ABSTRACTS


Biolinguistic Investigations
on the Language Faculty
January 26-28, 2015
Pavia, Italy

CONFERENCE PROGRAM

* All talks are given in *Sala del Camino* (Aula Magna) of IUSS, Pavia.

Monday, January 26

8:00-9:00	Registration
9:00-9:15	Welcome
9:15-10:00	Ken Wexler, MIT - Invited talk ***Developmental Biolinguistic Investigations in Syntax and Semantics***
10:00-10:45	Arhonto Terzi, Technological Educational Institute of Patras, Greece Theodoros Marinis, University of Reading Konstantinos Francis, University of Athens ***Clitics of Children With Autism: Impaired Syntax, Discourse/Pragmatics or Prosody?***
10:45-11:15	**Break**
11:15-12:00	Anna Gavarró, Universitat Autònoma de Barcelona Myriam Cantú-Sánchez, Universitat Autònoma de Barcelona ***A Study in Spanish SLI and the Founder Effect***
12:00-14:00	**Lunch**
14:00-14:45	Giuseppe Longobardi, University of York and University of Trieste Cristina Guardiano, Università degli Studi di Modena e Reggio Emilia Andrea Ceolin, University of York Guido Barbujani, University of Ferrara Silvia Ghirotto, University of Ferrara ***Across Language Families: Genome Diversity Mirrors Linguistic Variation Within Europe***
14:45-15:30	Giuseppe Longobardi, University of York and University of Trieste Andrea Ceolin, University of York Aaron Ecay, University of York and University of Pennsylvania Cristina Guardiano, Università degli Studi di Modena e Reggio Emilia Monica Alexandrina Irimia, University of York Nina Radkevich, University of York ***Algorithmic Generation of Random Languages Argues for Syntax as a Source of Phylogenetic Information***
15:30-16:00	**Break**
16:00-16:45	Anna Maria Di Sciullo, UQAM Stanca Somesfalean, UQAM ***Language Faculty, Language Development and Object Pronouns in Romanian***
16:45-18:00	**Poster Session** (see bellow)
	***Dinner**

Tuesday, January 27

9:00-9:45	Caterina Donati, Université Paris Diderot - Paris 7 Chiara Branchini, Università Ca' Foscari Venezia ***The Grammar of Code Blending. What Bimodal Bilinguals Can Teach Us About Language Architecture***
9:45-10:30	John Winward, Thammasat University, Thailand ***Second Language Users and the English Article System – Where Does It All Go Right?***
10:30-11:00	**Break**
11:00-11:45	Scott Thomas, Alexandria, Virginia ***Architecture (Conceptual and Cognitive) and Language Processing***
11:45-12:30	Manuela Ambar, University of Lisboa ***Root Subjunctive Clauses***
12:30-14:00	**Lunch**
14:00-14:45	Edward Ruoyang Shi, Universitat de Barcelona Saleh Alamri, Universitat de Barcelona ***FOXP2 and Language: A More Nuanced View***
14:45-15:30	Gonzalo Castillo, Universitat de Barcelona Elizabeth Qing Zhang, Universitat de Barcelona ***Is Externalization More Than a Side Effect? The Cognitive Abilities of Vocal Learning Birds***
15:30-16:00	**Break**
16:00- 16:45	Mirko Grimaldi, University of Salento / CRIL Anna Dora Manca, University of Salento / CRIL Francesco Sigona, University of Salento / CRIL Francesco Di Russo, University of Rome ***Electrophysiological Evidence of Italian Vowels Segregation and Representation in Human Auditory Cortex***
16:45-17:30	Camila Matamoros, Concordia University Charles Reiss, Concordia University ***Variables and Other Biolinguistic Issues in Phonology***
17:30- 18:00	**Break**
18:00-18:45	Joana Rosselló, Universitat de Barcelona ***Language Externalization Is Not Secondary: On the Integration of Speech and Thought***
18:45-19:15	Pedro Tiago Martins, Universitat Pompeu Fabra Bridget Samuels, University of Southern Carolina Cedric Boeckx, Universitat de Barcelona / ICREA ***What Makes Speech Human-Specific?***

Wednesday, January 28 – Symposium

Symposium: **The Language of Schizophrenia: New Questions for Biolinguistics**
Organizer: **Wolfram Hinzen, Universitat de Barcelona / ICREA**

9:00-9:15 Introduction: Roberto Cavallaro, San Raffaele Scientific Institute, Department of Clinical Neurosciences, Milan

9:15-10:00 Peter McKenna, FIDMAG Research Foundation, Benito Menni CASM Hospital, Barcelona
Everything You Wanted to Know About Schizophrenic Language But Were Afraid to Ask

10:00-11:30 Break

11:30-12:15 Wolfram Hinzen, Universitat de Barcelona / ICREA
The Positive Symptoms of Schizophrenia in Light of the Un-Cartesian Hypothesis

12:15-14:00 Lunch

14:00-14:45 Marta Bosia, San Raffaele Scientific Institute, Department of Clinical Neurosciences, Milan
Valentina Bambini, Institute for Advanced Study (IUSS), Pavia / NeTS
Andrea Moro, Institute for Advanced Study (IUSS), Pavia / NeTS
Roberto Cavallaro, San Raffaele Scientific Institute, Department of Clinical Neurosciences, Milan
Language, Pragmatics and Social Cognition in Schizophrenia

14:45-15:30 Edith Pomarol-Clotet, FIDMAG Research Foundation, Benito Menni CASM Hospital, Barcelona
Disordered Speech and Language in Schizophrenia: The Perspective From Brain Imaging

15:30-16:15: **Round Table on the Language Faculty and Schizophrenia**

16:15-17:00 Closing remarks

Poster session: Monday, January 26, 16:45-18:00

Cedric Boeckx, Universitat de Barcelona / ICREA
Evelina Leivada, Universitat de Barcelona
Parametric Hierarchies and the Three Factors in Language Design: A Biolinguistic Perspective

Pritha Chandra, Indian Institute of Technology Delhi
Feature-Value Pools & Strengths: The Expression of Variation

Gonzalo Castillo, Universitat de Barcelona
The Inhibitory Nature of Language and Creative Behavior

Sandra Villata, University of Geneva
Brian McElree, New York University

Julie Franck, University of Geneva
The Temporal Dynamics of Intervention Effects: A Speed-Accuracy Trade-Off Study on Wh-Islands

Edward Ruoyang Shi, Universitat de Barcelona
Elizabeth Qing Zhang, Universitat de Barcelona
Lexical Tone Acquisition: A Case Study in Comparative Biolinguistics

Stefano Rastelli, University of Pavia and University of Greenwich / CAROLE
Quantized Second Language Acquisition

Evelina Leivada, Universitat de Barcelona
Mind the Gap: (Non-)Manifested Patterns of Variation Across Linguistic and Cognitive Phenotypes

Tatiana Golovko, Novosibirsk State University
Alexander Saprygin, Novosibirsk State University
Mariya Timofeeva, Novosibirsk State University
Natalya Snytnikova, Novosibirsk State University
EEG Reactions During the Recognition of Sentences With Different Emotionally Personal Assessment...

Gerhard Jäger, Tübingen University
Does Population Size Affect Language Structure?

Ermenegildo Bidese, University of Trento
Andrea Padovan, University of Verona
Alessandra Tomaselli, University of Verona
Syntax as the Edge of Thought

Hiroyuki Nishina, Saitama University
Comparing Causative Recursion in Kinematic Grammar With Sentence Embedding in Human Grammar

INVITED PAPER

Ken Wexler, MIT

Developmental Biolinguistic Investigations in Syntax and Semantics

forthcoming

Clitics of children with autism: impaired syntax, discourse/pragmatics or prosody?

Arhonto Terzi[1], Theodoros Marinis[2], Konstantinos Francis[3]
Technological Educational Institute of W. Greece, Patras[1], Univ. of Reading[2], Univ. of Athens[3]

Background: Research on the language abilities of individuals with Autism Spectrum Disorders (ASD/autism) has focused until recently on pragmatics and prosody, presumably because these are the areas afflicted the most cross-linguistically in autism. Recent research, in English primarily, has also targeted morphosyntax (Roberts et al. 2004, Perovic at al. 2012, 2013). The study by Terzi et al. (2014) looked at 5-8 year old high-functioning Greek-speaking children with ASD, discovering that they fall behind their language and age matched controls with typical language development (TD) on both production and interpretation (i.e., binding) of pronominal clitics. Given the profile of ASD sketched above, and the fact that clitics: a) are an interface phenomenon, hence, their accurate comprehension and production involves discourse/pragmatics, syntax, and prosody (Anagnostopoulou 1997, Mavrogiorgos 2010, a.o.) and b) constitute an area of grammar known to be problematic in impaired language (e.g. Jakubovic et al. 1998; Tsimpli & Stavrakaki, 1999; Chondrogianni et al. 2014 on SLI), the above finding raises several questions. What is the source of the weakness on clitics that this particular population exhibits? Can the attested behavior possibly tell us something more about clitics in grammar? The study to be reported here investigates the difficulties that high-functioning ASD children have with (pronominal) clitics, by testing the contribution of discourse, syntax, and intonation on producing clitics and understanding their reference.

The current study: 20 high-functioning Greek-speaking children with ASD, aged 5;5-8;8 (M=6;11), and 20 TD vocabulary matched children of a similar age participated in the study. The children completed a series of baseline tasks assessing their non-verbal and verbal abilities, and two experimental tasks investigating comprehension and production of *clitics and full DPs across a range of conditions.* For comprehension, we tested binding of simple clitics using a task like the one in Terzi et al. (2014). In addition, we tested clitics in clitic left dislocation (ClLD) contexts, both comprehension and production, the latter with examples as in (1) below.

(1) Experimenter (showing Picture 1):	Here is a cat, a wolf, and a goat. Who kisses the cat?			
Experimenter (showing Picture 2):	Ti gata ….			
	the cat ….			
Child (completes the sentence):	**ti**	filai	o	likos.
	her-cl-acc	kisses	the	wolf.
	'It is the wolf that kisses her.'			

ClLD was included in our study: a) because children with ASD interpreted simple clitics as if they were in ClLD structures in Terzi et al. (2014), b) because ClLD structures are syntactically more complex than simple clitics, hence, they could test whether syntactic complexity impacts children's performance in this domain, and c) because we wanted to compare ClLD with structures in which the DP that starts the (response) sentence is focused, and does not allow the presence of a clitic, (2) below. Besides ClLD, cf. (1), we tested production of simple clitics.

We also elicited full DPs in two contexts: 1) using a wh-question *what does X do?* without introducing the participants/referents in the associated pictures, and 2) using a wh-object question *who is X pushing* and starting the response with a DP bearing focus intonation, asking children to complete the response. The latter are focus structures (which contrast ClLD in not allowing a clitic):

(2) Experimenter (showing Picture 1):	Here is a sheep, a wolf and a cat. Who is the wolf hugging?		
Experimenter (showing Picture 2):	TI GATA (focus intonation) …		
	the cat		
Child (completes the sentence):	agaliazi	o	likos.
	hugs	the	wolf
	'It is the cat that the wolf hugs.'		

The first DP condition tested whether children are able to use the discourse/pragmatics context to produce a DP, rather than a clitic. The second tested whether children are able to make use of the intonation cue of the focused DP in order to complete the sentence, crucially, without a clitic.

Results and Discussion: The children with ASD were less accurate than the TD children in the comprehension and production of clitics, replicating the study of Terzi et al. (2014), see Figure 1. All errors in comprehension involved reversal of thematic roles, indicating that they may interpret this structure as ClLD. A small number of errors in production were errors of clitic omission, but most errors involved using a DP instead; we believe the latter reflects a difficulty, even for high-functioning children with autism, to tell what is the prominent item in the discourse, and, subsequently, refer to it via a clitic. Results from ClLD show no difference between TD children and children with ASD, Figure 2, demonstrating that increase in syntactic complexity does not affect children with ASD disproportionately more than TD children. Distinguishing given information, as conveyed by ClLD, does not appear to trouble ASD children, although it has to be further investigated whether this is so just because the crucial DP is provided in the answer.

Figure 1: Comprehension and production of simple clitics

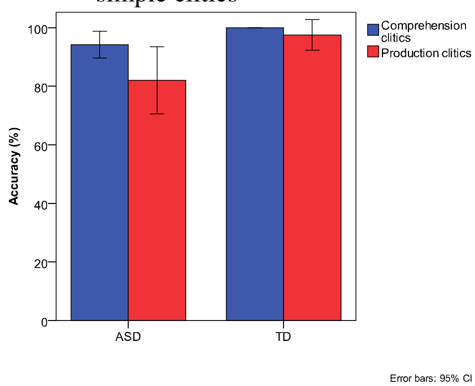
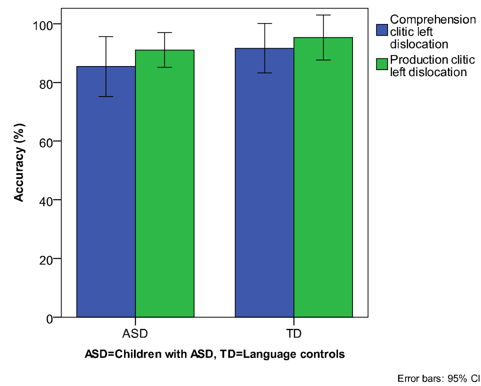
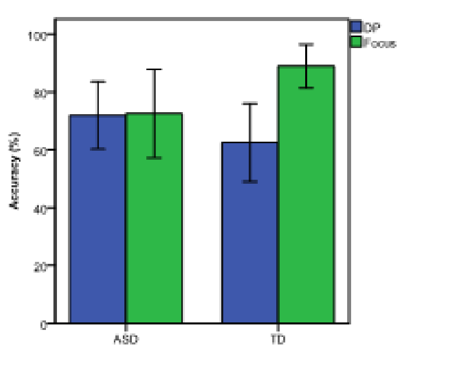


Figure 2: Comprehension and production of ClLD



Results on the production of DPs shows similar performance in the two groups when the use of the DP depends only on the discourse/pragmatic context, see Figure 3. However, when the children had to take into consideration the intonation of the DP produced by the experimenter in order to complete the sentence, children with ASD were less accurate than TD children, see Figure3, with most errors involving the use of a clitic. Taken together, the findings indicate that children with ASD do not differ from TD children in the comprehension and production of clitics when demands are increased within the domain of syntax, or when other criteria (such as given information) are offered by the experiment. However, ASD children are less successful than TD children in deciding on when to use a clitic, conceivably failing something like the *Prominence Condition* (Heim 1982). An additional difficulty they seem to have involves the prosody-syntax interface, in particular, to the processing of the prosodic cues of focused DPs, with repercussions for syntax.

Figure 3: Production of DPs vs. DPs in focus



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A study on Spanish SLI and the founder effect

Anna Gavarró & Myriam Cantú-Sánchez (Universitat Autònoma de Barcelona)

The founder effect, whereby genetic drift occurs when a new population is established by a very small number of individuals, is an important source of information on genetics and phenotypic variation both in human and non-human populations. In this paper we report an instance of the founder effect in a Pacific Spanish-speaking population associated in the genetic literature to a high incidence of Specific Language Impairment.

According to Villanueva et al. (2008), the incidence of SLI in the child population of Robinson Crusoe Island, in Chile, is around 35%; that is, 5 to 7 times higher than its incidence in the continental population. This is explained as a consequence of the founder effect: 75% of the impaired subjects were descendents of two founder brothers and have been identified with a genetic abnormality with its main locus on chromosome 7q (Villanueva et al. 2011). While the genetic profile of the population is well investigated, no detail is provided in any of the publications as to its linguistic performance. The goal of our research is to start filling this gap and consider the linguistic performance of the current child and adolescent population.

We designed and administered nine language tests to 45 children in the island, 31 descending from the original founder families, the other 14 of continental origin and with no consanguinity ties with the islanders. Three of the tasks explored performance in linguistic tasks known to be problematic at least for a subset of SLI subjects, although not necessarily resulting from a core-syntactic impairment: vocabulary retrieval, sentence repetition and repetition of nonce words (Bishop et al. 2006). One other task was morphological: nominal plural marking in Spanish, which is not expected to give any differentiated performance on the part of SLI subjects (Grinstead et al. 2008). The other five tasks targeted syntactic capabilities; some have been established to be generally problematic for children with SLI: production of object relative clauses (tested together with subject relative clauses) (Novogrodsky and Friedmann 2006), and grammaticality judgment and correction. The remaining appear to be taxing for subjects with SLI in Spanish: use of prepositions, use of determiners and gender and number agreement within DP (Restrepo 2001, Auza & Morgan 2013). The latter we analyse as a language-specific effect of the extended Optional Infinitive stage in Spanish (Rice, Wexler & Cleave 1995).

The overall results do not show any contrast as a function of the origin (continental vs. islander) of the subjects; they do show some age effect. Individual results are given in Figure 1. If indeed the incidence of SLI is 35% in the population of descendants of the founder families, as Villanueva et al. 2008 established, we would expect at least 10 affected subjects. However, at most three islander children tested may meet the criteria for a diagnosis of SLI, since they perform below their age peers in use of determiners, grammaticality judgment and/or sentence repetition. This result does not challenge the findings regarding the chromosomal abnormality affecting a sizeable proportion of the population of the island; rather it questions the relation between that affectation and a specific language impairment. This preliminary conclusion is in line with observations by Grodzinsky (2002) in connection to the KE family and the role of FoxP2.

