive to culture-specific differences. The theorising on politeness can be reconciled by approaching it as an emergent dynamic system, i.e. a system in which causality is circular and in which the individual and collective levels feedback and influence each other mutually. Such a perspective enables us to explain how Individual, idiosyncratic and strategic use of politeness can propagate into and stabilise as a linguistic system (proto-politeness), and how this system, in turn, puts constraints on the individual use of politeness. In this way, both universalist and culture-specific theories can be accounted for, without being mutually exclusive and without having to regard them as describing different phenomena. Furthermore, this description enables us to approach the question of how politeness came about to begin with since the direction of propagation in our feedback-loop describes the stabilization of idiosyncratic implicative noise toward a rule based learnable system.

This meta-theoretic account also let us draw experimental predictions, which we tested in the laboratory. Dyads of participants engaged in a chat-room like linguistic game, in which they had to request objects from an artificial intelligence by making use of an unknown (computer generated) language. Two chat-bots introduced idiosyncratic noise (politeness markers) into the channel. The manipulation of experimental conditions on different axes (collective vs. competitive play; functional vs. unfunctional markers) let us observe, under which conditions politeness markers are more likely to be picked up by participants and stabilized over time. We can thus infer the conditions for politeness to arise and describe its emergence quite carefully.

Both the meta-theoretic and the empirical construal of politeness in these terms, enable researchers to account for seemingly contradictory claims in politeness research, experimentally verify the conditions under which politeness arises and develops, and explain the dynamicity and breathtaking variety in which politeness presents itself in different cultures.

Keywords: politeness, emergence, meta-theory, experimental semiotics, dynamic systems, proto-politeness

Sep 27
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17:30

Backchannel Interjections in Human Language and Their Acquisition

Koji Kawahara

Nagoya University of Foreign Studies
kkoji@nufs.ac.jp

Interjections are holophrastic coded signals that refer to speech acts with a propositional content (Poggi, 2009). One such example would be *huh?* that gives rise to other-initiated repair (Dingemanse et al., 2013, 2015b): speakers use the word to resolve troubles of hearing or understanding. The main focus of this talk is on backchannel interjections like *ah* or its variant that is used to express agreement or satisfaction in order to facilitate conversation and encourage continuation. The backchannel interjections are important in linguistic analysis for the following three reasons. First, slight differences aside, the [a] sound is adopted cross-linguistically: *uh-hun*, *ah* (English), *aja* (Spanish), *ah* (Chinese, French, German, Japanese, Korean) and *aih* (Arabic). Second, it is produced by young children when they are around 6 to 8 months old. It is pointed out that [ma], [na] and [ama] are used to refer to ‘mother’ universally because these sounds are acquired in the very early stages and the notion mother is vitally important for young children (Murdock, 1959; Jakobson, 1960b). The same kind of phenomenon is found in backchannels.

Third, their high frequency is most important. We have investigated how often the backchannel expression *ah* is used in natural conversations in Japanese. We have counted the number of backchannels initiated by the [a] sound in three corpuses. Two of them are by young children: 1;5 and 2;02 (Hamasaki, 2004; Miyata, 2004). The other is based on university students (Miyata et al., 2010). We find that the backchannel is frequently used both by young children and adults. In the first two corpuses the conversation is between young children and their mother and we have counted the number of the interjection by young children. In the first, it is used about once per 36 seconds on average. In the second, it is about once per 55 seconds. In the final corpus the conversation is among four university students and the interjection is used about once per 26 seconds. A plausible explanation for the wide range of its uses is convergent evolution on condition that conversations are built out of sequences in systematic ways; it is shaped by selective pressures in an interactional environment (Sacks et al., 1974; Goffman, 1981; Schegloff, 2007; Enfield, 2013; Dingemanse et al., 2013).

Keywords: interjections, conversation, acquisition, convergent evolution

Signalling stories. The role of metacommunication signals in fiction as an evolved phenomenon and its implications for the evolution of storytelling and language

Sep 27
Day 2
17:30

Marta Sibierska

Nicolaus Copernicus University
marta.sibierska@gmail.com

In recent years, storytelling has become an increasingly important aspect in the discussion on language origins (Dunbar, 2014; Corballis, 2017b). One of the most influential models of storytelling is the one primarily proposed by (Boyd, 2009), presupposing that fiction is an adaptation evolved from play behaviour. As such, fiction seems to follow the universal patterns of animal play, consisting of the play proper phase as well as a pre-play exchange of metacommunication signals that indicate play intentions (cf. Bateson, 1972; Bekoff, 1975; Sutton-Smith, 1997; Burghardt, 2005; Graham and Burghardt, 2010). Although metacommunication signals have been mentioned (e.g. Collins, 2013), so far they have not been analysed in detail on the basis of empirical data. The paper presents the results of a study on the role of metacommunication signals in fiction. The study proper has been preceded by a pilot study on a corpus of 100 texts that has identified possible play signals, varying in their structure as well as the levels of conventionalisation and competence necessary to comprehend them (low or high competence signals). The study proper is based on texts that have been prepared with the use of two corpora: an online corpus of Polish language (sjp.pwn.pl/korpus) and a corpus of literary texts created specifically for the purposes of the study. The stimuli have been composed so that to exploit the possible combinations of authentic literary and non-literary texts as well as their altered versions with added or deleted signals of low and high competence. The study has been conducted on 180 participants — native speakers of Polish — who have been asked to assess the texts as either descriptions of events or stories (cf. Herman, 2007). By that, it has tested the hypothesis that texts are recognised as stories when they contain a play signal, regardless of their source; this, in turn, suggests that play signals are a constitutive element of storytelling. With that, the paper both develops and tests Boyd's model. Further, it points to the implications that this study has for storytelling and language evolution: e.g. as play signals are indispensable for verbal storytelling, can their counterparts be found also in non-verbal narratives? Do they have to be linguistically or stylistically complex? In other words, could it have been possible to “signal” stories with the use of protolanguage, vocalisations, or pantomime?

Keywords: storytelling, metacommunication signals, play

Sep 27
Day 2
17:30

Towards an action-based approach to the evolution of language and music

Rie Asano

University of Cologne
rie.asano@uni-koeln.de

Language and music considered as cognitive systems form a mosaic, consisting of multiple components with different evolutionary origins (Boeckx, 2013; Fitch, 2006). From a comparative language-music perspective, some of these components might be shared and based on the same evolutionary genesis, while others might be different and emerged independently in the course of evolution. Moreover, from a comparative between-species perspective, some might be shared with other animals, while others might be unique to humans. This shared-distinct dichotomy dominating the recent comparative approach usually depends on tailor-made categories fitting to just one domain or species and thus limits the range of investigation by its all-or-nothing contrastive view (De Waal and Ferrari, 2010; Theofanopoulou and Boeckx, 2015). Alternatively, the current paper suggests an action-based approach as a promising comparative approach to investigate language and music. In particular, based on the findings from cognitive and evolutionary neuroscience (Lieberman, 2002, 2016; Merchant et al., 2015; Honing and Merchant, 2014; Patel and Iversen, 2014; Rauschecker and Scott, 2009), I discuss how the cognitive systems language and music might be implemented in the brain in form of *distributed networks* on the basis of domain-general, action-based neural structures, particularly the basal ganglia, the cortico-basal ganglia-thalamo-cortical circuits, and the dorsal stream including Broca's area. This approach, on one hand, avoids the problematic shared-distinct dichotomy by examining cognitive systems in terms of *distributed networks* realized by means of the basic domain-general neural structures which also underlie action cognition such as representing goals, action planning and control as well as sensory-motor integration. On the other hand, it does not reduce distinct cognitive domains to a single all-purpose system because it explains the way how those neural structures implement each cognitive system differently. Moreover, such an action-based network approach to cognitive systems provides rich between-species comparative strategies because the above mentioned neural structures and networks are largely (but not completely) shared with non-human primates' action cognition (Mendoza and Merchant, 2014). Thus, the result of the current paper provides a strong support for hypotheses suggesting to regard current neurocognitive systems such as language and music as products of evolutionary changes from ancestral systems such as action cognition (Boeckx and Fujita, 2014; Fujita, 2016).