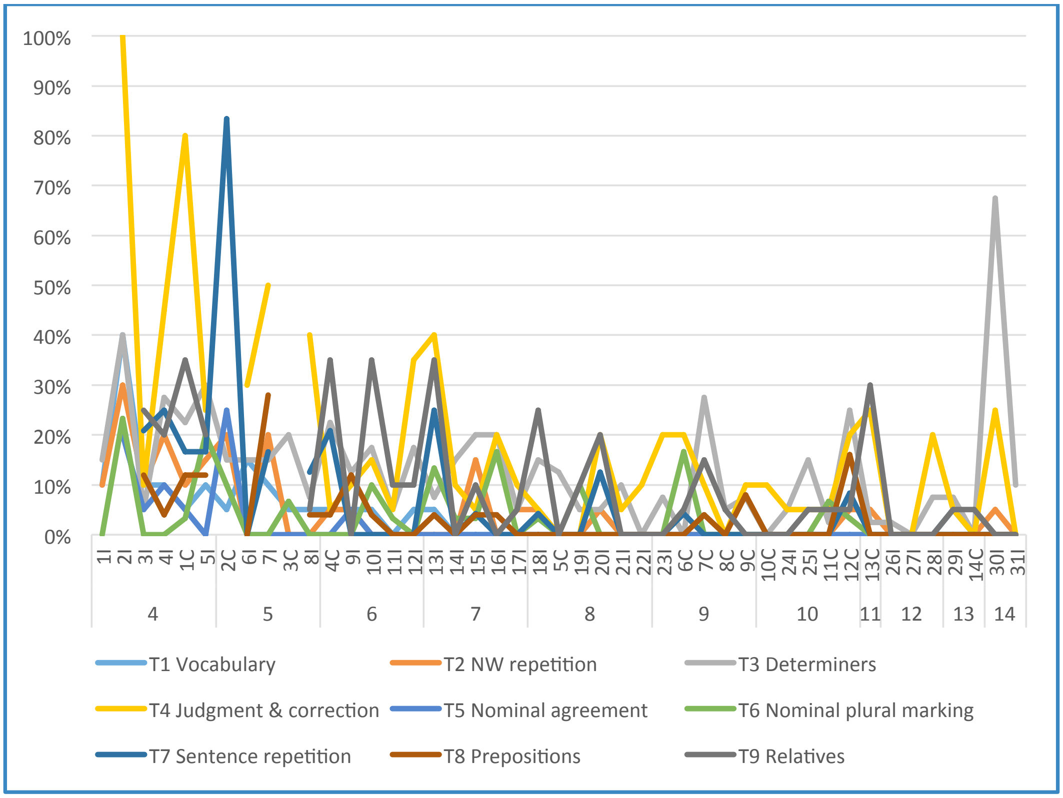

Figure 1: Percentage of errors by age, origin and individual
(I = islander, C = continental)

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Villanueva P., Z. de Barbieri, H. M. Palomino, H. Palomino (2008) High prevalence of specific language impairment in Robinson Crusoe Island. A possible founder effect. *Revista Médica de Chile* 136:186–192.

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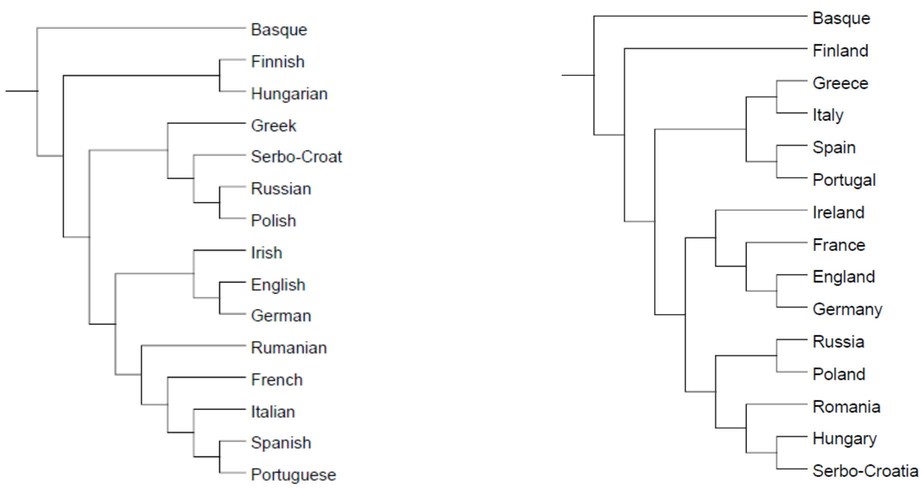
Across language families. Genome diversity mirrors linguistic variation within Europe

Giuseppe Longobardi (York), *Andrea Ceolin* (York), *Silvia Ghirotto* (Ferrara),
Cristina Guardiano (Modena e Reggio Emilia), *Guido Barbujani* (Ferrara)

Introduction. Darwin (1859) explicitly put forth the idea of a parallelism between biological evolution and language diversification, suggesting that a perfect phylogenetic tree of human populations would also represent the best pedigree of languages. Although analogies between linguistic and genetic variation have been variously explored (Renfrew 1987, Sokal et al 1988, Cavalli Sforza et al 1988, a.o.) and methods have been exchanged (McMahon and McMahon 2005, Gray et al 2009, Berwick et al 2013, a.o.), at a large geographical scale conclusions were received with skepticism, mainly for the weakness of linguistic procedures.
Methods. We use two recently-developed linguistic tools to interpret patterns of genome-wide variation in 15 European populations: Bouckaert et al's (2012) expanded list of Indo-European (IE) lexical cognates and Longobardi and Guardiano's (2009) Parametric Comparison Method (PCM), which compares languages represented as strings of binary symbols, each encoding the value of a syntactic parameter of UG.
Indo-European. We initially estimated four matrices of pairwise distances between 12 IE populations: genomic ($d_{GEN,}$ from publicly available databases), syntactic ($d_{SYN,}$ from PCM: Longobardi et al 2013), lexical ($d_{LEX,}$ from Bouckaert et al 2012), and geographic (d_{GEO}). ***Lexicon and syntax.*** First of all, we compared d_{SYN} and d_{LEX}, in order to check whether syntactic distances are able to produce plausible phylogenetic structures. The two matrices are highly correlated (Mantel test: r=0.82). To better understand to what extent the lexicon and syntax mirror each other, we converted the matrices into trees form, calculated the path difference distance between such trees, and compared this value with the distances between 100,000 random pairs of 12-leef tree topologies. None of these random distances was lower than that observed in the actual data. ***Languages, genes and geography.*** As expected, the two linguistic matrices showed similar correlations with genetic distances (r=0.49 for d_{SYN} and r=0.51 for d_{LEX}), both statistically significant. According to previous studies (Novembre 2008), genetic and geographic distances in Europe are highly correlated. In our experiments, the correlations of both lexicon and syntax with d_{GEN} are higher than between d_{GEN} and d_{GEO} (r=0.38), thus showing that, once precise measurements of linguistic differences are used, language turns out an even better predictor of genetic differences than geography.
Indo-European and non Indo-European. We extended the analysis to 3 non-IE languages (Basque, Hungarian and Finnish). The correlations between d_{GEN} and both d_{SYN} (r=0.60) and d_{LEX} (r=0.54) rise higher, and remain higher than that between d_{GEN} and d_{GEO} (r=0.30), that in turn decreases. The correlation between d_{GEN} and d_{SYN} remains significant even when holding the effect of geography constant (partial Mantel test: r=0.57). The correlation between d_{GEN} and d_{LEX} also rises, though by a small amount, presumably due to the lack of cross-family lexical cognates (lexical distances between unrelated languages are 1 by definition). Thus, the more languages from different families that are added for comparison, the more we expect reliance on syntax rather than lexicon to become crucial. ***Syntax.*** The tree inferred from d_{SYN} first separates Basque and then the Finno-Ugric languages from all the IE varieties. Within this cluster, Romance, Germanic and Slavic form 3 clades; then Greek and Irish occur as outliers of their geographic neighbors. Principal Component Analysis neatly separates IE languages from the others. ***Genes.*** The tree inferred from d_{GEN} shows that 2 linguistic outliers, Finns and Basques, are clearly differentiated also genomically. The rest of the tree mainly reflects geography, containing all IE-speaking populations, along with Hungarians, who appear close to their neighbors (Serbs and Rumanians). The Principal Component Analysis identifies a cluster of European populations which include Hungarians, opposed to two clear outliers, namely Finns and Basques. ***Correlations.*** A tight relationship between the syntactic and the genetic trees emerged, one highly unlikely to have arisen solely by chance (P <0.004). The only salient divergence is the genetic position of Hungarians, mostly falling within a large group of Central Europeans. We further investigated genomic data with TreeMix, a method for identifying gene flow episodes after the main splits: other than a contribution of migrants to Rumania from Russia (0.43), as well as from Greece, that mirrors at least the received concept of a Balkan *Sprachbund* and even some parametric convergences (Longobardi et al 2013), a gene flow is detectable from Southern Europe to Hungary (0.31), exactly as predicted from the PCA. If Hungarian is removed, d_{SYN}/d_{GEN} rises noticeably (r=0.74), while d_{GEO}/d_{GEN} remains low (r=0.28), the sharpest demonstration to date of a language/biology correlation.

Conclusions. Evidence for parallelism of gene/language transmission had previously been provided at a regional scale and without formal quantification of language distances. Here, especially through generative syntax, precise comparison and measurement is possible even between different established linguistic families. Using standard methods of evolutionary biology and without resorting to methodologically disputable long-range lexical comparisons, syntax alone discriminates the three ancestral populations of modern Europe, and combined with genetics detects the secondary character of a fraction of one of them. Indeed, we showed that populations speaking similar languages in Europe tend to be biologically closer than expected on the mere basis of location, so that, at such a continental scale, language offers a better prediction of genomic diversity than geography. Our results confirm the fruitfulness of importing numerical and biostatistical methods into language phylogenetics, but even more of resorting to radically new and deeper levels of taxonomic characters (PCM and the biolinguistic framework inspiring it: Di Sciullo and Boeckx 2011) for a shared reconstruction of demographic and linguistic history. Previous studies could venture into addressing Darwin's gene/language issue thanks to the theoretical progress of 20th century genetics; broad genomic datasets and the corresponding progress of formal grammatical theory over the past 50 years now enable us to accurately test the hypothesis on ever larger and more solid grounds.



Trees from d_{SYN} (left) and d_{GEN} (right)

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Algorithmic generation of random languages argues for syntax as a source of phylogenetic information

Giuseppe Longobardi (Trieste, York), *Luca Bortolussi* (Trieste), *Andrea Ceolin* (York), *Aaron Ecay* (UPenn, York), *Cristina Guardiano* (Modena e Reggio Emilia), *Monica Alexandrina Irimia* (York), *Dimitris Michelioudakis* (York), *Nina Radkevich* (York) *Andrea Sgarro* (Trieste)

The Parametric Comparison Method (PCM, Longobardi and Guardiano 2009) uses syntactic parameters (Chomsky 1981, Baker 2001, Biberauer and Roberts 2012) to study phylogenetic relationships between languages. This method has already successfully generated phylogenies of Indo-European (IE) languages (Longobardi et al. 2013) which are competitive with those produced by the classical comparative method (Durie and Ross 1996), lexicostatistics (Dyen et al. 1992), or Bayesian phylogenetics (Bouckaert et al. 2012). A question raised by the PCM framework, and indeed by all these methods, is whether their conclusions about language relatedness are secure against chance similarities between languages. As far as the PCM goes, using a randomly simulated distribution of parametric distances between languages (which are defined to range between 0 and 1), it is possible to perform statistical tests of the hypothesis that the distances observed in the real world are unlikely to arise by chance, and thus to motivate judgments of relatedness based on syntax. Bortolussi et al. (B+; 2011) have proposed an algorithm to enumerate the possible languages defined by a system of heavily interdependent parameters and to sample randomly from that set. We propose an improvement to this algorithm, thus validating the PCM as a method to formally study the relationship between languages and populations.

One notable feature of the implicational structure underlying the PCM is that each parameter is not simply a binary value (+ or –) set independently of other parameters. Rather, based on the value of certain other parameters it is sometimes necessary to assign a 0 (absence of a value). The presence of these implications, and the fact that a large majority of parameters are implicationally dependent on others, biases the B+ algorithm. Because it samples from a uniform distribution rather than assigning independent distributions to individual parameters, it is more likely to output parameters set to values that implicationally unlock other parameters, rather than the opposite, non-unlocking values. This is illustrated in Figure 1 below.

This property of the B+ algorithm has the effect that it exaggerates the degree of similarity of languages in its output. We have constructed an alternative algorithm which samples distributions over parameters rather than languages. It is reminiscent of the suggestion that children acquire language by following a decision tree which first sets "macroparameters" with large syntactic effects, and later proceed to setting parameters of decreasing size until the syntactic behavior of the target language is fully specified. (Biberauer and Roberts 2012)

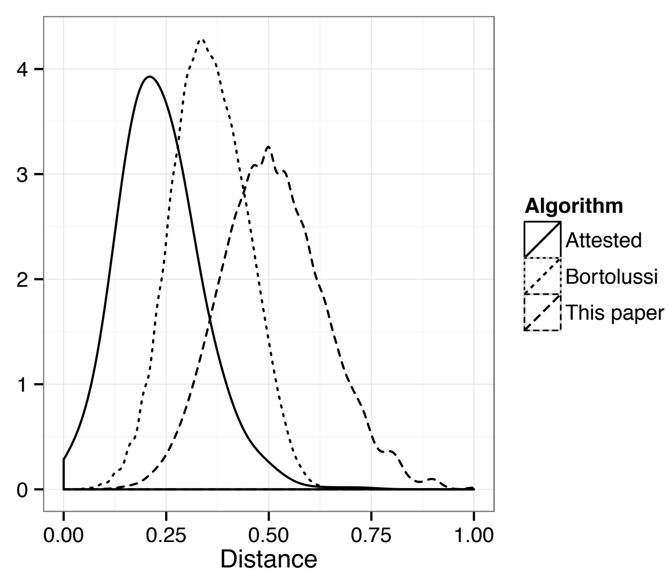
The output of this sampling algorithm is compared to the B+ algorithm in Figure 2, which depicts the distribution of ~500,000 language pairs drawn from the B+ algorithm, an identically sized sample from our algorithm, and 561 real-world language pairs (34 languages, including 23 IE languages, 3 Finno-Ugric, 2 Semitic, 2 Altaic, 2 varieties of Basque, Wolof and Mandarin Chinese). The mean and median distance among randomly generated language pairs on our algorithm are very close to the intuitively expected value of 0.5. The distributions thus generated allow statistical tests to be performed on attested languages. There are 119 language pairs which are below the 1/1,000 chance threshold (δ=0.158), whereas if the attested languages were randomly distributed we would expect (roughly) only one such pair. Only 6 of these pairs do not fall within established language families. These fall into three groups where historical contact may have played a direct or indirect role: Hungarian/Turkish (δ=0.118); Pashto/Turkish (δ=0.147) and Pashto/Buryat (δ=0.154); and Serbo-Croatian/Estonian (δ=0.152), Serbo-Croatian/Finnish (δ=0.147), and Slovenian/Estonian (δ=0.152).

The comparison of the distribution of actual language distances with the random distances generated by our algorithm reveals that the actual distances do not resemble random ones, and thus may contain useful phylogenetic information. This impression is confirmed by the results of a distance-based tree- building algorithm, KITSCH (Felsenstein 1993). In the output, the IE languages form a clade, with the expected smaller subfamilies embedded in it. Outlying clades are formed by the other language families (Semitic, Finno-Ugric+Altaic, Basque varieties), followed by Mandarin Chinese. Finally, the only sub-Saharan African language in the dataset, Wolof, is identified as the most outlying language, perhaps reflecting population migrations out of Africa. These results confirm that syntactic parameters provide novel information for the study of the prehistory of human languages, which agrees with the outcomes of previous lexicon-based phylogenies or other independently known historical variables, and hints at the possibility of aiming toward a greater time depth, given that parameters are part of a universal faculty of language.

Figure 1: Based on the following parameters from Table A (Longobardi and Guardiano 2009): **P1:** Grammaticalized person **P2:** Grammaticalized number (set only if +P1) **P3:** Grammaticalized gender (set only if +P2). The B+ algorithm generates each of these languages with equal probability whereas marginal parameter probabilities differ, whereas our algorithm generates different probabilities for languages, but equal probabilities for each individual parameter.

B+				**Our algorithm**				
P1	P2	P3	Probability	P1	P2	P3	Probability	
+	+	+	0.25	+	+	+	0.125	
+	+	-	0.25	+	+	-	0.125	
+	-	0	0.25	+	-	0	0.25	
-	0	0	0.25	-	0	0	0.5	
0.75	0.67	0.5		0.5	0.5	0.5		← marginal prob. of parameter

Figure 2:



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Language Faculty, Language Development and Object pronouns in Romanian

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We assume that the Language Faculty does not change through time, and that syntactic variation is the consequence of minimal changes in the feature structure of functional categories, which are brought about by language acquisition and languages in contact. We also assume that evolutionary developmental principles emerge in the historical development of languages as a consequence of natural laws reducing complexity. One consequence of such principles is the gradual elimination of the oscillation of a dependent with respect to its head (Di Sciullo 2011, 2012, 2013, Di Sciullo and Nicolis 2012, Di Sciullo and Somesfalean 2012). We provide further arguments for such symmetry breaking universals by considering the development of object pronouns in the diachrony of Romanian. We raise the question whether the growth of language in the individual recapitulates the historical development of languages and whether the indeterminacy of the oscillation period in the dynamics of language historical development may contribute to the understanding of SLI, and in particular the omission of 3rd person clitics in disphasia (Wexler, to appear).

1. Purpose and hypothesis. We assume that a pronominal, in its clitic or strong pronoun form, may occur pre or post verbally, according to parametric variation and to principles reducing complexity (Chomsky 2005's third factor principles). We examine pronominal objects in Old Romanian (OR, 16th -18th century), and show that the fluctuation in their position (pre-/post-verbal) and in their form (clitic/strong pronoun) is the result of the Directional Asymmetry Principle (DAP), a complexity-reducing principle proposed in Di Sciullo (2011), on the basis of the development of possessive pronouns from genitives in the evolution of Classical to Modern Greek and of Latin to Italian, and according to which language evolution is symmetry breaking. We show that DAP is sensitive to both derivational and representational complexity. Under its effects, on grounds of derivational complexity reduction, Romanian lost the discourse-driven verb movement that yielded enclisis. On grounds of representational (sensori-motor) complexity reduction, Romanian lost the use of strong pronouns in contexts that now only allow clitics. Thus, a fluctuating phase in the evolution of pronominal objects is followed by a phase where a preponderant use is attested (i.e. proclitics in Modern Romanian). We confirm previous findings on the diachronic development of the Romanian DP under the effects of DAP, showing the role of complexity reduction in language change.