Keywords: language, music, action, evolution, comparative approach, networks, basal ganglia, cortico-basal ganglia-thalamo-cortical circuits, dorsal stream, Broca's area

Differences on the OXTR between modern humans and extinct hominids: a window to our language-ready behavior

Sep 27
Day 2
17:30

Alejandro Muñoz Andirkó¹, Constantina Theofanopoulou^{1,2,3} and Cedric Boeckx^{1,3,4}

¹University of Barcelona

²Rockefeller University

³University of Barcelona Institute of Complex Systems (UBICS)

⁴Institució Catalana de Recerca i Estudis Avançats (ICREA)

sanyi.personal@gmail.com | constantinaki@hotmail.com | cedric.boeckx@ub.edu

Oxytocin is an important neurotransmitter that functions through its receptor (OXTR) to control a diverse set of biological processes: pregnancy and uterine contractions, milk-ejection, attachment between mothers and their young, bond formation, copulation and orgasm, suppression of stress, thermoregulation, olfactory processing, eye-contact and recognition of familiar individuals. Changes on the OXTR have been repeatedly associated with social deficits (like Autism Spectrum Disorders and Schizophrenia) and aggressive behavior, and interestingly, with communication problems, suggesting a role of oxytocin in our linguistic cognition. Since many different Single Nucleotide Polymorphisms (SNPs) on this gene have been associated with specific behavioral phenotypes, we used the OXTR as a testbed for possible behavioral differences between modern humans on the one hand and extinct hominids on the other. We searched if there are any Single Nucleotide Polymorphisms (SNPs) on the OXTR in humans, when compared to Neanderthals and Denisovans, and if any of those coincide with SNPs that have been already shown to have a behavioral correlate in humans. For the identification of SNPs on the OXTR in human populations, we made an exhaustive research in the Pubmed literature (<https://www.ncbi.nlm.nih.gov/>). We used the sequences found in the Hg19 database for humans and in the Ancient Genome Browser (offered by the Max Planck Institute of Evolutionary Anthropology) for Neanderthals and Denisovans. For the pairwise alignments we used Multialin, GATA, Alview and Decipher. We identified several loci on the OXTR where humans differ from both Neanderthals and Denisovans, from which one has been linked to autism and social impairment (rs237884). Our findings are suggestive of a more social and friendly behavior in modern humans in comparison with our extinct hominids. More genes with identified SNPs in human disease should be tested for robust conclusions to be drawn.

Keywords: oxytocin receptor, modern humans, Neanderthals, Denisovans, SNPs

Evolutionarily conserved pathways for Lexicalization

Thomas O'Rourke, and Saleh Alamri

University of Barcelona

tomo.orourke@gmail.com | saleh.alamrim@gmail.com

Human beings display distinctive forms of communication, social interaction and expressive capacity. Despite the multifaceted nature of human communication, classical theories of language have attempted to identify its neurobiological substrate in discrete regions of the neocortex: Broca's and Wernicke's areas. Likewise, humans exhibit rapid on-line language processing, including vocalizing, receiving, gathering and interpreting (Duff et al., 2009; Duff and Brown-Schmidt, 2012). The medial temporal lobe plays a crucial role in these processes, which depend in large part on the declarative memory system. Humans' expressive capacities also depend on a huge lexical repertoire, which has its most significant neurobiological hub at the posterior temporal-parietal-occipital junction.

We provide evidence that largely marginalized cortical/subcortical regions, underpin two seemingly distinct yet related facets of language: the flexible discourse which is the hallmark of much social communication and the encoding of memories (hence meanings) that are picked out by lexical items.

Our hypothesis highlights important components at the neurobiological level in these processes of communication and lexicalization: the hippocampus, the prefrontal cortex, and distinct white-matter matter tracts connecting the prefrontal cortex with both anterior and posterior parahippocampal regions.

We consider the roles played by two white-matter tracts: the uncinate fasciculus (UF) - which connects the prefrontal cortex to the anterior temporal lobe (including medial regions relaying to hippocampus), and inferior fronto-occipital fasciculus (IFOF), connecting posterior temporal and occipital regions. Based on lesion and functional imaging data (as in Mummery et al., 1999; Papagno et al., 2011), we propose that the UF supports the long-term encoding of proper names in the temporal pole via the medial temporal lobe, drawing on some of the same correlates of social cognition involved in real-time social interactions. From an evolutionary perspective the UF has largely shared structure with non-human primates (de Schotten et al., 2012), suggesting that many of the cognitive correlates underlying proper-name encoding are shared with other species. Indeed, lesions to UF-connected regions induce similar cross-species deficits (Olson et al., 2007). The IFOF, on the other hand, is quite distinct in humans as compared with other primates (de Schotten et al., 2012).

We carry out a review of several lesions in which fronto-temporal white-matter/hippocampus are affected, including the language profiles of patients. This serves to highlight the need to extend the language network beyond the long-standing dogma of there being limited "language areas" in the brain.

Keywords: uncinate fasciculus, hippocampus, lexicalization, online language processing

From a rhythmic musical protolanguage to a metrical and tonal-harmonic music

Alexandre Celma-Miralles^{1*} and Joana Rosselló Ximenes²

¹Pompeu Fabra University

²University of Barcelona

*alexandre.celma@upf.edu

Sep 27
Day 2
17:30

Music and language are two distinctively human universals that have evolved by mutual interaction. Darwin suggested that before speaking, our ancestors were able to sing in a way structurally and functionally similar to what birds do. We assume that at an early stage, a musical protolanguage yielded a communicational system that was the common basis for music and language. At some point, within our genus, this musical protolanguage may have developed rhythmic structures with an underlying beat. This rhythmic period within the musical protolanguage may have consisted of vocalizations and drumming behaviors based on a steady beat, permitting social interactive activities within groups, such as dance-like and other cohesive rituals. More recently, the hierarchical recursion along with grammar and lexical meaning joined this musical protolanguage and gave rise to language, which in turn affected music. Linguistic recursion (i.e. merge), made the musical meter possible, which allows to organize the beat into complex hierarchical patterns. Indeed, we propose that metrical rhythms would have preceded tonality in the evolution of music. The idea is that harmonic relationships and tonality were added to a metrical protomusic in parallel to the emergence of grammar in the cognitive modern *Homo sapiens*. We argue that a rhythmic protomusic may have appeared in the genus *Homo* between the earlier vocalizations of older ancestors and our modern metrical and tonal-harmonic music. That beat is more primitive than meter is suggested by the fact that some animals perceive but do not externalize it. Crucially, these animals are all related to vocal learner species, which suggests that the recruitment of fine auditory-motor connections in the brain was primordial for the earlier forms of music and language. In addition, externalization, either in musical rhythm or language, requires a complex social behavior, which for rhythm is already present in the drumming behavior of certain primates. The role of vocalizations, in turn, goes even further: their harmonic spectrum underpinned the tones of our musical scales, but the use of tones as cognitive referential points (i.e. tonality) may have been driven by a linguistic brain interpreting and favorizing certain harmonic relationships learned through cultural transmission. Thus, driven to a large extent by language, music has turned out to be as we know it nowadays.

Keywords: musical protolanguage, beat and meter, harmony and tonality, language evolution

Sep 27
Day 2
17:30

The interplay between the medium and syntax in language re-construction

Marek Placiński and Monika Boruta

Nicolaus Copernicus University
m.placinski92@gmail.com | monika.feba@vp.pl

Inquiry into language evolution has recently focused on the question of the so-called *natural word order*, i.e. a word order which may be primary in a cognitive and phylogenetic sense (Dryer, 2005; Pagel, 2009; Gell-Mann and Ruhlen, 2011). Some substantial insights into this topic originate in gesture and sign studies. Research by Goldin-Meadow et al. (2008) has inspired scientists to use the *silent gesture* paradigm, which requires participants to narrate events with the use of their hands. The results of the initial Goldin-Meadow et al.'s study revealed that participants tended to produce SOV word order of a transitive event, regardless of the syntax of their native language. The finding was corroborated to a degree in later studies; however, some of them shed more light on the issue (Gibson et al., 2013; Hall et al., 2013; Sandler et al., 2005). The aim of our study is to test whether the SOV order is dominant when participants communicate events with whole-body pantomime and with mono- and dia- transitive verbs.