The OR use of enclitics, the development of Differential Object Marking (DOM), and the rise of Clitic Doubling (CD) constructions are all phenomena that have been addressed and discussed in recent works (Zafiu 2014, Hill 2013, Chiriacescu & Von Heusinger 2009, Alboiu & Hill 2012, Von Heusinger & Onea Gaspar 2008, a.o.). We consider some of these facts in a broader perspective, as instances of language development processes. The notion of language evolution goes beyond the classical notion of language change and grammaticalization (Roberts & Roussou 2003) by incorporating recent results from evolutionary developmental biology. This incorporation has both descriptive and explanatory advantages over classical notions of language change and grammaticalization. The descriptive advantage is that fluctuating stages are predicted to occur and can be described systematically. The explanatory advantage is that questions such as why languages change and why grammaticalization exists can be addressed on the basis of the existence of general laws governing the development and evolution of biological form.

2. Data. In Old Romanian (OR, 16th -18th century), object personal pronouns can be post-verbal, (1a), (2a), (3a), and pre-verbal (4a), (5a), with what looks like a strong preference for a post-verbal positioning for both clitics and strong pronouns. In contrast, Modern Romanian (MR) manifests an exclusive proclitic use in the same contexts (1b), (2b), (3b), (4b), (5b).

(1) a. *cu slavă priimişi **mine*** […] (Coresi, 137r)
with glory received me.ACC.1SG.
b. *cu slavă **mă** primişi* (MR)
with glory CL.me.ACC.1SG. received
'With glory you have received me.'

(2) a. *Doamne, cîntec nou cînt **ţie,*** […]. (Coresi, 274r)
Lord, song new sing PRON.DAT.2SG
b. *Doamne, cântec nou **îţi** cânt* […]. (MR)
Lord, song new CL.DAT.2P.SG. sing
'Lord, a new song I sing to you.'

(3) a. […] *fără dereptate mînară-**mă*** […] (Coresi, 238v)
without reason led=CL.ACC.1SG.
b. […] *fără dereptate* ***mă*** *mînară* (MR)
without reason CL.ACC.1SG. led
'Without reason (they) led me'
(4) a. *nu* ***mă*** *ruşinez cînd caut* […] (Coresi, 231v)
not CL.REFL.1SG. embarrass when search
b. *nu* ***mă*** *ruşinez cînd caut* […] (MR)
not CL.REFL.1SG. embarrass when search
'(I) am not ashamed when (I) search'
(5) a. *Şi acestu sfat* ***îi*** *da* […] (Amiras, 253v)
and this advice CL.DAT.3SG. give
b. *Şi acest sfat* ***îi*** *dădea* […] (MR)
and this advice CL.DAT.3SG. give
'And he got this advice'

3. Analysis and predictions. We assume that pronouns are determiners, as in Postal (1969), and that clitics and strong pronouns differ in their level of complexity, as in Kayne (1991, 1994), Uriagereka (1995), Cardinaletti & Starke (1999), Sportiche (1999), Di Sciullo (1990), a.o. We also appeal to two notions of complexity proposed in Di Sciullo (2012). Internal complexity is derived by the operations of the Language Faculty and is measured in terms of length of derivations. Thus, a derivation of a linguistic expression that involves fewer operations will be preferred over a more 'costly' derivation on grounds of computational efficiency. External complexity is legible at the sensori-motor (SM) interface and is calculated in terms of density of representations, which is not limited to string linear measure, but includes supra-segmental material such as tone, as discussed in Di Sciullo (2005), and stress. Thus, a representation that contains less SM material will be less 'costly' on grounds of representational efficiency. We propose that the change in the pattern of pronominal objects from OR to MR is the result of a bi-fold complexity reduction mechanism, namely the reduction of both I-complexity, which is basically derivational, and the reduction of E-complexity, which is basically representational. Given these assumptions, the derivation of proclitic constructions involves fewer operations than the derivation of post-verbal pronoun constructions. It follows that the derivation of (3b), (4), and (5) is less costly from a computational point of view than the derivation of (1), (2), and (3a), hence it is preferable for efficiency reasons. Thus, in a fluctuation period such as the one observed in OR, our analysis predicts that given DAP and the fact that the derivation of post-verbal clitic objects is more derivationally costly, proclisis will be preferred. Our prediction is confirmed by MR data.

4. Ontogeny, phylogeny and SLI. Development is at the core of both biology and language viewed as a biological phenomenon. In this perspective, the principles of language growth are geneticaly based in addition to learning processes (Chomsky 1968, 2005, 2011, Lenneberg 1967). The principles of language growth are not learned on the basis of quantitative data a child is exposed to in a given span of time, ontogeny is related to phylogeny on deeper grounds. Based on our targeted analysis, we find reasons to relate principles of language growth to Evolutionary developmental principles and offer a third factor approach to the variable omission of clitics in SLI.

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THE GRAMMAR OF CODE BLENDING
WHAT BIMODAL BILINGUALS CAN TEACH US ABOUT LANGUAGE ARCHITECTURE

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Contrary to common beliefs, bilingualism or even multilingualism is a much more common condition than monolingualism. Bilinguals are by definition individuals that are competent in two languages, and can thus be said, descriptively, to possess two grammars. The frequency of this condition must be in a direct relation with the nature itself of the language organ and its core properties. Not surprisingly, the issue of the relation between the two grammars has been at the center of much research and many speculations in the last fifty years.
Mixed utterances, which are spontaneously produced by every bilingual, and where the two grammars appear to alternate very quickly or even to « cooperate » in the making up of a single utterance, are particularly interesting from this point of view, and have been widely analysed and discussed, generating controversial descriptions and theoretical conclusions (see Muysken 2000 for an overview).

This talk will address this crucial topic about the nature and architecture of the language organ from the exceptional viewpoint of bimodal bilinguals. Bimodal bilinguals are individuals who are competent in a sign language and a spoken language. Their exceptionality lies in the fact that they have two separate channels available for their two grammars: the audio-oral channel and the visuo-gestural channel. This entails that the articulatory constraints that filter the mixed productions of unimodal bilinguals are not in place with this population. In simple words, these individuals do not have to alternate the two languages they speak, but they can in principle use both of them simultaneously. And indeed this is what they do: bimodal bilinguals have been reported to largely prefer code blending (CB: Emmorey et al. 2005), i. e. simultaneous mixing, over code switching (i. e. the kind of alternation observable in unimodal speakers) in a variety of language contact situations: English-American Sign Language (Emmorey et al. 2005); French-Quebec Sign Language (Petitto et al. 2001); Dutch-Sign Language of the Netherlands (van den Bogaerde and Baker 2006); Portuguese-Brasilian Sign Language (Quadros et al. 2010).

The talk will analyse the phenomenon of Code Blending trying to see how far the autonomy of the two simultaneous utterances can go: can they express two different contents? Can they display a different grammar, e.g. word order? What about prosodic alignment, and morpho-syntactic features?

The data come from a corpus of CB produced by 6 Italian/Italian Sign Language (LIS) KODAs aged 8-10 and from grammaticality judgements and elicited production of two trained Italian/LIS CODAs.
We found three different types of CB: one word order (prescribed by either Italian or LIS) imposed to both strings (type1, ex. 1-2), two word orders each governing the corresponding string (type 2, ex. 3), and a unique utterance spread over two channels (type3, ex. 4).

(1) Type1: Italian word order (SVO)

It.	Una	bambina	va	allo	zoo
	a	child	go.3s	to.the	zoo
LIS.		GIRL	GO	ZOO	

'A girl goes to the zoo'

(2) Type1: LIS word order (SOV)

it.	Zio	zia	vero	Roma	abita
	uncle	aunt	actually	Rome	live.3s
LIS.	UNCLE	AUNT	REAL	ROME	LIVE

'My uncle and aunt actually live in Rome'

(3) Type2: Two word orders

it.	Non	ho	capito
	not	have.1s	understand.pst
LIS.	UNDERSTAND		NOT

'I don't' understand'

(4) Type3

it.	Parla	con	Biancaneve
	talk.3s	with	Snow White
LIS.	TALK		HUNTER

'The hunter talks with Snow White'

Interestingly, word order typologies correlate with morphological and prosodic endowment of the strings: two full morphologies and prosodic strings in type 2 and type 3, full morphology and prosody of only one string, the one dictating word order, in type1. As for content, some very restricted instances of mismatch are observed, but only in Type 2.

The results suggest that CB is not a unitary phenomenon but may involve three different processes: (i) a monolingual derivation with a double lexicalization as a late phenomenon; (ii) a bilingual derivation with a double lexicalization as an early phenomenon, and (iii) a bilingual derivation with a mixed lexicalization as an early phenomenon.

Some consequences for our understanding of the architecture of grammar and the status of bilingualism with respect to the langue organ will be discussed.

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Second language users and the English article system – where does it all go right?
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The acquisition of articles is one of the most challenging aspects of second language acquisition, and has generated significant L2A research. In Fitch's *dendrological* approach to language the "**ability to infer hierarchical (tree-based) structures**" is central. [1] This research examines article acquisition by adult learners whose L1 is Thai, a language without articles, and maps accuracy rates to each sub-task needed to infer tree-based structures.

Words are typed tokens with characteristic distributional patterns: tree building relies on allocating words to distinct (lexical) categories. Articles and adjectives have clearly distinct distributional characteristics. It has been claimed that learners assimilate articles as adjectives.[2] If so, L2 learners may be expected to make distributional errors in article use.

The typing has sub-divisions: In English, the distinction between count and non-count nouns has implications for determiner selection (including article use). The vast majority of languages (including Thai) distinguish mass nuns from count nouns, but the distinction appears to be purely grammatical, mapping poorly to 'common sense' perception (non-count *rice* vs. count *lentils*) and varying arbitrarily across languages. We investigated whether the English count / non count distinction is reflected in Thai learners' omission of articles.

Trees require structure dependence. Previous studies show that L2 learners omit articles more frequently with Adj+N structures than with bare nouns. One possible but unexplored reason is that users are attending to linear order rather than the whole structure of the noun phrase (a singular count noun will almost always require a preceding article in English, whereas an adjective may or may not). Although English has a canonical Det-Adj-N word order, there are a small number of adjectives that may be placed before or after the noun.

The semantic / pragmatic function(s) or articles is the difficult bit. Previous research demonstrates that the errors that L2 speakers make are not random, but map very predictably onto the interaction of semantic / pragmatic factors of definiteness and specificity. These are not available to conscious introspection by users yet are powerful predictors of errors.

Methods: Participants comprised first year undergraduates at a Thai university. A 56,000 POS-tagged word corpus of free writing by 76 participants was supplemented by fill-the-gap forced elicitation experiments (n=63), to explore low frequency tokens. Semantic / pragmatic factors were explored using 80 learners at six different levels of overall English proficiency.

Distributional errors were explored through the corpus, using an extended version of Valian's criteria (1996, p.565). [3] Of almost 2,000 article tokens in the corpus, only two showed possible violations of the distributional principles. Errors at this level are negligible.

The count / non-count distinction was explored though forced elicitation experiments. Mass nouns in English behave like plural count nouns: they can appear without articles, and cannot take the definite article *a* / *an*. We hypothesised that participants would be significantly more likely to omit articles with non-count nouns that with count. Repeated measures ANOVAs confirmed that differences in mean omission rates were significant at the 0.01 level. There is controversy about whether the count / mass distinction is lexically stored or generated in syntax. Either way, the participants appear to be sensitive to the relationship between count / mass status and article use, even when their *choice* of article remains non-native-like.

To explore structure dependence an initial frequency list of adjectives that may appear either before or after the noun were identified from previous research.[4] Five sets of tokens paired for word order (N Adj *vs*. Adj N) were constructed using the criteria of frequency in reference corpora, *naturalness*, and familiarity to the participants in the context of their current English course. The tokens were then tested against the British National Corpus to check that these Adj / N combinations appear roughly equally in both orders. This was confirmed ($p > 0.01$).

To explore the role of **semantic / pragmatic factors**, the research followed previous studies in using tokens where specificity / definiteness conflict, and tokens where they do not. [5] Accuracy was predicted to be high with no-conflict tokens, significantly lower where semantic factors create competition among cues. Repeated measures ANOVAs confirm that differences in mean error rates between the two were significant at the 0.01 level. The pattern persisted across all English proficiency levels. In the highest group (IELTS>7), there was no statistically significant difference with a Native Speaker Control Group on non-conflict sentence types, while performance on conflict types remained different at the 0.01 level.

Conclusions.

We believe that the research offers clues to the innate biases (or *Bayesian priors*) and learning behaviours of L2 users. Distributional errors were at zero. The mass / count distinction was strongly associated with differences in article omission rates (although the articles *supplied* were often non-native-like). In contrast, the relative placement of nouns and adjectives had no influence on article omission, even though N-Adj forms are extremely rare in English – a tree, it seems, is a tree either way. In semantic / pragmatics, article use was high when specificity and definiteness marched together, significantly lower when they were in conflict. The data match childhood acquisition studies. Valian (*op.cit.)* showed that child determiner use is accurate by the age of 2;0 - 2;5 using distributional criteria. Crain and Nakayama (1987) showed that young children are sensitive to structure dependence. [6] However, Valian goes on to report that children frequently omit articles in environments where an article would be obligatory in adult speech (a finding replicated in many subsequent studies). Overall, the results reported here suggest that L2 and child acquisition are matched - learners readily acquire knowledge of categories and sub-categories, both functional and lexical, and of their respective distributional requirements. This is neither L1 transfer, nor L1 'interference' – languages like Thai simply lack articles. Both children and adult L2 learners, however, struggle to work out the complex semantic / pragmatic functions of determiners and it is this difficulty that persists in the face of copious learning opportunities (articles are the highest-frequency tokens in English reference corpora). This failure to acquire has also been the focus of most previous L2A research. This research suggest that the errors learners *do not* make are as worthy of attention as those they do.

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Architecture (Conceptual and Cognitive) and Language Processing

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In their critique of the "conceptual architecture of linguistics and neurobiology as presently conceived," Poeppel and Embick (2005) discuss mismatches between the objects studied in those fields, and the problem of finding ways to "reduce or match up" the concepts in one field to the concepts in the other. In Embick and Poeppel (2014), they refer to Marr's (1982) levels of analysis (what needs to be computed, the representations and algorithm, and the physical realization); regarding sound localization, they write, "the high-level computational theory of the task ... turns out to be subserved by different algorithms in the avian versus mammalian auditory brainstem circuitry; and the specific cellular implementation reflects a specialization for one type of algorithm or the other"—thus it's an example of what they see as a fruitful matching up between these recognized cognitive operations and the particular physical mechanisms that appear to enable them.

In fact, there are multiple useful ways of connecting up these things. For instance, Anderson et al. (2012) aligned fMRI data to a simple model of children solving math problems, and the combination enabled a (highly constrained) kind of "mind reading" (Anderson, 2012)—something that is more than a "self-indulgent neo-phrenology" hopefully (Fitch, 2009), since the brain-imaging data used in this way is intended to help validate the behavioral model. It does not get us the computational primitives of the sort that Poeppel and Embick want, yet it is highly consistent with their goal of using results in one field to navigate among the options presented by another.

Poeppel and Embick referred to "conceptual architecture" of the fields of inquiry (i.e. linguistics and neurobiology), but our focus here is on the architecture of cognition itself. This is an important and possibly necessary focus, we think, given our current state of understanding. Work in dual-task experiments (Pashler, 1994) especially has led to cognitive architectures in which modules (for e.g. declarative and procedural memory) communicate via a substantial bottleneck (Anderson, 2007). This arrangement itself, and almost *by* itself, if not too far off the mark, takes us from initial notions of chunking (Miller, 1956) toward some fairly detailed proposals concerning its implementation (e.g. Anderson and Lebiere, 1998, ch. 7). Consistent with Chomsky's (2007) answer to the question of whether Merge is just some sort of language-specific operation ("We know that it is not"), the arrangement causes lists of items to be built by linking memory chunks together hierarchically. This more-or-less guarantees the use of such structures, in some way, for language—in this architecture, at least.

For the field of language processing, however, it might be more important, and probably more interesting, to take a deeper look at what this architecture appears to lack. It provides direct support for only the simplest forms of recursion. (Ignoring certain details, procedural memory 'reads and writes' through the same bottleneck, so a procedure can repeatedly act on its own outputs.) It isn't at all obvious what sort of control-structure should be created for center-embeddings, for instance—a troubling fact for theorists, apparently, presumably because of concerns over where things stand here with respect to the Chomsky hierarchy (Chomsky, 1956); and it has also troubled researchers trying to get a working parser actually up and running (see Ball, 2003). But this lack of an appropriate ready-made control-structure simply reflects the fact that, to get things working at this level, we still have to determine what the precise processing mechanisms for (e.g.) center-embedding are—the ones that create, in fact, the severe performance limitations that we see (as in Miller and Chomsky, 1963).

Situating this particular kind of storage mechanism (whatever it is) within the general (cognitive) architecture (as we currently understand it), it might be best to start by extending the architecture as little as possible—or not at all. The details are not at all clear, but we strongly suspect that a particular line of inquiry has already provided the basis for a solution here—or a crucial piece of it. Fodor (1998) argues that a reader "creates prosodic boundaries, and then takes them seriously as if they were part of the signal, aligning syntactic boundaries with them." And the "theoretical advantage of this prosodic packaging device is clear. It is not an ad hoc gadget, but something that must exist in any case ..." because, presumably, something has to handle prosody. We are led to a stronger hypothesis: Fodor's prosodic packager fulfills an architecturally necessary role. Without it, it's possible that we'd have no good way of keeping alive the material that syntax must get at to create these comparatively more complex structures. (The exact correspondence is non-trivial, of course, given the evident readjustments between prosodic and syntactic structure.) Altmann and Trafton (2002), in a similar situation, had to solve largely the same (underlying) problem (i.e. of keeping memory elements sufficiently activated; others, they argued, had erroneously assumed the existence of a control stack, so Altmann and Trafton looked at how subgoals might be encoded and strengthened in declarative memory, enabling subsequent retrievals).