What constitutes the material for our research is the recordings of simple transitive events. The actors in the recordings are students of English Studies at the Nicolaus Copernicus University in Toruń. The actors were instructed to perform whole-bodily pantomime of simple transitive events such as “the boy pulls the girl’s hair” or “she pulls the door”. The re-enactments, following Gibson et al.’s (2013) terminology, were both reversible (the agent and the patient of the sentence are animate) and non-reversible (the agent is animate, and the patient is not). To analyse the syntactic structure of the sentences, we fed the recordings into ELAN and annotated them with the labels corresponding to their function in the re-enactment: subject (agent), the verb (action) and the object (patient) separately, so as to determine the order in which these were performed.

Keywords: natural word order, pantomime, evolution of language, ordering of events

Self-touching, gesticulations and attentional processes. An eye-tracking study

Sylwester Orzechowski¹, Przemysław Żywicznyński² and Sławomir Wacewicz^{2*}

¹Maria Curie-Skłodowska University

²Nicolaus Copernicus University

*wacewicz@umk.pl

Sep 27
Day 2
17:30

Self-touching behaviors — such as scratching one's cheek or rubbing one's nose — are typically accounted for in terms of self-regulation (e.g. coping with negative affect or disruptions of attention), but there are also lines of research indicating that self-touching plays a supportive role in the dynamics of face-to-face interaction. Although self-touching behaviors are extremely common in face-to-face interaction, little is known about the perception of these movements and the degree to which they attract visual attention. In this paper, we report an eye-tracking study on the perception of self-touches, in which 27 subjects saw a videorecording of an actor performing posed discrete self-touching behaviors while narrating a story. We compared the proportion of visual attention allocated to self-touches, gesticulations and the face, measured in terms of relative dwell time and average fixation duration. While the face was the most fixated area, self-touching activity attracted significantly more attention than gesticulations. We offer several interpretations of this result, including those underscoring the informative-interactive potential of self-touches.

Keywords: self-touching, gesticulations, co-speech gestures, visual perception, eye tracking, self-regulation, illustrators, visual attention

Sep 27
Day 2
17:30

Associations between variation in the vasopressin 1a receptor gene and social behaviour in humans – from altruism to autism

Stefanie Sturm

University of Barcelona
stefaniesturm@outlook.com

The goal of the poster is to present the results of an interdisciplinary scientific review investigating the role of arginine vasopressin (AVP) for human social behaviour. It will focus on the association between genetic variation in the AVP r1a receptor gene and different degrees of social competence, and how these associations are mediated on a molecular level.

In recent years, a lot of research has been done on the two structurally very similar neuropeptides, oxytocin and vasopressin. New studies are regularly published, often investigating very specific questions, and the contribution of my review is to collect and evaluate the knowledge we have to date and to try to see the bigger picture.

Evaluating the most recent findings in this field and integrating it into the framework that has already been created by previous reviews (Albers, 2012; Caldwell et al., 2008) investigating the role of AVP for social behaviour, I aim to shed some light on the genetic basis of human social behaviour, to which communicative behaviour is closely linked. The underlying assumption here is that communicative behaviour determines our species specific needs for communicative tools – and this being, in the case of humans, most famously, language.

Most of the information I am evaluating comes from studies comparing different genetic variants with behavioural properties such as the degree of altruistic behaviour (measured through the Dictator Game, for example), or atypical behavioural patterns such as those that can be observed in individuals with autism spectrum disorder, combined with imagining genetics and findings coming from experiments with non-human primates or other mammals. We are still in the early stages of understanding the molecular basis of behaviour, but we can see a clear link between certain variants of the AVP 1a receptor gene and certain social behaviours.

By understanding the role of AVP for social behaviour and its genetic basis, a goal which we can hope to achieve in the future, we will move closer to understanding the role of genetics in behaviour on the one hand, and the evolutionary history of the human traits that make it possible for us to use a communication system that is as complex and abstract as natural language.