Fodor (2013a) discusses prosody and doubly center-embedded relative clauses, but one word should be stricken from her own remarks on that work. "Improbably," she says (Fodor, 2013b), "we offer a phonological explanation." She shouldn't have said "Improbably." If this work on cognitive architecture is on the right track, then we shouldn't be surprised to find ourselves making use of just those things that happen already to be cognitively available to us. And according to Marr's distinctions, we arrived here partly by considering something about physical realization—though not cellular-level neurobiology. Instead, we paid attention to some (hypothesized) constraints of the higher-level structure of the machine on which cognition runs.

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Root Subjunctive Clauses

finiteness and the interplay evaluation-assertion

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Over the last decades numerous works have significantly contributed to improve our understanding of subjunctive clauses; yet different aspects of their syntax remain intriguing and challenging for the theory of grammar.

1. **Subjunctive**. As the traditional labels 'subjunctive' or 'conjunctive' suggest, *dependency* has been seen as the hallmark property of subjunctive. As a corollary it is generally considered the mood of subordination *par excellence*, being selected by given classes of matrix predicates, not occurring freely in matrix clauses, as opposed to indicative, the independent mood of unembedded assertions (Quer 1998).

The idea that the subjunctive is *dependent* goes back to traditional grammarians. Beyond the common dichotomy *realis (indicative) vs. irrealis (subjunctive),* whose empirical problems are described (Farkas 1992*,* Giannakidou 1998), other views were explored: Soares-Barbosa (1822) observed that the subjunctive occurs dependent on a verb *visible* or *hidden*, recalling what in the early generative grammar was known as Ross's (1970) *performative* approach.

While the indicative is associated to a given modal value, the subjunctive appears associated with a rich variety of modalities. The difficulty of identifying the unifying property shared by the different uses of subjunctive led scholars (Portner 1997, Marques 2004, 2009, Schlenker 2005) to take it as the *unmarked* or default mood, as opposed to indicative the *marked* mood. Clearly the concept of *markedness* would have to be defined. But whatever its precise definition, when we turn to the syntactic encoding of subjunctive and indicative we have to have a *calculus* of the properties of their triggers.

Though it is commonly assumed that indicative is not subject to licensing, plausibly both moods have to be licensed. I argue for this hypothesis here. Moreover I assume that the subjunctive, as any other mood, involves licensing of tense and that different projections of the left periphery, relating the propositional content to the discourse, do the rest. With respect to *tense* in subjunctives there has always been certain controversy (Picallo 1985, Stowell 1982, 1993, Martin 1996, Bošković 1997, Demirdache H, Uribe-Etxebarria M. 2000, Manzini 2000, Kempchinsky 1986, 2009, a.o.). I will assume licensing of tense is done through valuation of t(ense)-features in the probe-goal system, differentiating t-features from φ-features as in Pesetsky & Torrego 2004, but keeping Chomsky's 2001 concepts of *valued-unvalued* and *bundle of features*. A distinction between t_{ev}-features (event-related) and t_t-features (morphological-related) solves the paradox created by the need of the tense of subjunctive being dependent (Picallo 2005) *and* independent (Stowell 1982). I assume subjunctives are CPs where some features remain unvalued and get valued in the higher domain, much as ECMs (Ambar 2005, 2007, Uriagereka & Gallego 2007) and differently from Chomsky 2001 (whose exclusion of C is solved by *feature inheritance* in Chomsky 2007). As for the second component of subjunctive licensing (discourse projections), concepts discussed in the semantic characterization of subjunctive, crucially veridicality, worlds and logophoricity, models of evaluation and anchors Giannakidou 1994, 2009, Speas 2004, Bianchi 2001, Quer 1998, 2009, a.o.) will support our proposal: the role of evaluation in the account of subjunctive is accomplished in EvaluativeP and AssertiveP also plays a role (Quer 2009), two projections of the left periphery independently proposed for other phenomena (Ambar 2000, 2003). Roughly EvaluativeP is the projection of subjunctive, AssertiveP the projection of indicative. The difficulty of detecting the *unifying* property of subjunctive may then be the effect of the interaction of different values of these projections, which underlie Giannakidou's (non)veridicality.

2. **Main clauses**. A challenging point is how semantic properties are encoded into the syntactic structure. The main research on subjunctives has then inevitably focused on their distribution in subordinate contexts where both semantic and syntactic properties are

involved. Our main concern in this section is to highlight the relevance of matrix subjunctive clauses in the characterization of subjunctive.

Though the properties of subjunctive main clauses have been subject to less systematic scrutiny, they raise relevant questions on the characterization of subjunctive. The ban on subjunctive in root clauses has contributed to notions such as *marked vs. unmarked* mood and to the idea that the subjunctive is somehow defective or dependent.

Sentences like (1a) are assertions, where the speaker reports his knowledge on a given state of affairs grounded in the common ground. The subjunctive is ruled out from this context (1b):

(1) a. Ele vai ao cinema.
he go.IND.PRS.3SG to.the movies
'He goes to the movies.'
b. *Ele vá ao cinema.
he go.SBJV.PRS.3SG to.the movies

However if we turn to sentences expressing a given attitude of the speaker, an evaluation of the state of affairs described, the subjunctive occurs by its own (2a,a'), and with the pretended meaning it is the *indicative* that cannot occur (2b,b'):

(2) a. Vá ele às aulas! (e /assim terá êxito nos seus estudos)
go.SBJV.PRS.3SG he to the courses (so he will succeed in his studies)
'Let him go to the courses!'
a'. Assim ele vá às aulas!
so he go.SBJV.PRS.3SG to the courses
b. # Vai ele às aulas!
go.IND.PRS.3SG he to the courses
b'. # Assim ele vai às aulas!
so he go.IND.PRS.3SG to the courses

Things become more puzzling if emphatic strategies of affirmation-negation interact with the speaker's presupposition based in the common ground:

(3) a. *Sigam* eles o teu conselho *sigam*! [speaker's *disapproval;* presupposition: bad *advice*)]
Follow.SUBJ3PL they your advice *follow*.SUBJ.3PL
b. *Não* sigam eles o teu conselho *não*! [speaker's *approval*; presupp.: good *advice*
Not follow.SUBJ.3PL they your advice *not.*

(2)-(3) are root clauses. In Emonds's (1970, 2004, 2012) identification of root or root-like contexts (RIDE), roots are unselected finite IPs subject to the Tensed Sentence Constraint (TSC) and are always Discourse Projections. Though the properties of (2)-(3) fit this definition of root, there are other subjunctive main clauses which don't –imperatives in subjunctive mood may occur in embedded selected contexts; likewise discourse phenomena like topic and focus can occur freely in embedded unselected contexts and in a more restricted way in selected contexts, showing that these can be discourse projections – this is the case of Portuguese and Spanish though not of English. In line of Hooper & Thompson's (1973) claim that root clauses are restricted to assertive contexts in embedded, we will explore the interplay evaluative-assertive in (2) and (3). In this connection three other issues will be discussed: (i) the relation Assertive-tense and its link with TSC; (ii) the parameterization across languages ((non)discourse-prominent languages); (iii) we will show that Evaluation-Assertion and Tense licensing don't overlap.

Finally, we conjecture how these phenomena, which we are arguing encode evaluation (related to emotion) and Assertion (knowledge, Common Ground) into syntactic structure can "contribute to our understanding of the human capacity for language, understood as a generative procedure that relates sounds and meanings via syntax", therefore to the properties of the "language organ".

FOXP2 and language: a more nuanced view

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To date FOXP2 occupies a very special place in the context of biolinguistics. Although it is now clear that it's not the language gene, or that it was selected "for" language (Berwick 2011), nonetheless FOXP2 had led to substantial progress in the context of figuring out the relation between the genotype and the cognitive phenotype of our species. In this paper we wish to draw lessons from recent work on FOXP2 in other species to help reveal the role this gene may play in the context of the language faculty. Our argument is based on three findings:

First, recent work by Mendoza et al. 2014 on Drosophila FOXP reinforces the idea that the gene is a crucial component of the neural circuitry mediating motor learning, specifically circuits involving the basal ganglia.

Second, inserting a humanized version of the Foxp2 gene into the mouse results in alterations of the cortico-basal ganglia circuits (Enard et al. 2009), and leads to a faster information transfer between systems responsible for procedural memory (e.g., basal ganglia), and systems responsible for declarative memory (e.g., hippocampus) (Schreiweis et al. 2014).

Third, as one would expect from a gene deeply implicated in vocal learning abilities, FOXP2 deficits not only lead to language problems, it also impacts musical abilities (Alcock et al. 2000, Jentschke, Koelsch, Sallat & Friederici 2008).

On the basis of these findings, we would like to recast some of the claims put forth in van der Lely and Pinker 2014 regarding the nature of 'grammatical SLI'. Van der Lely and Pinker argue that the deficit in question pertains to what they call "extended syntax", which they equate with the dorsal pathway connecting Broca's area with the temporal lobe. Although the evidence they review indeed highlight the relevance of this brain structure, we think that their proposal (i) only captures part of the neurological basis of the deficit, and (ii) fail to capture the more generic nature of the deficit. Specifically, we would like to claim that the relevance of the cortico-cortical dorsal pathway should not be dissociated from the importance of the basal ganglia-hippocampal connection, and that both the cortical and subcortical routes play a role in language processing and language learning. Second, the role of the dorsal pathway should be recast in terms of the procedural/declarative memory systems to accommodate findings from music cognition, and motor learning more generally.

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Is externalization more than a side effect?
The case for the cognitive abilities of vocal learning birds

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In Chomsky (2007), an evolutionary hypothesis for the emergence of language and externalization is presented: "The core principle of language, unbounded Merge, must have arisen from some rewiring of the brain, presumably the effect of some small mutation. (…) The individual so endowed would have had many advantages: capacities for complex thought, planning, interpretation, and so on. The capacity would be transmitted to offspring, coming to dominate a small breeding group. At that stage, there would be an advantage to externalization, so the capacity would be linked as a secondary process to the sensorimotor system for externalization and interaction, including communication. It is not easy to imagine an account of human evolution that does not assume at least this much."

We would like to take Chomsky's challenge by proposing an alternative scenario for the emergence of externalization. In order to do so, we will depart from a review on the state of the art of the study of vocal learning behavior in birds. Some species of birds have been found to acquire their species-specific songs after a period of learning that displays many similarities with language acquisition in humans, including a babbling (*subsong*) stage, and a critical period after which songs become more structurally and phonologically fixed (Doupe & Kuhl 1999). The FoxP2 gene, known for its implication in developmental verbal dyspraxia in humans (Lai et al. 2001), seems to also be involved in song acquisition in birds (Haesler et al. 2004). Crucially, such involvement cannot be reduced to the external component of language; on the contrary, evidence is converging towards FoxP2 being an enhancer of domain-general learning processes, or, more specifically, of the transfer from declarative into procedural knowledge (Schreiweis et al. 2014), two systems of learning that act in parallel and compete for resources in solving cognitive tasks (Ullman 2001).

In brain terms, LMAN nucleus, situated in the bird's analogue of the primate's prefrontal cortex (*nidopallium*), seems to be responsible for the exploratory vocalizations characteristic of the subsong stage, as shown by the fact that its lesion reduces song variability (Fee & Goldberg 2011). Although variability is a feature of the subsong stage, it can also be found to some extent in adult birds, corresponding to their non-breeding season, when the males of some species practice the accuracy that during breeding season will be required to adequately perform in front of the females. It has been found that a higher expression of FoxP2 is present in the striatum during the non-breeding season in vocal learning birds (Haesler et al. 2004), suggesting that exploratory vocalizations depend on a network that at least involves both LMAN and the striatum. Fixed songs, on the other hand, would depend on a network that comprises HVC (an area analogous to the primate's premotor cortex), and also the striatum.

Vocal learning, therefore, entails a gradual decrease in the LMAN-mediated control of vocalizations in favor of HVC (Gadagkar & Goldberg 2013). During this process, both LMAN and HVC should compete to gain control of the bird's vocal production, with time favoring the odds against LMAN. Such competition should not be very different at all from the one held by the declarative and procedural systems in other domains of cognition.

We note that the presence of exploratory vocalizations, identified with the declarative aspects of domain-general learning, may be correlated with the relative size of the bird's nidopallium, where LMAN is located. Even if vocal learning is a highly specialized component (Doupe 1994), we argue that there has to be a minimum point of efficiency in the LMAN-striatum network for the vocal learning-ready brain to be able to become selected-for. Moreover, since changes in a brain area should necessarily affect more than a single behavioral aspect, we should expect to find that general cognitive enhancements often co-occur with vocal learning. This correlation can be found in Emery (2006), a review of the range of intelligent behaviors displayed by two species of vocal learners, corvids and parrots, which happen to have an exceptionally large nidopallium compared to other birds. We will also discuss the case of hummingbirds, vocal learners which possess a very different brain configuration compared with other vocal learners (Iwaniuk & Hurd 2005), but that can nonetheless support the hypothesis that there is a minimum point of efficiency of the LMAN-striatum network for vocal learning to emerge.

In sum, we contend that externalization draws from the same cognitive resources as the rest of cognition. Given this observation, the internal and external components of language should be expected to co-evolve, and such co-evolution should predate (and support) the later emergence of unbounded Merge and the systematic, arbitrary links between the interfaces that are needed to form symbols.

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Electrophysiological Evidence of Italian Vowels Segregation and Representation in Human Auditory Cortex

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Human speech processing shows a unique property: a high-resolution system for acoustic decoding and phonological encoding tied with ability for abstraction and a very efficient memory mechanisms, both residing in a high developed cortical (and sub-cortical) pathways (Hickok & Poeppel, 2007; Specht, 2014). Lateralization of function in auditory cortex has remained, however, a persistent puzzle.

The two predominant neurocognitive models of speech processing diverge in the assumptions about the hemispheric lateralization of speech perception. The *Dual Stream Model* (DSM, Hickok & Poeppel, 2007) assumes that the primary auditory cortex (comprising part of the superior temporal gyrus, STG) is involved in spectro-temporal processing bilaterally and that the anterior and the posterior inferior portions of the superior temporal sulcus (STS), in the secondary auditory cortex, are involved in phonological processing and representation bilaterally, although a weak left-hemisphere bias at this level of processing is tentatively supposed (cf. also Poeppel, 2003; Boemio et al., 2005). The *What/How* model (Rauschecker & Scott, 2009) assumes that the primary auditory cortex is involved in specific processing of sounds, whereas the left STG processes the acoustic-phonetic properties of stimuli. Finally, left STS is associated with the processing of higher order information in the speech signal, consonant-vowel combinations and words.

Magnetoencephalography (MEG) investigations have attempted to detect the nature of these representations by exploring the functional organization of the dedicated auditory circuits through the N1m auditory response to speech stimuli (Obleser et al., 2003; 2004; Shestakova et al., 2004). N1m, i.e., the magnetic counterpart of the electroencephalographic (EEG) N1 component, is a neural correlate of feature extraction whose properties bare important information on the speech cortical mapping mechanisms (Näätänen et al., 1999). Overall, in MEG studies, mostly on vowels, N1m modulations and the location of its neural sources provided evidence for specific pool of neurons, which were more sensitive to phonological features than to pure spectral properties of speech sounds. Vowel selectivity suggested a *phonemotopic* organization of the secondary auditory cortex pathway (Obleser et al., 2004; Eulitz et al., 2004; Scharinger et al., 2011). However, whether the auditory cortices house abstract and categorical representations of speech sounds phonemotopically and whether auditory speech processing is left-lateralized remain controversial issues. In this work, the auditory responses to Salento Italian (SI) vowels (i.e., /i, ɛ, a, ɔ, u/) have been investigated by using EEG and the N1 event related potential (ERP) component. SI provides us a suitable phonological system of five vowels that differ along three acoustic-articulatory dimensions: i.e., place of articulation, lip rounding and height. Aims of the study were: (i) to determine whether also the N1 ERP responses could be suitable for a phonemotopic mapping of vowels; (ii) to establish to what extent N1 modulations were dependent on spectro-acoustic properties of vowels; (iii) to test whether, at different neuronal modulations due to different phonemes, separable vowel cortical sources could be correlated.

To the best of our knowledge, this is the first study that uses ERP responses and the related source analysis in this kind of research. Most of probes indeed, have preferred MEG than EEG for its quality in terms of spatial resolution, even though experiments on repeatability of MEG and EEG measures showed minor advantages for the MEG (Liu et al., 2002; Cohen & Halgren, 2003). Furthermore, advance in the EEG source analysis software made the brain localization more accurate. EEG activity was recorded with an ActiCAP 64Ch (Brain Product GmbH) system in 16 Italian healthy subjects. Seating in front of a computer monitor they were asked to listen to SI natural vowels and to push a button with the left index whenever they heard a pure tone used as a distractor stimulus. Vowels and pure tone were administered randomly.

Peak latency and amplitude as well as source location (BESA 2000) of N1s to SI vowels – modeled as a equivalent current dipole (ECD) in three-dimensional (Talairach coordinates) source space – showed three important results: (i) N1 ERP response was a good parameter in monitoring the early cortical stages of speech processes since its changes to vowels were dependent on their phonological patterns; (ii) as hypothesized by Näätänen & Picton (1987), in the typical time range of N1 elicitation emerged two distinct auditory cortical responses: an earlier and bilaterally evoked at about 130 ms (N1a) in the primary auditory cortex (i.e., BA41 in the Heschl's gyrus), and a later activity, with a significant leftward asymmetry at 150 ms (N1b) originated within the secondary auditory cortex (i.e., BA22 in the STG/STS) (cf. Fig. 1 and 2); (iii) Talairach coordinates suggested medial-lateral, posterior-anterior and superior-inferior gradients for front/back (place of articulation) and round/unrounded features at the N1a, whereas posterior-anterior and superior-inferior gradients for front/back, round/unrounded and height at the N1b. Crucially, ECD absolute distance between vowels revealed smaller distances for vowels differing in place of articulation, lip rounding (/i-u/, /ɛ-ɔ/) and height (/a-ɛ/, /ɛ-i/,

/a-ɔ/, /ɔ-u/) at the N1a and larger significant distances for the same couples of vowels at the N1b, confirming the phonemotopic nature of auditory cortex (cf. Fig. 2). Also, by using multidimensional scaling, we found that the relational organization between vowel centroids in the spectro-acoustic domain is well preserved in neural space (cf. Fig. 2).

Despite the contradictory predictions of the current models of speech perception, our data suggest a hierarchical and asymmetric architecture of auditory speech processing. Interestingly (and novelty), based on the N1 component and ECD source location, our findings clearly show a dynamic modulation of speech processing between the dorsal and ventral auditory areas, with bilateral activation of primary auditory cortices and a left functional asymmetric activation of the secondary auditory cortices. We hypothesize that this observed asymmetry may reflect categorical perception of phonemes: i.e., after the bilaterally extraction of the main sensory/acoustic properties in the primary auditory cortex, an increasing leftward process leads to the extraction of invariant (opposite) patterns of phonemes (i.e., distinctive features) in the secondary auditory cortex, transforming them into discrete representations. In summary, we suggest that both auditory cortices contribute to the perception of phonetic signals, but their contribution vary as a function of the spectro-acoustic properties computed.

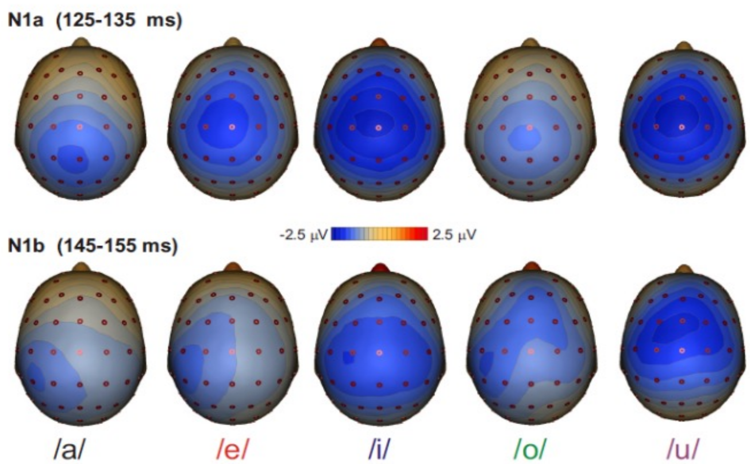

Figure 1: N1a and N1b topographical tridimensional maps displayed from a top view

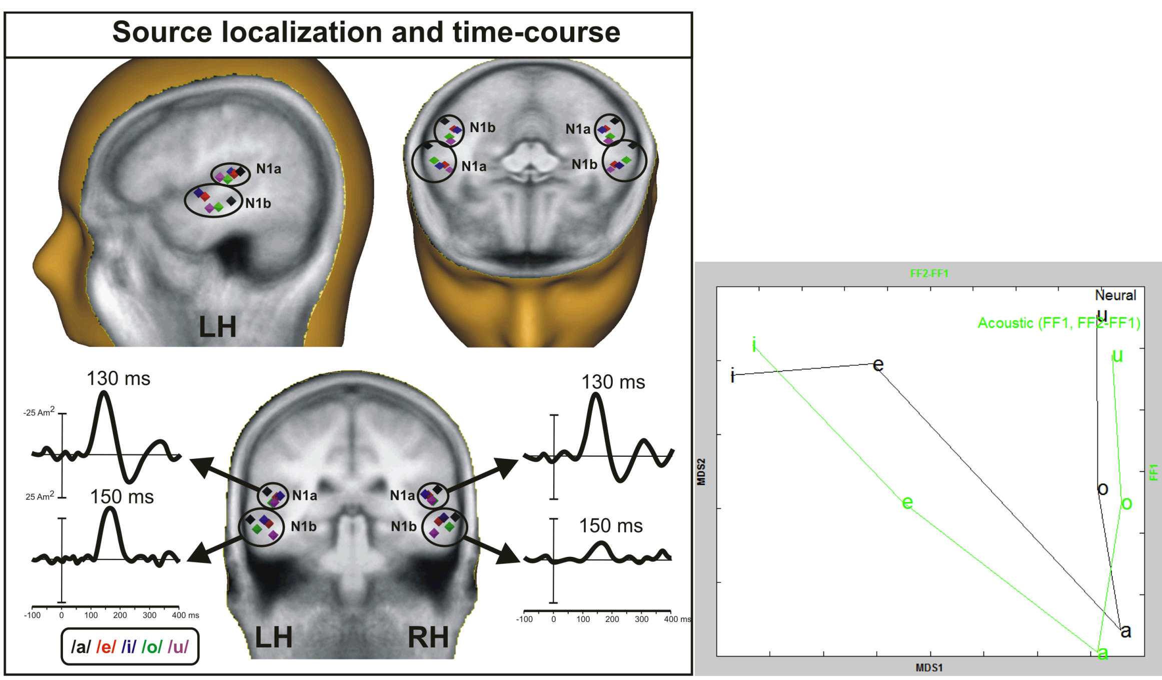

Figure 2: Intracranial source localization of N1a and N1b components (on the left) and Multidimensional scaling of acoustic and neural space in the secondary auditory cortex (on the right).

Variables and other Biolinguistic Issues in Phonology

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This paper is complementary both to work like that of Hornstein and Pietroski [4], who explicitly exclude phonology in their discussion of a possible set of 'basic operations' for language; and to work like that of Mesgarani *et al.* [5] who report finding evidence for phonetic/phonological feature encoding in the brain. We are interested in the combinatoric and syntactic properties of phonological computation. We are influenced by scholars like Poeppel [6] who maintain that neuroscientists need theoreticians to tell them what primitives to look for in the brain: "The commitment to an algorithm or computation [...] commits one to representations of one form or another with increasing specificity and also provides clear constraints for what the neural circuitry must accomplish. The kinds of operation that might provide the basis for investigation include concatenation, segmentation, combination, labelling, and other elementary (and generic) operations that could be implemented quite straightforwardly in neural circuits".

Of course, compiling a massive list of candidates for representational and computational linguistic primitives, would not be as useful as finding a restricted list of basic operations—we want to "abstract from the welter of descriptive complexity certain general principles governing computation that would allow the rules of a particular language to be given in very simple forms" [1]. If we theoretical linguists can posit a small set of primitives, we simplify the tasks of our colleagues since "the less attributed to genetic information (in our case, the topic of UG) for determining the development of an organism, the more feasible the study of its evolution" ([2]) and its neural bases.

With a view to unifying phonology with other branches of cognitive science and neuroscience, we discuss several well known phonological phenomena:

Combinatoric explosion: Using a set of fairly standard phonological assumptions (binary features, underspecification, a restricted rule formalism) we show that even highly restricted systems lead to massive combinatorial explosion. For example, with just 4 binary features and underspecification, we can define 2.4×10^{24} languages (segment inventories). Such mathematically trivial results have two corollaries that we explore: (a) Combinatorial explosion means that we can get a lot of descriptive power with few elements, and thus a restricted, genetically determined UG can still allow for a "welter of descriptive complexity"; and (b) Since it is implausible that learners search a space of such astronomical size in converging on the ambient language, we need to understand acquisition of an I-language in terms of a UG also defined *intensionally*.

Sets and Quantification: The works of Poeppel and Mesgarani *et al.* refer to the distinctive features that define phonological equivalence classes. For example, the English plural is pronounced as [s] after the *voiceless stop* consonants [p,t,k], as in *caps, cats, packs*, but as [z] after the *voiced stop* consonants [b,d,g] as in *cabs, cads, bags*. The fact that phonological processes refer to such *natural classes* of speech segment can be formalized in terms of basic set-theoretic relations, such as subset-superset relations and intersection, primitive notions that fit Poeppel's demands for "elementary (and generic) operations that could be implemented quite straightforwardly in neural circuits."

When an operation identifies segments that share a subset of properties, it is performing a calculation of partial or total identity. There exist phonological processes that appear to require a calculation of *non-identity* as well. For example, some languages will delete vowels between consonants under certain conditions, but only if the consonants are *non-identical*. One obvious way to formalize such conditions is by use of the existential operator of first order logic, $\exists$: the rule applies only if there exists at least one feature with respect to which the two consonants *disagree*. If we accept that these examples are well-characterized, we can exhort our neuroscientist colleagues to look for evidence of neural circuitry performing computations of quantificational logic.

Mapping a function: Phonological rules are ordered but a given string can meet the conditions for application in more than one position. We can describe the situation as finding a set of subsequences of a string that match the rule's requirements and applying the rule to *all* of them at once. This idea of applying a function to a set of inputs is used in functional programming and is typically called *mapping* a function over a set. Mapping is a higher-order function.

Variables and Functions: Gallistel (e.g. [3]) insists upon the necessity of *variables* to account for many cognitive phenomena (*e.g.*, insect navigation). Our phonological discussions of mapping, sets and quantification, all rely fundamentally on variables. Further examples from phonology, such as the status of α-notation in rules, can be adduced to reinforce Gallistel's arguments about the need for a model of the mind/brain that computes using variables implemented *via* an addressable read/write memory. Given the robustness of phonological descriptions, we aim to contribute to the transformation that Gallistel foresees: "The truths the cognitive scientists know about information processing, when integrated into neuroscience, will transform our understanding of how the brain works"[3].

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Language externalization is not secondary: On the integration of speech and thought

The importance of speech/sign for thought has been overly underestimated. Yet, if Sapiens' specific mode of thought (and social behavior) is for the most part shaped by the faculty of language as maintained in the un-Cartesian approach (Hinzen 2013), the conclusion is warranted. Against it, however, one can deny the premise and maintain that language *expresses* rather than makes thought. This is the common sense view and, probably, also the dominant view in the academia. Another way to refuse the conclusion is to delimit a narrow faculty of language consisting exclusively of the internal, central and amodal system which underlies and mediates the perception and production of speech, two systems which would be considered secondary with regard to the central one. As is well known, this is the Chomskian position according to which, speech production and perception are considered a mere secondary step subsumed under the so called *externalization.* Whichever of the two positions, separately or together, leads to a radical separation of speech and thought. The separation gap increases if following Chomsky (see Chomsky 2004, 2013) one assumes that the faculty of language matches optimally with thought (his Conceptual-Intentional system) rather than with externalization.

Against this framework, in this talk we will focus on externalization and provide different arguments in favor of the thesis stated in the title. As a consequence the un-Cartesian view will be reinforced from below.

From a conceptual point of view, two arguments will be developed. The first argument posits that language is the most complete faculty ever evolved in the sense that it embraces and interrelates a sensory system which qualifies as an input/perceptual system (Fodor 1983)), a cognitive system and a motor system, which crucially are all interdependent. That it is precisely the motor-cognitive-perceptual connection that is crucial is suggested by the openness of the externalization: the system can be oral-auditory or gestural-visual. The second argument shows that externalization can be vindicated without assuming that language evolution is crucially informed by animal communication (Bolhuis et al 2014, Hauser et al 2013). To elevate speech to the level of the internal systems indeed entails to elevate communication, but communication of ideas, which has no precedent in the ontologically dubious domain of animal communication (Balari & Lorenzo 2013). The communication of ideas among conspecifics in our species is instead beyond dispute, which allows to develop the argument that the only extant communication system is precisely language.

Once communication/externalization is restated as above, words and grammar will be considered in its light. It will then be argued that the communicative (sound/sign) and cognitive (meaning) dimensions of language go arm in arm irremissibly and are responsible of our species' mental and social profiles. They are like the two sides of a coin. It does not make sense to claim any kind of priority of either. Words, which constitute an indispensable ingredient of language and are its currency, constitute supporting evidence to the stance defended here: they are internal (even a candidate to FLN in Hauser, Chomsky & Fitch 2002 with regard to the C-I system) and external ("externalized symbols" in Hauser 2009) at the same time and by definition. By means of deixis and other resources, grammar, which has to be distinguished from the computational engine and only makes sense with words, builds complex reference to the external world as well as allows for the expression of intentions beyond the declarative form (questions, commands, etc.). In sum, basic ingredients of the internal system like words and grammar do not make any sense if not considered in the light of communication/externalization. The alternative is an internal computational system which can hardly count as language if devoid of the linguistic specificity of words and grammar.

Turning next to brain correlates, it turns out that the classical view that language is left-lateralized has been to some extent called into question (Boeckx 2014). It is said that left perisylvian areas would be in charge of speech(/sign)/externalization rather than language properly, which would recruit the homolog areas in the right neocortex and also subcortical (mainly thalamus and basal ganglia) circuitry along with the cerebellum. And certainly, what is mainly in dispute is whether grammar in the more abstract off line sense is abided by these left areas, mainly Broca's area (Matchin et al 2014). That the online syntactic processing recruits Broca's area and the sensorimotor integration is brought about by the left-lateralized Dorsal PathwayI (DPI) can be taken for sure and, therefore, that there is left-lateralization of these tasks at least. Furthermore, it is even possible that left lateralization itself is the result of the sensorimotor integration itself (Pulvermüller 2012) relying on the DPI. In this connection it would be crucial for left-lateralization the babbling stage in the first year of exposure to speech/sign. Taking at its face value that left-lateralization is driven by the sensorimotor integration and that speech is left-lateralized, the so called positive symptoms of schizophrenia, namely auditory vocal hallucinations, thought disorder and delusions and their brain correlates will provide in deep and extensive evidence that the malfunctioning of the speech circuitry in the left hemisphere is enough to disrupt rational thought and, therefore, that language externalization as such (perception and production) is of significant cognitive import.

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What makes speech human-specific?

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There is still no categorical answer for why humans, and no other species, have speech, or why speech is the way it is. Several purely anatomical arguments (descent of larynx, loss of air sacs) have been put forward, but they have been shown to be false, biologically implausible, or of limited scope. In addition, it's been argued (Samuels 2011) that virtually all ingredients entering into human phonology can be found in other species. That is, it may be that what underlies human phonology is a unique combination of abilities, but the individual abilities themselves may be found in many other species.

In this paper we would like to pursue this reasoning and ask why this particular combination of phonological abilities is found in humans. Our general answer is that this is due to the fact that only humans have the sort of recursive syntax our language faculty is famous for. In order for this type of syntax to be externalized, the 'externalizing component' (i.e., phonology broadly speaking) must be organized in particular, species-specific ways. From this organization, speech as we know it arises.

Our argument in favor of this position will be supported by considerations from two domains. First, both lexical and post-lexical phonology are defined by domains that are not intrinsic to phonology, but rather, are imposed by morphosyntax. While this has been recognized since the beginning of the generative era, the phase-based approach to syntax has revealed that the relationship is quite close, with isomorphism between morphosyntactic and phonological domains (see e.g. Marvin 2002, Kahnemuyipour 2009, Samuels 2011). Thus, the phonological component is crucially shaped by its interface with syntax: syntax provides phonology with structured input in a cyclical fashion. In the absence of input of this kind, lexical phonology in particular would lose its defining characteristic, "inside-out" morpheme-by-morpheme cyclicity. This appears to be confirmed by Al-Sayyid Bedouin Sign Language, which has no lexical phonology and a striking lack of derivational and inflectional morphology (Aronoff et al. 2008); on our view, the former is the result of the latter. Moreover, Minimalist pursuits appear to lead to the hypothesis that there is a deep asymmetry between the mapping from syntax to meaning and the mapping from syntax to sound/sign (Chomsky 2008, 2010), with the former being privileged, confirming Bromberger & Halle's (1989) conclusion that phonology is fundamentally different. The idea that the cyclicity of phonology is parasitic on the cyclicity of Merge accords with this idea; the emergence of Merge, then, can be seen as the unifying event which enabled the pairing of this externalization system with the conceptual-intensional systems.

Second, we will argue that syntax forces the mind/brain to assign species-specific cognitive values to phonological ingredients such as vowels and consonants, otherwise attested in other species (e.g., Gelada Baboons). It has been shown that this species is able to produce vocalizations which not only employ what we would perceive as consonants and vowels, but are also structured in a way which resembles human sound systems, with different vowel qualities and consonants distinguished by manner and place of articulation, as well as duration similar to that of human speech (Richman 1976, et seq; Bergman 2013). There are, of course, different ways of articulating sounds with the same acoustic effect, even among humans, but the fact alone that there are indeed other species which are able to produce consonants and vowels in a dynamic manner and yet do not have human-like speech shows that just having that inventory is not a diagnosis for neither speech or language. So why is it, then, that we humans have it and species like Gelada Baboons don't? We will argue that the different cognitive import given by humans to vowels and consonants is the solution to the externalization of the complex syntactic component that other species lack.

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Everything you wanted to know about schizophrenic language but were afraid to ask

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Language has been a longstanding area of theoretical interest in schizophrenia, and thas been the subject of considerable empirical investigation. Questions have ranged from whether or not there is a primary linguistic disturbance in patients who show incoherent speech, to whether language is the key to understanding the disorder as a whole.

Why is it even considered that there might be a language disorder in schizophrenia? The simple answer is that a proportion of patients (probably a minority though there are no precise estimates) show speech that is difficult to follow. When severe, this can be hard to distinguish clinically from fluent dysphasia, and classic aphasic phenomena like neologisms and paraphasias can be demonstrated. The limited available data indicate that this severe speech disorganization does not resemble any known form of dysphasia – in particular there is no prominent naming deficit and no more than a subtle comprehension deficit. Another linguistic abnormality in thought-disordered patients is unclear reference at the level of discourse (ie between sentences). There is also evidence for non-linguistic changes – ie in the thought behind the speech – in speech disorganized patients, but there are differing views as to what these might be.