Keywords: vasopressin, neuropeptides, evolution of language, communication, genetic variation, hormones, biological basis of communication

Vocabulary acquisition over a 1-week training program, an electrophysiological study

Sep 27
Day 2
17:30

Neus Ramos-Escobar¹, Clément François¹, Matti Laine² and Antoni Rodríguez-Fornells^{1*}

¹Cognition and Brain Plasticity Group, Bellvitge Biomedical Research Institute

²Åbo Akademi University

*arforne1ls@gmail.com

The ability to acquire a new vocabulary frequently occurs in our lives, not only when learning a new language but also when starting a new activity. The centro-parietal N400 component of the event-related brain potentials has been classically associated to semantic-conceptual processes. Nonetheless, recent ERP studies have provided evidence for a fronto-central N400 involved in novel word learning tasks. In the present study, we used the Ancient Farming Equipment Paradigm to examine the brain responses of 25 adult participants acquiring a new vocabulary (novel object picture with non-word pairs) over five consecutive days. Three memory tasks (overt naming, covert naming and recognition tasks) were administered during each training session and a four months follow-up tested the maintenance of the word to picture associations. During the first and last training sessions EEG was recorded. Interestingly, both behavioral and ERP data showed evidences of learning with correctly learned associations eliciting changes in ERP components over time. The LPC component after picture increases throughout blocks and this enhancement correlates with a decrease in N400 amplitude after pseudo-word, which may reflect a priming effect of semantic facilitation. Moreover, the increment of N400 amplitude after picture in Day 5 seems to reinforce this idea of an anticipation when knowledge is already acquired. In summary, these results provide further evidence for the involvement of the FN400 and LPC component in the early stages of word learning.

Keywords: word learning, N400/FN400, learning/memory

Sep 27
Day 2
17:30

Satisficing trumps optimizing in human communication

Bruno Galantucci
Yeshiva University
Haskins Laboratories
bruno.galantucci@gmail.com

The dominant models of human communication all share the assumption that, when people communicate, they aim to optimize the informational transactions they perform. The assumption has a wide scope, ranging from the minimization of physical noise to the systematic repair of conversational breakdowns. In this talk I will present evidence suggesting that the assumption might reflect an unrealistic idealization.

An earlier indication that this might be the case comes from research showing that, because of cognitive biases, people do not always perform all of the steps necessary to prevent communicational breakdowns. This is typically viewed as a failure in using the ability to optimize communication. To my knowledge, the possibility that people might not even aim to optimize their communicative interactions has never been entertained. In a series of studies performed in my lab, we have gathered evidence suggesting that this possibility might very well be real.

The first two studies focused on spontaneous conversations over instant messaging. In one of them we crossed the conversations of two pairs or participants a number of times (a bit like when a phone call is mixed with another) and found that it is not uncommon for people to not notice the crossings. The second study replicated the first but with odd messages we created and inserted. Again, people did not notice the odd insertions, even when they contradicted basic information they had (e.g., the message referred to a participant as “a man” when she was a woman and this was well-known to the conversational partner).

The third study upped the ante in two ways. First, we focused on spontaneous face-to-face conversations with a confederate. Second, the odd message inserted was “colorless green ideas sleep furiously”, a sentence which was bound to be incoherent in pretty much any conversational context. Again, it was not uncommon for people to not notice the incoherence.

In the fourth study the odd insertion had a concrete interactional impact. Participants played a simple communication game in which, after a few mundane turns, they were instructed by the experimenter to move “the jandel”. Although “jandel” is a non-word, it was not uncommon for people to pick an object without initiating a repair sequence.

I will conclude by arguing that the results of these studies suggest that human communication – much as human cognition – prefers satisficing over optimizing and, precisely for this reason, it constantly lives on the brink of failure.

Keywords: psychology, linguistics, cognitive science, human communication, pragmatics

The greed for computational resources as the drive for larger brains

Sep 27
Day 2
17:30

Daniele Panizza

University of Goettingen
daniele.panizza@gmail.com

A line of research (Hauser et al., 2002; Berwick and Chomsky, 2016) has attempted to identify a common property (the Basic Property) underlying the evolution of human language, symbolic and mathematical abilities as Merge, a compositional and recursive set-formation operation, plus sensory-motoric and conceptual-intentional interfaces. While non-human complex behavior can be modeled as an iterative process (e.g. tool making = loop[modify(object) → if ready(object) : stop; else : continue]) it has been argued that hierarchical linguistic computation (Hauser et al., 2002) requires recursion (e.g. “the boy walks” = Merge[Merge[the, boy], walks]). In computability theory it follows from the Church-Turing hypothesis (Kleene, 1967) that any recursive function can be modeled as an iterative model (and vice versa) by a Turing Machine, which is exactly how CPUs handle recursion. Here, we propose that the Basic Property should be defined as a more basic principle, namely *abstract reference*. Given an iterative function f , *abstract reference* is the capacity of passing to f any kind of argument such as an object (e.g. a concrete object or an abstract representation), a variable or another function. This property turns an iterative algorithm into a potentially recursive function able to perform a) multi-argument operations (Odifreddi and Cooper, 2016) and b) embedded level of abstraction (Corballis, 2011). Crucially, this property allows (only) the human computation system to operate recursively and compositionally. However, this comes at a cost. Unlike iterative algorithms, multi-argument and recursive functions must retain in memory the function call as well as all other embedded functions or objects until the end of the computation. Thus a computational system using *abstract reference* is more resource-demanding than a system using only iterative algorithms. We claim that this is the primary reason why human ancestors selected for larger and more complex brains. This has the following implications for paleoanthropology.

- The ‘greed for computational resources’ due to *abstract reference* has been the driving force for the brain expansion and reorganization taking place almost linearly over time in the following 3myr (see endocast data Holloway et al., 2004). In contrast, cultural development as hominid industry did not advance for periods of 1.5myr (Mode-I: 3.3mya-1.75mya; Mode-II: 1.75mya-100kya), while it advanced rapidly during the Neolithic revolution where brain size remained steady (Oppenheimer, 2013).
- The Australopithecus Africanus was the first animal to have *abstract reference* as hominid brain reorganization was underway (Albrecht et al., 2014).
- The most conservative estimate for the emergence of language is around 400kya, when the earliest art figurines (Bednarik, 2003; d’Errico and Nowell, 2000) and fully abstract engravings (Mania and Mania, 1988; Bednarik, 2008), which have never been produced by other animals and presuppose symbolic and mathematical abilities, had been made by *homo erectus*.

Keywords: language Evolution, brain Evolution, recursion, basic Property

**Mini-Symposium:
Insights from birdsong into the
evolution and development of spoken
language**

Sep 28
Day 3
16:00

General description

Constantina Theofanopoulou

University of Barcelona

Rockefeller University

University of Barcelona Institute of Complex Systems (UBICS)

constantinaki@hotmail.com

One of the most striking components that render human language a complex communicative system is the ability to produce and combine vocal expressions that are learned in the first stages of life. This ability for vocal learning is not only found in human speech; other mammals (bats, cetaceans, sea lions, and elephants) and birds (songbirds, parrots, and hummingbirds) have independently evolved this trait for communicative purposes. Aim of this minisymposium is to highlight the insights birdsong-research has offered into the evolution and development of speech, from genes to behavior.

Songbirds have been the animals most extensively studied in the context of vocal learning. Their song-learning ability does not only display a metaphorical parallel to human speech-learning, since there is now evidence that vocal learning in both taxa (namely song in songbirds and speech and song in humans) has undergone convergent evolution, based on behavior, neural connectivity, and gene expression specializations in song and speech brain regions (Doupe and Kuhl, 1999; Jarvis, 2004; Pfenning et al., 2014).

In this minisymposium we will focus on specific insights of song-learning that have provided a foundation for the understanding of the specialized mechanisms of learned voice production that appear to be convergent with human speech learning. More explicitly, Erich D. Jarvis will talk about specialized molecular convergences in vocal learners and will propose that key components of language are continuous among species. Constance Scharff will zoom in genes specialized for vocal learning and specifically in the role of the FoxP1/2/4 genes in birdsong, genes that have been implicated in language deficits in humans. Carel ten Cate will shed light on the the computational/'grammatical' mechanisms that guide (vocal) learning in humans and/or birds. Finally, Constantina Theofanopoulou will focus on the implications of neurohormones (particularly, oxytocin) in the social reward mechanisms that boost songbirds' ability to learn their tutors' song.