In many patients with schizophrenia speech appears to be normal; they speak coherently and have no problems comprehending what is said to them. Linguistic analysis of expressed speech in these patients nevertheless reveals quantitative changes from normal speech – notably, though not exclusively, a simplified grammatical structure and syntactic error-making.

Some other symptoms of schizophrenia have an apparent linguistic dimension. Thus auditory hallucinations are typically 'verbal' in form; ie they consist of heard speech. The linguistic study of auditory verbal hallucinations, however, has so far been neglected. In another class of symptoms there are subjective changes in the possession of thought – patients describe thoughts which are not their own entering their heads or their own thoughts being withdrawn from their heads, or being freely available to others. These symptoms have been argued to be understandable as the consequence a disturbance of the deictic frame, but supporting evidence is lacking.

There have been a number of attempts to explain schizophrenia as a whole in terms of a fundamental disorder of language. The most important contemporary example of such an approach is the work of Crow. The main problem such theories face is that their explanatory power is restricted to only circumscribed parts of the clinical picture. For example, no linguistic approach to date provides any kind of framework for understanding delusions, one of the most important symptoms of schizophrenia and perhaps its defining feature.

This talk will summarize the current state of knowledge on language abnormality in schizophrenia, correct some popular misconceptions, point out some experimental pitfalls, and try to specify what the remaining challenges are.

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The positive symptoms of schizophrenia in light of the un-Cartesian hypothesis

How might language matter to psychosis? The short answer is that cognition with language and cognition without it are not the same; and a different cognitive type of the kind we see in schizophrenia could represent a different linguistic type and hence intra-species variation with respect to the genetic specifications for 'Universal Grammar', as Crow (1997) claimed on independent grounds (see also Morice & McNicol, 1986:248). More specifically, 'schizophrenia' is defined to come with three kinds of characteristic 'positive' symptoms:

(1) Disordered speech (Formal Thought Disorder, FTD)
(2) Delusions
(3) Hallucinations (typically auditory verbal)

(1) *is* a linguistic symptom. (3) is, merely descriptively, a disorder in the *perception of speech*; moreover, subtypes of auditory verbal hallucinations can be identified by their linguistic forms (McCarthy-Jones et al., 2012). (2) is the phenomenon that patients assert sentences that are not merely false but not conceivably true, while at the same time held with incontrovertible certainty, such as 'I am Jesus', 'I have a wine glass in my stomach', 'I wear my father's hair', or 'The Mafia is trying to kill me'. In addition, there are 'referential' delusions, where normally neutral events are interpreted as significant.

Judging sentences true or false is commonly regarded as a matter of 'thought' or 'belief' rather than language – yet what is thought? Thought in humans takes a sapiens-specific form; it is generative and combinatorial, it obeys structural principles, and it has a content, being true or false. The un-Cartesian hypothesis (Hinzen & Sheehan, 2013) is that the generative system behind such creative thought and behind language is the same and hence the structuring principles in question *are* those of Universal Grammar. Grammatical organization therefore is responsible for a specific kind of meaning that uniquely patterns with such organization. The un-Cartesian programme identifies this specifically as *referential* and *propositional* meaning, which we never find purely lexically, nor (arguably) in non-linguistic animals.

A disturbance in referential and propositional meaning is virtually a re-description of the phenomenon of delusions. Impairment in the role of language in normal cognitive functioning, as viewed under the un-Cartesian hypothesis, therefore predicts (2). Put differently, psychosis is a distortion in our sense of reality; a theory of psychosis therefore requires a cognitive principle from which such a principle (a sense of 'reality', or truth) derives. Language in humans is a candidate for being that principle, since language is necessarily social and shared, crossing between minds and integrating minds and reality. It *is* a form of social cognition, whose normal functioning inversely correlates with the 'autism' (social withdrawal) of patients with schizophrenia.

Empirically, changes in linguistic patterns have been found *across* the symptoms of schizophrenia. They include reduced syntactic complexity (recursion) (Morice & McNicol, 1986), problems with pronominal reference (Rochester & Martin, 1979; Ceccherini & Crow, 2003), and reference in general (insofar as reference is meant to target objects and events that actually exist) (Moya, 1989). In FTD specifically, they include the organization of discourse according to lexical associations more than sentential meaning or topics, poverty of (propositional) content ('nothing is said'), incoherence (Chaika, 1974), neologisms, and impossible meanings (e.g., 'A conclusion is my French Professor').

Overall, these appear as problems in handling language as a tool that allows reference to a shared world and making predicative statements about it with objective (non-personal) validity. In line with this, delusions *are* statements with a personal validity only; they are also necessarily unembedded, since 'I think I am Napoleon' or 'It seems to me that I am Napoleon' are not expressions of delusions proper. From this linguistic feature it follows that delusions often lack justification, and cannot be controverted, since either of these things require embedding and representing the relevant propositions as thought contents rather than brute facts.

Rather than looking at language pathology, however, the psychology and neuropsychology of schizophrenia have largely focused on non-linguistic cognitive variables such as attention, perception, memory, 'theory of mind' (ToM), or executive functioning. Finding selective (disproportionate) deficits in one or more of these domains has proved difficult, however, as has the explanatory connection between neurocognitive deficits and positive symptoms (which are 'excesses' of normal cognitive function rather than deficits) (McKenna, 2007). The cognitive neuropsychology of schizophrenia has sought to *link* neurocognitive impairment and symptoms via concrete mechanisms. Two central and related concepts have been formulated by Frith (1992): that of a deficit in the self-monitoring of willed motor action, and that of a deficit in meta-representation ('theory of mind'). Yet it is not clear how a theory based on the former concept accounts for the fact that clinically, patients with schizophrenia do not typically exhibit any obvious problems with motor control: the problem lies, as Frith (2012) notes, at a 'conscious' level, the level of *thinking* about one's own actions, which may well be language-mediated. Second, either concept has difficulties accounting for a major category of delusions, termed 'delusional intuitions' by Schneider.

Finally, meta-representation as defined by Frith amounts to clauses with recursion, hence particular grammatical forms, suggesting that theorizing about mental states could merely *be* using language, i.e. processing such structures as 'He believes I like him'. This coheres with evidence for the language-dependence of full ToM in development (DeVilliers, 2007), and it eliminates the problem that ToM, as such, does not explain (i) why we think propositionally in the first place, (ii) engage in forms of reference and predication that are identified grammatically, or (iii) structure our communication via a species-specific deictic frame, in which all thought contents are subordinated to an 'I think', i.e. a thinker identifying himself in the first person, speaking for a hearer identified in the second, about the world as identified in the third. Grammatical Person is essential to a human-specific deictic frame, the disintegration of which Crow (2012) argued to lie at the heart of first rank psychotic symptoms.

Since Bleuler (1911), schizophrenia has been called a disintegration of 'selfhood'. Not all forms of selfhood are human-specific or dependent on language, but some clearly are. If the thought disturbance that we see arises at a *personal* level, we need to account for what *makes* thought (first-) personal in this sense, and gives us a narrative identity. Language is likely to be an essential part of any such account.

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Language, pragmatics and social cognition in schizophrenia

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Schizophrenia is a devastating mental disorder that affects 1% of the world's population, characterized by core cognitive impairment and long-term disability. The functional outcome in schizophrenia is largely predicted by neurocognitive deficits, with a critical mediating effect of social abilities (Brekke et al., 2007; Schmidt et al., 2011), directly affected by communicative skills.

Anomalies in the speech of patients were reported since first descriptions of schizophrenia by Bleuler and even prior by Kraepelin, as features of dementia praecox. However, only in the past decades language and communication dysfunctions have become a topic for systematic investigations. Several aspects of language, encompassing semantics and syntax, were found to be impaired in schizophrenia (Kuperberg 2010), but results are still controversial, and the interaction between linguistic and cognitive deficits is unclear. In a previous study we showed that patients affected by schizophrenia exhibit specific impairments in recognizing syntactic errors violating general principles of Universal Grammar and that the syntactic deficit is largely independent of cognitive performances (Moro et al., in preparation). In the same work, we also observed that patients are indeed able to judge semantic relations, suggesting that semantic meaning processing could be intact in schizophrenia. Recent research supports this hypothesis, describing language disruption in schizophrenia in terms of impairments at the pragmatic rather than semantic level, i.e., matching meaning and context. Schizophrenic patients seem unable to infer the meaning that the speaker intends to convey, to grasp figurative uses of language (Schettino et al. 2010), to catch irony and humor (Polimeni et al. 2010), which results in inappropriate behavior in communicative interaction. Importantly, pragmatics is seen as resulting from the interplay of a number of cognitive abilities, spanning from Theory of Mind to memory and executive functions (Bambini & Bara 2012). This constellation of abilities has been shown to be compromised in schizophrenia, with a special emphasis on the social component (Bechi et al. 2013). Yet social and general cognition on the one side and pragmatic abilities on the other side have not been systematically investigated in relation to one another in the case of schizophrenia. In this scenario, a comprehensive exploration of the patient's communicative abilities becomes of primary importance, in order to assess the relationship between the pragmatic competence and the major aspects of psychopathology, neurocognition and social cognition. The present study aims at specifically assessing pragmatic skills with a newly developed protocol, and to analyze relationships between communication-related skills and psychopathological and neuropsychological measures, especially focusing on aspects of social cognition.

39 patients affected by schizophrenia (DSM-IV TR, all subtypes; mean age = 40.87, SD=10.3; mean education = 11.89, SD = 2.68) and 32 healthy controls (mean age = 42.03, SD= 10,63; mean education = 13.25, SD = 13.25, SD = 3.79) were assessed for pragmatic abilities through the APACS test (Assessment of Pragmatic Abilities and Cognitive Substrates), a newly developed instrument addressing two main pragmatic domains, important for successful communication in daily living: discourse management (through interviews and story comprehension tasks) and derivation of communicated meaning (through figurative language and humor comprehension tasks). Innovatively, APACS aims at reproducing conversational contexts as much as possible, basing on topics and photographs directly related to the daily living communicative experience, and being structured in three compact parts that do not require to shift from task to task with increasing effort overload.

Patients were also assessed with Positive and Negative Syndrome Scale, measuring symptoms severity; Theory of Mind Picture Sequencing Task, measuring Theory of Mind (ToM); The Brief Assessment of Cognition in Schizophrenia, evaluating the main cognitive functions usually impaired in schizophrenia.

Results showed a wide impairment of pragmatics and communication abilities in patients, performing significantly worse than controls in all subtests, excluding scene description ($ps < 0.001$). The worst performance were obtained in the subtests assessing comprehension, especially story comprehension, humor and figurative language. The PANNS scale did not correlate significantly with any subtest. On

the contrary, several social and cognitive domains correlated significantly with the pragmatic tasks. In particular, ToM correlated with figurative language and humor comprehension, whereas verbal memory correlated with narrative comprehension, humor and the most complex part of figurative language comprehension ($ps < 0.001$, Bonferroni correction). We built exploratory regression trees investigating the relation between several predictors and the performance in the pragmatic tasks. ToM was the best predictor for figurative language comprehension, while verbal memory was the best predictor for story comprehension, humour and complex figurative language comprehension.
Our data confirm that linguistic deficits in schizophrenia are widespread and include specific pragmatic abilities that may be at the base of communicative dysfunction and contribute to the social withdrawal that characterizes the illness. As suggested by regressions analysis, ToM seems to be crucial for figurative language comprehension, while, for more complex pragmatic tasks such as humour, an intact verbal memory seems to be required. Overall, our findings suggest that communicative behavior in schizophrenic patients is largely depending on cognitive and socio-cognitive components, in addition to specific knowledge impairments at the syntactic level (Moro et al. in prep). A deeper understanding of the interplay of the different components may lead to more refined neuropragmatic models, as well as to the development of new and effective therapeutic strategies.

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Disordered speech and language in schizophrenia: the perspective from brain imaging

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The psychiatric disorder schizophrenia is associated with important changes in language. Studies carried out on unselected groups of patients have demonstrated simplified grammatical structure in expressed speech coupled with making of errors which are predominantly (though not exclusively) syntactic. Furthermore, a proportion of patients with the disorder (probably a minority although precise figures are lacking) additionally show thought disorder, disorganized and incoherent speech which, when severe, features dysphasia-like abnormalities such as neologisms and paraphasias. Though it has been disputed over the years whether the abnormality in thought disorder is in language or in 'the thought behind the speech', a substantial body of evidence has now demonstrated beyond doubt that the disorder is in part linguistically based (for a review of language abnormality in schizophrenia see McKenna and Oh, 2005).

An important question is therefore whether these speech and language changes have correlates in brain structure and/or function. In schizophrenia as a whole there is an approximately 2% reduction in whole brain and grey matter volume. The distribution of structural changes, as revealed using techniques such as voxel-based morphometry (VBM) or cortical thickness analysis , is widespread and does not selectively implicate classical language regions of the brain such as Broca's or Wernicke's areas. On the other hand, both conventional volume measurement studies (Sun et al, 2009) and those using VBM (Horn et al, 2010) have found greater volume reductions in the superior temporal cortex in patients showing the symptom of thought disorder compared to those without. A recent VBM study by our group (Sans-Sansa et al 2013) found that patients with high scores on thought disorder showed clusters of volume reduction in two left-sided areas approximating to Broca's and Wernicke's areas, and also in the medial frontal and orbitofrontal cortex bilaterally. Neurological lesions in this latter area can also give rise to disordered (disinhibited and perseverative) speech.

Do functional imaging studies also support changes in language regions in thought-disordered schizophrenia? Here, studies have been few and the numbers of patients with and without the symptom have often been small. Sometimes changes have been examined at rest, sometimes during paradigms designed to elicit disorganized speech, and sometimes using psychological paradigms which have only an uncertain relationship to the symptom of thought disorder. Broadly speaking, these findings implicate the temporal lobe cortex and the prefrontal cortex. However, few if any functional imaging studies to date have used linguistic paradigms.

The emerging picture of brain correlates of thought disorder is of abnormality in language areas, but a detailed mapping of these changes is currently lacking.

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Parametric Hierarchies and the Three Factors in Language Design: A Biolinguistic Perspective

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The aim of this paper is to revisit standard assumptions in the linguistic literature from a biolinguistic point of view. The focus is on (i) parametric hierarchies and the primitives of Universal Grammar (UG) and (ii) Chomsky's (2005) 'three factors in language design'. Revisiting standard linguistic assumptions from a biolinguistic perspective is likely to entail a shift of focus from language-specific, presumably UG-represented particularities to principles of general cognitive architecture and possibly progress with respect to the Granularity Mismatch Problem (Poeppel & Embick 2005).

(Macro)parameters in the early stages of the Principles & Parameters (Chomsky 1981) approach were conceived as giving rise to certain hierarchies and parametric paths such as those proposed in Baker (2003). Parameters were also understood as determining clusters of surface properties by means of selecting a parametric path, the selection of which would leave other options unexplored. The present work discusses the nature of macroparametric variation and its predicted hierarchies through implementing a program analysis to two pools of data consisting of DP parameters in order to pinpoint relations of parameter setting and setability across a variety of languages.

Assuming that any parametric approach to UG and variation is at the same time a theory that makes use of parametric paths and hierarchies, this study provides insights into the nature of such concepts as these occur in two specific pool of data that consists of hierarchically-organized parameters. The dependencies are approached through implementing a program-based analysis that measure relations of setability that exist between the different parameters in the two pools of data at hand, taken from Longobardi & Guardiano (2009) and Longobardi et al. (2013): These are binary parameters coming from the nominal domain, presented alongside setting states and setability relations, across different contemporary and/or ancient languages. Setting occurs on the basis of language data, whereas setability depends on the status [+, -] of the non-dependent parameters that the parametric dependency specifies.

The fact that Longobardi & Guardiano (2009) and Longobardi et al. (2013) articulate in sufficient detail and across a variety of languages the status of all the input nodes as well as the parametric dependencies that define the neutralization/setability of their dependent parameters makes their pool of data a unique candidate for program analysis of the corresponding hierarchies. However, any observations about the nature of the relevant dependencies and hierarchies that are drawn from this pool of data should not be read only in relation to these specific parameters or this specific functional domain.

There is partial overlap between the two pools of data in terms of languages and parameters, however there are also differences: for example, languages that are found only in one of the two pools of data. As a result, the formed hierarchies also differ to some extent. However, despite these differences, the analyses of the two pools of data give rise to similar results. This suggests that the obtained results are highly likely to have parallels in data and parameters from other functional domains, because dependencies and states aside, the developed program does not see the linguistic status of the parameters under examination; it simply traces issues related to their existence. This is what explains the similarity in the results even though program input was partially different.

The relevant portion of the parametric space defined in Longobardi & Guardiano (2009) & Longobardi et al. (2013) i.e. those dependent parameters that can reach neutralization/setability in more than one ways) was converted into program input in order to (i) shed light on how deterministic models that assume such dependencies are and (ii) see whether languages proceed in uniform ways in terms of the number and the complexity of the setability paths they involve. The results showed that languages proceed in largely non-uniform ways both in terms of the number of settable parameters they involve but also with respect to the number of ways to reach setability of a given parameter. These observations give rise to five intertwined problems that pertain to (i) cross-linguistic variability in setability relations, (ii) the (species-) uniform character of UG, (iii) the fixed character of the architecture of UG, (iv) the overproduction of predicted paths by the system, and (iv) optimality considerations (Boeckx & Leivada 2013). In their totality, these problems suggest that the notion of parametric dependencies runs into empirical problems that should cast doubt on the feasibility of parametric approaches to UG that postulate hierarchically-organized parameters.

(i) corresponds to the setability problem: there is qualitative and quantitative crosslinguistic dissimilarity in terms of the setability paths that each language shows as realized. Qualitative dissimilarity boils down to varying complexity in the hierarchies: language A might achieve setability of a parameter on the basis of a path that consists of a single node, whereas language B might achieve setability of the exact same parameter on the basis of another path that has nine nodes. Quantitative dissimilarity boils down to optionality: language A might be able to achieve setability of a parameter on the basis of one path, whereas language B might have four setability paths.

(ii) is related to Chomsky's (2005) three factors in language design. The first factor which refers to biological endowment (i.e. UG viewed as a cognitive map that encodes all possible variation paths through encoding parametric paths) is meant to be understood as species-uniform. Under this assumption, (ii) is dubbed the uniformity problem: If the first factor is indeed species-uniform, why do the cognitive maps of acquirers of different languages show up encoding varying numbers of setability paths?

(iii) is the fixity problem: The (un)availability of a setability path materializes not at the beginning but in the course of navigating the parametric space and after setting the input parameters to a target value. However, if one views UG as an innate fixed nucleus (Piattelli-Palmarini 1980), it is hard to argue in favor of the existence of a component that is both fixed and unfixed. Put differently, the fixed architecture of the system cannot be both fixed and moving at the same time, and yet it is moving if parts of it are continuously adjusted in the course of navigation.

(iv) and (v) are interrelated points and both are suggestive of the character of macroparametric hierarchies. The first one corresponds to the overproduction problem: The system overproduces by predicting paths that no language, from the ones existing in the pool of data, realizes. The second point is the direct consequence of the first and it refers to the optimality problem: It is shown that the system is not deterministic enough and it overgenerates, but the languages under consideration do show some kind of optimal organization in not realizing the most complex paths.

These reflections on the primitives and the architecture of UG pave the road for revisiting the Chomskyan take on the three factors in language design. Chomsky has described the first factor as "genetic endowment, apparently nearly uniform for the species, which interprets part of the environment as linguistic experience". Biologists, however, would argue that such a connection between 'grammars' and 'genes' is untenable. A genocentric vision of UG would be problematic for biology has slowly but unmistakably dropped its genocentrism (see Pigliucci & Müller 2010 and Fodor & Piattelli-Palmarini 2010).

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Feature-value Pools & Strengths: The expression of variation

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In line with the Principles and Parameters approach (Chomsky 1981), Baker (2010) proposes macro/syntactic parameters in minimalist syntax to account for variation in typologically related and unrelated languages. A contrasting analysis of variation, proposed by Borer (1984), Kayne (2007) among others focuses on formal features (micro-parameters) as the real driving force behind variation. Local, small-scale/dialectal differences, emanating from these micro (featural) parameters, are assumed to constitute an ideal domain of inquiry. This paper adds to this debate and contends that (a) feature-value pools, not just features, are important determinants of variation and (b) feature-values and their strengths are as varied for dialects and closely related languages as for typologically unrelated languages. In other words, the I-language systems of related and geographically close languages are sometimes quite varied/large-scale, contra suggestions of micro-variationists. In this sense, the language system mirrors the variation patterns observed in population genetics, where genetic variation within a population/race is sometimes more varied than that observed between different populations/races (cf. Stern 2000).

Nouns are inherently marked with person, number and gender features, plus their values (e.g. the noun 'boy' is 3person, singular and masculine). Feature-values have noticeable impact on computations, as numerous studies on Person-Case Constraint, Person Licensing Condition, Split-Ergativity etc have shown us. I assume that these feature-values are represented in a binary-fashion (see Adger and Svenonius (2011) for other possible representations for features).

(1) Person values
   (a) 1person: [+1p]/[-1p]
   (b) 2person: [+2p]/[-2p]
   (c) 3person: [+3p]/[-3p]

(2) Number Values
   (a) Plural: [+plural]/[-plural]
   (b) Singular: [+singular]/[-singular]

Note that the binary-value system does not relate values with each other. [-1p] does not imply [+2p] and [+3p]. Each value therefore has a negative and a positive value. Additionally, there is a null or default value [ ] that fails to impose any constraint and is part of every feature-value pool. A list of all feature-values (3) is provided by UG, out of which each language makes a one-time selection (4a-b).

(3) Possible feature-value pools
   [+plural], [-plural], [+singular], [-singular], [ ] ; [+1p], [-1p], [+2p], [-2p], [+3p], [-3p], [ ], …

(4)
   a. Language 1: [+plural], [+singular], [+1p], [+2p], [+3p], [ ]
   b. Language 2: [+plural], [+singular], [+1p], [-2p], [+3p], [ ]

Illustrating with (4), language 1 has only strong feature-values, unlike language 2 with a weak 2nd person value. Weak features are underspecified in syntax. Differential selection of feature-value pools, as I show below, determines variation at the micro/dialectal, meso/typologically related and macro/typologically unrelated languages. I test this against ergativity differences among Dyirbal, Giramay, Walpiri, Nepali and Basque. Ergativity is a case-agreement system that exists/overlaps with the nominative/default system and marks the transitive subject (A) differently from the transitive object (O) and intransitive subject (S).

Pama-Nyungan languages Dyirbal and Walpiri have garnered wide-scale attention for variation in ergative patterns (Bitter and Hale 1996, Legate 2012). Dyiribal exhibits ergativity in third person, but not with first and second persons (5)-(6).

(5) puma yabu-pgu bura-n
father.abs. mother-erg. see.non.fut
'Mother saw father'

(6) n^{y}urra pana-na bura-n
you.pl.nom. we-acc. see-non.fut
'We saw you all'

In featural terms, Dyirbal ergativity is [-1p], [-2p], which explains why its ergativity does not overlap with the default that is present with all persons. However, Giramay, a dialect of Dyirbal, has no such person restrictions (7)-(8).

(7) Ngadya/ngayba/nganya
I-erg. I-nom. Me.acc

(8) Nginda/nginba/ngina
You-erg. You-nom. You-acc

I assume that this dialectal difference arises from the default [ ] value of Giramay ergativity. The default value allows the ergative to pattern in tandem with the nominative case system. Dyirbal and its dialects therefore have quite substantial differences in their respective feature-value pools, unlike what is predicted by micro-variationists for closely related languages.

A meso-comparsion with the typologically related language Walpiri presents further insights into the structure of feature-value pools. Walpiri, like Giramay, does not exhibit a person split. Additionally, its ergative subjects have the same verbal agreement patterns as the nominative system (9)-(10). This indicates that Walpiri too has a [ ] feature-value for ergativity, which makes the ergative-nominative overlap possible.

(9) nyuntulu-rlu ka-npa-ju ngaju nya-nyi
you-erg pres-2s.1s. me-abs. see-nonpast
'You see me'

(10) nyuntu ka-npa nparnka-mi
2s.abs. pres-2s.subj. run.nonpast
'You are running'

Interestingly, similar nominative-ergative overlaps are also found in two completely unrelated languages – the Indo-Aryan language Nepali (Bickel &Yadava 2000) and Basque (Rezac, Albizu and Extepare 2010). I take such similarities to indicate that feature-value differences between unrelated languages are sometimes less than those found between related languages and dialects.

In the end, this paper also indicates that the system of feature-values in human language is reminiscent of the system of gene-values in human populations. Genetic information is carried on pairs of alleles via chromosomes. Each allele is a different value of a gene, and is selected from a list of values inherited from the parents. Alleles are either homozygotes with the same value or heterozygotes with different values, and are mostly chosen by the organism based on their strengths. Differential gene or allele pools greatly influence phenotypic variation within a population/race. My contention is that closely related languages or dialects similarly make differential feature-value selections that also influence their external-language forms.

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The inhibitory nature of language and creative behavior

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The relationship between creativity and the Language Faculty is an important subject of study in Linguistics. In Chomsky (2009 [1966]), the notion of the *creative aspect of language use* refers to the fact that, impervious to external stimuli, "people, even small children, use language in ways that are uncaused and innovative, while still appropriate" (McGilvray 2009). According to this line of thought, which dates back to Descartes and Humboldt, creativity is an intrinsic aspect of the nature of language, and the exploration of the former should shed light on the latter. This paper proposes to tackle creativity from the angle of neuroscience and comparative biology in order to provide a more biologically-grounded approach to the study of the origins of language. Its main tenet is that an increase in connectivity and inhibitory capabilities in the Prefrontal-thalamic-basal ganglia network within human phylogeny is responsible for the emergence of creative behavior in our species.

While language, or more specifically, syntax, is a more advanced, human-specific manifestation of creative behavior, experimental evidence shows that traces of creativity can also be found in some of our close and distant relatives: primates and birds. This cognitive ability, however, only appears under limited circumstances in nonhuman animals, and seems to be secondary to a strong tendency to display fixed action patterns when solving cognitive problems. I would like to refer to what we know about the brains of these partially creative species to provide a possible explanation for why this is so. My hypothesis is that fixed action patterns can only be overcome when a specific threshold of inhibition is met within a brain network, and that human brains, because of their structure, are outstandingly good at meeting that threshold. Human-specific creativity, therefore, is not a new brain mechanism, but a property that pertains to all brains: inhibition –as granted by inhibitory interneurons.

To reinforce my proposal, I also want to connect it to Coolidge & Wynn's (2005) hypothesis that an increase in working memory capabilities is behind the evolution of language and human-specific behavior. Working memory (Baddeley & Hitch 1974; Baddeley 1992) is a cognitive construct that, in its current form (e.g. Baddeley 2010), attempts to capture how the mind integrates relevant pieces of information in the process of guiding behavior. I argue that working memory can also be understood in terms of the Prefrontal-thalamic-basal ganglia network, and so it can help us complement this research framework for the puzzle of creativity. More specifically, while inhibition may be the property that unlocks creative behavior, working memory (defined here as the amount of activation that can be simultaneously employed in guiding behavior [Martín-Loeches 2006]) would determine the complexity or the range of potential solutions that are available to a specific organism when solving a cognitive task.

This whole picture has implications not just for how language appeared in the human species but also for the study of how it is *put to use* (Chomsky 1986). It is expected that the cognitive advantages granted by an enhanced Prefrontal-thalamic-basal ganglia network are employed by (or even constitute) syntax, since syntax is characterized by being both creative, which requires inhibition, and complex, which requires working memory capacities that are advanced enough to handle the hierarchical structure of sentences. A discussion on this particular understanding of syntax follows, where I suggest that syntax is just the human-specific, linguistic side of the larger process of how the episodic buffer of working memory integrates information.

Such integration processes will always be mediated by inhibitory mechanisms in the brain, so a prediction follows that both the parsing and production of language should constantly fight against (inhibit) context-based interferences from frequent structures and word combinations (syntagmatic interferences), and from parts of the set of possible elements that can be used at any given moment to continue a sentence (paradigmatic interferences). Evidence for the existence of both types of interferences is provided by alluding to some psycholinguistic experiments such as Dell et al. (2008) and Van Dyke & McElree (2006).

Following Chomsky (2009 [1966]), the questions of the origin and implementation of language cannot avoid a discussion on their creative nature if they are to be satisfactory answered. My contention is that a cognitive phylogeny for creativity can be established if we pay attention to the structural changes that facilitate its phenotypic expression. The fact that nonhuman animals tend to display fixed action patterns and are unable to acquire language are not coincidental phenomena, but two surface manifestations of a single research topic that concerns the workings of the brain: the study of neural inhibition.

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THE TEMPORAL DYNAMICS OF INTERVENTION EFFECTS: A SPEED-ACCURACY TRADE-OFF STUDY ON WH-ISLANDS

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Interference in long-distance dependencies is core to both Relativized Minimality (henceforth RM, e.g., Rizzi 2004) and cue-based memory retrieval models (henceforth CB, e.g., McElree et al. 2003). According to RM, the local relation between an extracted element and its trace is disrupted when it crosses an intervening element whose morphosyntactic featural specification matches the specification of the elements it separates: the higher the degree of feature overlap, the more degraded the resulting configuration. According to CB, retrieval interference is generated under the same conditions, although both syntactic and semantic features can engender interference (e.g., Van Dyke 2007). Two acceptability judgment studies on wh-islands conducted in English and French (Atkinson et al. 2013, Villata et al. 2013) showed that sentences with two lexically restricted wh-elements (2) are more acceptable than those containing two bare wh-elements (1), despite that in both configurations the featural specification of the intervener completely overlaps that of the extracted element ([+Q, +N] in (2) and [+N] in (1)). Although this finding is hard to account by RM (for a tentative explanation see Rizzi 2011), it is in line with CB, which predicts semantic distinctiveness of lexically restricted wh-elements to engender less retrieval interference than bare wh-elements, and therefore higher acceptability rates.
In the present study in French, we explored the temporal dynamics of interference effects by using the speed-accuracy trade-off (SAT) procedure, allowing to derive a full-time course function describing how accuracy varies with retrieval time by tracking response changes as a function of processing time.

Thirty-six sets of 16 sentences each were generated:

- 4 sentences consisted of the 4 experimental conditions illustrated in (1)-(4), which are all cases of Extraction from wh-islands. These 4 conditions were obtained by crossing the lexical restriction of the 1st wh-element (Wh1) and of the 2nd wh-element (Wh2):

  (1) **Bare Identity**: *What$_i$* do you wonder *who* built __ $_i$?
  (2) **Complex Identity**: *Which building$_i$* do you wonder *which engineer* built __ $_i$?
  (3) **Inclusion**: *Which building$_i$* do you wonder *who* built __ $_i$?
  (4) **Inverse Inclusion**: *What$_i$* do you wonder *which engineer* built __ $_i$?

- 4 sentences consisted of the corresponding sentences (1)-(4) without extraction:

  (5) **Bare Identity**: *Who* wonders *who* built this building?
  (6) **Complex Identity**: *Which tourist* wonders *which engineer* built this building?
  (7) **Inclusion**: *Which tourist* wonders *who* built this building?
  (8) **Inverse Inclusion**: *Who* wonders *which engineer* built this building?

- The remaining 8 sentences consisted of ungrammatical versions of (1)-(8) obtained by replacing the transitive embedded verb with an intransitive one (e.g., What do you wonder who *slept* ?). This condition was necessary in order to derive false alarms rates for scaling d' functions.

Sentences were presented one phrase at the time on a computer screen, and participants were asked to make binary acceptability judgments by pressing one of the 2 allowed buttons on the keyboard at each of 18 tones presented at 250 ms intervals following the onset of the last phrase. Participants were asked to respond within 300 ms of the tone and this from the very first tone, even if at this time the processing of the string was not fully completed. Participants were thus trained to start by pressing both buttons at the same time, meaning that they still didn't know the answer, until they made their decision. By asking participants to express their judgments several times during the whole course of the sentence processing, the SAT procedure minimizes the trade off between speed and accuracy presented in traditional reaction time tasks.

Finally, to control for response bias, accuracy was measured in d' units, which is a measure of the difference between false alarm rates on the ungrammatical sentences (the sentence is incorrectly judged acceptable) and hit rates on the wh-islands (the sentence is correctly judged acceptable).

Figure 1 shows the average full time-course functions for acceptability judgments of the 15 participants tested for conditions (1)-(4) in d' units (hit rates for (1)-(4) scaled against false alarm rates for ungrammatical variants with intransitive verbs). An ANOVA on asymptotic values shows significant main effects of both the extracted wh-element Wh1 (F(1,14)= 31.74, *p*<.001) and the intervening wh-element Wh2 (F(1,14)= 20.83, *p*<.001), with higher d' values for lexically restricted wh-elements, and no interaction. These asymptotes' patterns replicate previous results obtained with acceptability judgment tasks (e.g., Villata et al. 2013), and conform to the prediction of CB that lexical restriction increases distinctiveness of the constituents in memory. Interestingly, analysis of processing speed (SAT dynamics) revealed that Bare Identity was processed, on average, twice as fast as the other 3 conditions. Inspection of individual subjects' functions for this condition (Fig. 2) revealed that this difference is due to a clear non-monotonicity in the dynamics: 11 of the 15 subjects showed disproportionally high acceptance rates for Bare Identity early in processing, which were reversed later in processing, suggesting late interpretative problems. Non-monotonicity is also found in the other three conditions, to an extent that varies with the overall acceptability of the condition (the higher the acceptability rate, the lesser the non-monotonicity). Although it is possible that syntactic constraints of the type proposed in RM are operative late in comprehension, it is more plausible to see the late rejection of Bare Identity as due to the difficulty of constructing an informative interpretation (e.g., Abrusan 2014, Honcoop 1996).

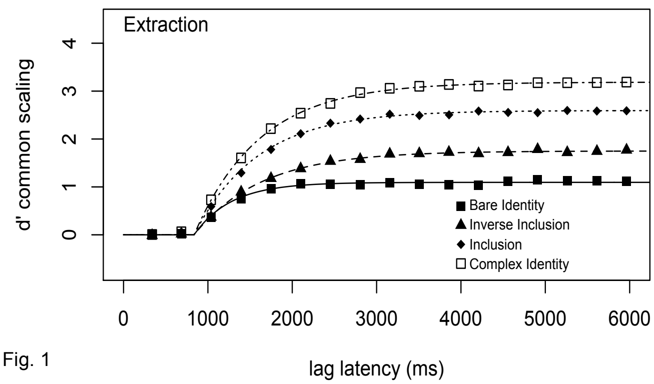

Fig. 1

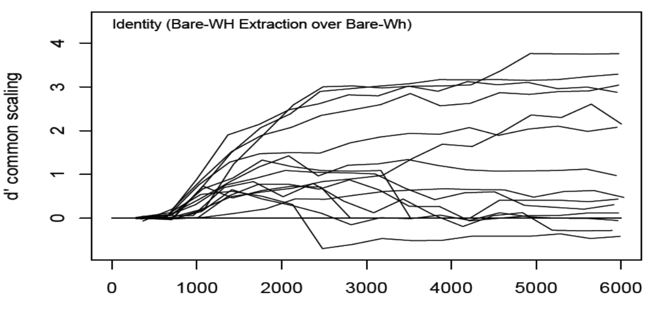

Fig. 2

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Lexical Tone Acquisition: A Case Study in Comparative Biolinguistics

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By re-examining the data from recent experiments by Lu (2014), we propose that musical pitch is an innate human ability and underlies lexical tone acquisition. In other words, lexical tone acquisition reduces to the establishment of a mapping of musical pitch onto a natural language lexicon, which is associated with a developmental schedule /sensitive period.