Using birds to provide insights in the evolution of grammatical rule learning

Carel ten Cate

Leiden University

c.j.ten.cate@biology.leidenuniv.nl

The abilities of non-human animals to learn and abstract grammatical rules may provide a window on the origin of human grammatical rule learning abilities — an area of controversies. A central question in this debate is whether the computational and learning mechanisms that guide learning about language structure are special and specific to language or humans. This question can only be answered by examining the rule learning abilities of other species and exploring the similarities and differences. An increasing number of studies are using the artificial grammar learning (AGL) paradigm to investigate these abilities. In our work we do so using birds. I will present an overview of this work and relate our findings to those in other species and those obtained in humans.

Small steps in animal models, giant leaps for language evolution?

Constance Scharff

Freie Universität Berlin

constance.scharff@fu-berlin.de

Spoken language and birdsong share a number of striking parallels. Comparing the biologically tractable aspects of language and birdsong can address which properties are shared and which are unique to each. I will review evidence for the relevance of the FoxP1/2/4 genes and their associated molecular network for speech and their role in the songbird basal ganglia circuit relevant for the acquisition and production of birdsong. Many questions regarding the similarities between spoken language and birdsong remain unanswered, but increasing evidence suggests that human and non-human communication systems may rely on conserved molecular toolkits that act as genetic modules. These may specify the neural circuits subserving these particular behaviors, and organize their function. Elucidating these genetic modules in different animal models may inform the evolution of language and other complex traits.

Insights from non-human animals into the neurobiology of language

Erich D. Jarvis

Rockefeller University

jarvis@neuro.duke.edu

Understanding mechanisms of language can be considered one of the final frontiers towards understanding brain mechanisms of complex behaviors. A challenge has been that language was considered unique to humans. However, the last several decades has seen a surge in non-human animal studies that inform us about language. Here we will present a modern synthesis of these studies, from molecular, circuit, to behavior levels of analyses. A key new concept is that components of language, including vocal learning, are continuous among species, and therefore can be used to gain insight into mechanisms and evolution of language. Testing these hypotheses will require developing novel brain circuit manipulation tools, so that we can manipulate complex brain circuits and the traits they control, including language circuits.

Social reward in vocal learning: the case of oxytocin

Constantina Theofanopoulou

University of Barcelona

Rockefeller University

constantinaki@hotmail.com

Language acquisition in humans and song learning in songbirds naturally happen as a social learning experience, providing an excellent opportunity to reveal social motivation and reward mechanisms that boost sensorimotor learning, namely to reveal what is it that drives the social motivation for imitation of communicative sounds, as opposed to natural/environmental sounds. Our knowledge about the mechanisms that control these social mechanisms is limited. I will review evidence on the relevance of 'reward'-neurotransmitters, like dopamine, in the songbird neural circuit responsible for vocal-learning and will propose a role for oxytocin in the social motivation of this circuit, showing evidence at a behavioral and neural level. Since in humans deficiencies in the oxytocinergic system have been repeatedly associated with social communication problems, I will put forward that oxytocin might be specifically involved in the mechanisms enhancing the vocal aspect of human language, with a possible therapeutic function.

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Conference Program

	Day 1 (Sep 26)	Day 2 (Sep 27)	Day 3 (Sep 28)
8:30	Registration		
9:00	Opening remarks	Keynote 3: Martin Kuhlwilm	
9:30	Keynote 1: Sonja Vernes	McBride Mann & Hoeschele	Macuch Silva et al.
10:00	Coffee break	Coffee break	Nölle et al.
11:00	Casas et al.	Gontier	Coffee Break
11:30	Spranger	Ferretti et al.	N. Johansson
12:00	Smith et al.	Geurts	Cuskley
12:30	Rogalska-Chodecka	Seifert & Asano	Pleyer & Hartmann
13:00			
13:30	Lunch break	Lunch break	Lunch break
14:00			
14:30	Tamariz & Martin	Tamariz	S. Johansson
15:00		Feeney	Loria
15:30	Flash presentations	Hernandez-Gutierrez et al.	Mini-symposium: 15:30 - ten Cate
16:00		Goucha et al.	16:15 - Scharff
16:30	Coffee break	Coffee break	Coffee break
17:00	Mühlenbernd et al.	Martins	Mini-symposium: 17:45 - Jarvis
17:30	Hartmann & Pleyer		18:30 - Theofanopoulou
18:00	Keynote 2: Olga Feher	Posters + Wine reception	(Closing remarks)
18:30			
TBA		Dinner	Dinner