The idea that pitch in music is somehow related to lexical tone in language is not new (Patel, 2008; Deutsch, 2004). The fact that tonal properties develop earlier than other phonological elements of language (Li & Thompson, 1977) indicates the possibility that the lexical tones children acquire may draw on some non-linguistic cognitive property. At first, tones manifest themselves in the absence of full-fledged segmental and supra-segmental linguistic properties (Zhu & Dodd 2000). In the course of development, these primitive tones, which we take to be direct reflexes of musical pitches, are mapped onto lexical information of growing complexity. In previous work we argued that from the evolutionary perspective, lexical tone is exapted from our music ability, specifically pitch (Shi and Zhang 2013). Ontogeny would then parallel phylogeny.

Here we provide the empirical data presented in Lu (2014), which we argue further strengthens our claim. Lu focuses on two Beijing native children who are prelingually deaf (aged 5 years and 8 months and 5 years and 3 months respectively). The children got cochlear implant after 3 and a half years. These children produce at most one tone. In the speech of one of the two children, there are only level tones. In the speech of the other, only falling tones. Lu’s explanation that the [acquisition] device of tonal acquisition plays an important role and starts to decline after children get 3 years old cannot be the reason why only unitary tones (level or falling) are found in the children’s utterances.

By comparing the data reported in congenital amusia research, we find that amusics are impaired at detecting pitch changes of less than a semitone (Hyde and Peretz, 2004) and at distinguishing between rising and falling pitches (Liu et al., 2010), but they do well at singing. This suggests that the production of music pitch is innate in humans. Lexical tone production , then, must be due to problems with the mapping of musical pitches onto linguistic properties like syllables. In the case of the children studied by Lu (2014), we suggest that the children adopt different default strategies in the course of lexical tone production. Either they fall back on the level tone, which we take to be the default, and an almost direct reflex of musical pitch or, as in the case of the falling tone, they resort to the default intonation for sentences, which they generalize onto all syllables.

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QUANTIZED SECOND LANGUAGE ACQUISITION: ELECTROPHYSIOLOGICAL AND BEHAVIORAL CUES OF L2 DEVELOPMENTAL DISCONTINUITY IN ADULTHOOD

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1.The Discontinuity Hypothesis (DH). I present the embryonic stage of a L2 developmental hypothesis. The DH[1] is based on the interpretation of ERP responses and behavioral data in longitudinal studies where subjects act as their own experimental controls over time. The DH proposes that Second Language Acquisition (SLA) of morphosyntax in adulthood is not piecemeal because it abides by the law of discontinuous dispersion/accumulation of energy in nature, which is a *quantized* process featuring coefficient values. An adult L2 learner's morphosyntactic competence is made of a superposition of two representation/processing coefficients. These are Statistical Learning (SL) and Grammatical Learning (GL). SL and GL work as multiplicative factors on developmental variables (any learnable morphosyntactic items). SL is learning by chunks. It is a bottom-up, frequency-driven process based on learners' early and lifelong sensitivity to forward and backward transition probabilities among adjacent and nonadjacent words in a sequence. GL is learning by abstract features (gender, number, aspect, tense etc.) working as labels[23] that learners attach to statistically significant (but up to that point) still unheaded, *concatenations* of words. A discontinuous *quantum leap* in SLA occurs when SL and the brain structures that support it are superposed by GL and its representational/processing mechanisms. At this point, statistical representations in a learner's competence geminate and have a grammatical counterpart. A steady-state condition is achieved when learners can process the same things twice (statistically and grammatically) switching in real time between coefficients – like native speakers do[14-17] – depending on factors such as the degree of entropy of learned items [21-22] individual attitude and environmental variables. **2. Distinctive feature of the DH.** The DH is alternative to stage-models of "interlanguage" and of "stages/order of acquisition" which entail the idea that targetlike forms gradually substitute learners' errors. The DH proposes instead that both correct and incorrect forms are initially the result of a statistical pre-treatment of the L2 input by learners. Statistical forms (shallowly processed[25] chunks, formulas and constructions) and their grammatical counterparts are *entangled* in a learner's competence: a grammatical, targetlike item and its many possible statistical counterparts interact in ways such that one cannot be described independently from the other. A *quantum state* of a learners' morphosyntactic competence can indeed be described only as a whole (statistical and grammatical). **3. Electrophysiological cues**. Longitudinal ERP studies[2-10] in the last ten years have shown that at low proficiency levels, the L2 processing of morphosyntactic features (such as agreement in the VP) only involves N400 components, which are often coupled with the declarative memory system and with associative, statistical learning[18-19]. As L2 proficiency increases, the processing of the same features involves P600s and sometimes even LANs. The electrophysiological shift between N400-P600 ERP components has been often assumed to mirror the passage from a learners' capacity of detecting statistically-based patterns in the input to the capacity of inducing productive rules. Recent findings[11-13] have shown instead that both very advanced learners and native speakers may remain either N400 or P600 dominant (as to the violation of the same morphosyntactic rule), opening up to the possibility that also a near-native competence encompasses a dual-route processing mechanism alternating SL and GL under different circumstances. **4. Behavioral cues**: advanced regression models (e.g. ISIE and VNC [20]), when applied to the study of large longitudinal learner corpora, have revealed that the acquisition of a given grammatical feature may be preceded by phase in which only its statistical counterparts (targetlike and non targetlike *chunks*) are used. Regression analysis applied to relatively short time-series[24] (time-series reported in SLA studies are often shorter than those of neuroscience or biology studies) shows that some parametrically unrelated features of L2 morphosyntax are acquired almost simultaneously and within a very short time. **5. Developmental predictions**: (a) There are parts of the L2 grammar (dubbed "noncombinatorial") – those involving *internal Merge* and external interface phenomena – that are less likely to be learned by adults because their computation cannot be supported by backward and forward transition probabilities; (b) When discontinuity occurs, L2 processing direction becomes head-driven and top-down[26], rather than jumpy (like when it is driven only by transitional probabilities and by a learners' lexical knowledge). **6. A flaw in explanatory adequacy:** the issue of learners' *evaluation metric* is not addressed in the DH, so the crucial question of why learners eventually choose the targetlike grammatical form rather than its statistical counterpart has not been addressed properly so far. Suggestions from the audience would be welcome.

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Mind the Gap:
(Non-)Manifested Patterns of Variation across Linguistic and Cognitive Phenotypes

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One of the key points in the biolinguistic agenda relates to understanding the nature of linguistic variation as well as its constraints. The aim of this work is to explore the limits of variation across different (i) linguistic phenotypes and (ii) cognitive phenotypes, showing that a strong parallel exists between the two. It is proposed that the same loci of variation can be identified across the two research programs (comparative linguistics/variation across languages and comparative biolinguistics/variation across pathologies).

The relevant literature on variation across languages makes reference to three possible loci: (i) parameters that are part of the mental lexicon by being localized on functional heads (lexical parameters), (ii) parameters that are syntactic in that they pertain to narrow syntax variation (NS parameters), and (iii) parameters that are morphophonological variants; viewed as the product of the externalization process (PF 'parameters'). Syntactic variation has been often called 'parametric' and has been attributed to the different possible values of unfixed principles that Universal Grammar makes available (Chomsky 1981). From the three possible answers to the question about the locus of variation, the most minimalist is the third one and it is the one explored in the current state of development of the biolinguistic enterprise (Berwick & Chomsky 2011). The present work reviews the literature on different types of variation and offers arguments against assuming a theory of variation that puts forward the existence of different sources for it (i.e. both syntactic and morphophonological variation). It is shown that even when variation is explicitly called syntactic, a closer look of shows that in reality it is morphological or phonological. On this basis, it is argued that that all points of variation can be reduced to the mophophonological component of grammar.

Putting this claim in perspective to standard assumptions in the framework of Distributed Morphology (Halle & Marantz 1993), variation enters the picture in the road from Morphological Structure to Phonological Form and from Phonological Form to the phonetic interface (figure 1). Variation can also be found in the conceptual interface, since different languages employ different form-sound/-sign associations. This variation is not specified in syntax, but rather comes in the form of contextual variables, provided with values at the Conceptual Interface (cf. Ramchand & Svenonius 2006).

Comparing this state of affairs with the literature on variation across cognitive phenotypes, it is observed that the same loci of variation stand out across the two research programs. Reviewing the literature on five disorders (Specific Language Impairment [SLI], autism, Down Syndrome, aphasia, schizophrenia) in two varieties of Modern Greek (Standard and Cypriot), the picture that emerges is that some aspects of grammar are particularly susceptible to impairment. Benítez-Burraco & Boeckx (2014) identify inflectional morphology as one such aspect on the basis of reports coming from studies on SLI, speech-sound disorder and autism. The present work seeks to broaden the picture by bringing more pathologies into the comparison as well as by discussing the role of phonology and extragrammatical factors in deriving variation.

More concretely, the language development of Standard Modern Greek-speaking children with SLI has been described as involving a PF marking that is available inconsistently (Tsimpli 2001). In this context, it was argued that phonological salience of features is argued to play an important role in providing an account of crosslinguistic differences across instances of typical and non-typical development (Tsimpli 2001). More recently, Kambanaros et al. (2014) reported findings on object and action picture-naming accuracy in children with SLI that are bilectal in Standard Modern and Cypriot Greek. According to their findings, both SLIs and typically developing controls produced semantic descriptions or circumlocutions for verbs. This observation entails intact access to the semantic information of the target word and difficulties in accessing its phonological representation. Comprehension for action names was relatively intact for both SLIs and controls: "this finding is taken to be the result of a breakdown at the interface of the semantic lexicon and phonological representations, or access to them" (Kambanaros et al. 2014). Apart from morphophonology, it has been suggested that extragrammatical/pragmatic factors also may play a role: Katsos et al. (2011) showed that Spanish-speaking children with SLI were disproportionately challenged by pragmatic meaning compared to their age-matched peers, performing more poorly with pragmatics than with semantics.

With respect to autism, variation once more seems to be confined to either morphophonology or the semantics-pragmatics interface. Terzi et al. (2014), presenting results from Standard Greek-speaking children with autism, suggest that clitics constitute a vulnerable domain probably due to the fact that autistic children "fall behind in the pragmatic conditions that call for the presence of a clitic, rather than of the corresponding DP". This argument is reinforced by the fact that autistic children performed lower than their typically developing controls on the pragmatics baseline task.

Studies in Greek agrammatism (Fyndanis et al. 2012), Down Syndrome (Christodoulou 2011, 2014) and schizophrenia (Kambanaros et al. 2010) will also be comparatively discussed, showing that all of them eventually converge in describing the nature of linguistic impairment within the disorder they investigate in either morphophonological or extragrammatical terms.

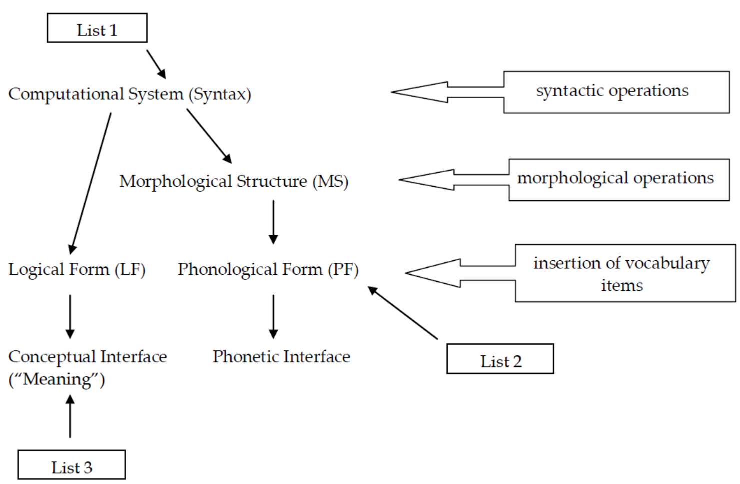

Figure 1: The model of grammar in DM (adapted from Pfau 2009: 65, following Halle & Marantz 1993 and Harley & Noyer 2003)

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EEG reactions during the recognition of sentences with different emotionally personal assessment in the Russians and Tuvinians

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According to the fundamental lexical theory, there are different lexical items for describing personal human properties in every culture (Hjelle, Ziegler, 1992). In particular, special words for defining such characteristics as “anxiety” and “aggression” exist. However, the perception of these characteristics can vary significantly among different ethnic groups, which may be reflected on the objectively recorded indices of brain activity. The aim of the study was to compare the behavioral responses and EEG responses in the Russian-speaking subjects and the Russian-Tuvinian bilinguals during the recognition of written sentences related to the description of anxiety and aggression. The study involved 119 subjects (57 Russian Caucasians and 62 Tuvinian Mongoloids, in both groups there were 58 men and 61 women the mean age for both groups being of 21.1 ± 2.5). In the experiment, the subjects were offered written sentences on the computer screen, which either contained or did not contain a grammar mistake. The task was to evaluate the grammatical correctness of sentences. The Russian subjects during two experimental sessions were given 200 sentences in Russian and 120 sentences in English. The Tuvinian subjects in addition to that participated in the third session, with 200 sentences in Tuvinian. The sentences in the Russian and Tuvinian languages were selected so that 20% of them evaluated the anxiety level of the participants, 20% assessed the anxiety of other people, 20% evaluated the level of aggression of the participants, 20% assessed the aggression of other people and 20% assessed inanimate things. The subjects were not informed before the experiment that the given sentences would contain any personal assessments.

During the task the electroencephalography was recorded for all subjects. The EEGs in the Russian subjects were recorded through 123 channels with the help of the Neuroscan system, USA. In Tuvinians the mobile 63 channel EEG amplifier of the Brain Products Company, Germany was used. After the removal of the oculomotor artefacts the event-related potentials (ERP) and the event-related spectral perturbations (ERSP) were calculated (Delorme and Makeig, 2004).

The comparison of behavioral responses showed that Tuvinians recognize the Russian grammar better than the grammar of the other two languages. The experimental data show that the quality of recognizing grammar in the Tuvinian subjects was almost the same for the tasksin the Tuvinian and Russian languages. But it took them much longer to recognize the tasks in Tuvinian, which can be explained by the fact that they use Tuvinian as a spoken language, but not as a written language, and Russian as both a spoken and written language. When comparing the behavioral responses to the sentences with different emotional and personal assessment both groups of subjects showed a reduction of the reaction rate when recognizing the sentences evaluating aggression, as compared with other classes of sentences. At the same time in the Tuvinian subjects a stronger response deceleration was found to the sentences that evaluate the aggression of other people than when evaluating their own aggression. Besides the Tuvinian subjects showed a statistically reliable reduction of the quality of grammar recognition of the sentences evaluating aggression of other people in comparison with the sentences evaluating their own aggression.

The comparison of the tasks in different languages without regard to the emotionality showed that the amplitude of the P600 peak in the left fronto-temporal cortex (Broca's area) in the Russians was higher to rhe Russian sentences than to the English. In the Tuvinians no differences were found between the Russian and Tuvinian tasks, but the amplitude was found to decrease at the solution of tasks in English.

The intergroup comparison of the ERSP amplitudes for the Russian and English languages showed that slow-wave (delta- and theta-) oscillatory responses were higher in the Tuvinians than in the Russians. Conversely, the amplitudes of responses in the alpha- and beta-ranges were higher in the Russians in comparison with the Tuvinians for both languages. The intragroup comparisons showed that the slow-wave reactions in the Russians were higher to the Russian language and alpha-beta responses were higher to the English language. In the Tuvinian subjects the slow-wave reactions were stronger to the Tuvinian language tasks and alpha-beta responses were stronger when performing a task in Russian. The results can be interpreted as the different indices of involvement of affective and cognitive mechanisms for assessing the speech in native and foreign languages.

When comparing the ERSP in the tasks with different emotional and personal relations, in both groups the large amplitude of theta synchronization was revealed in the perception of sentences evaluating aggression, as compared with other classes of sentences. Such differences can be interpreted as an index of higher emotionality of reactions related to the assessment of aggression. This effect did not depend on the language type and was only dependent on the semantics of sentences. In the Russian subjects the emotionality decrease effect was seen when reading the sentences evaluating others' aggression, compared with the sentences evaluating the aggression of the participant. On the contrary, in the Tuvinian subjects a large amplitude of the EEG responses was found in the theta range to the sentences that evaluated the aggression of others than when evaluating their own aggression.

Conclusion: The comparison of the behavioral and EEG responses in the Russians and Tuvinians in the perception of sentences in different languages and in the perception of emotional and personal evaluation sentences revealed the intergroup differences associated with both cognitive and affective processing of the written language. The Russians showed a relatively greater involvement of cognitive processes, and the Tuvinians showed affective evaluations of the sentences that were more noticeable for the native language than for the foreign language. The comparison of the EEG responses identified an emotionality reduction effect in the Russian subjects and an emotionality increase in the Tuvinian subjects while moving from the evaluation of their own aggression to the evaluation of other people aggression.

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Does population size affect language structure?

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Recent years have seen a series of proposals (often coming from outside of academic linguistics) trying to establish a correlation between aspects of language structure and extra-linguistic variables. The claim by the economist Keith Chen (2013; The American Economic Reviews 103) that variables such as GDP or the prevalence of smoking depends on the tense system of the language of a population is perhaps the starkest but by no means the only such claim. An often noted problem with such analyses is the fact that different languages (and different populations) may share a common history, which makes their features non-independent, while standard statistical techniques require a sample of mutually independent data points to be applicable in a meaningful way.

To establish this point but also to show how modern biolinguistics provides the tools to control for common ancestry in statistical studies, this paper investigates a simple and easy-to-operationalize linguistic variable, the size of the sound inventory of a language. Hay and Bauer (2007, Language 83) claim that there is a positive correlation between sound inventory size and population size, while Atkinson (2011, Science 332) notes that phonemic diversity across the languages of the world contains a signal of the migration of our species out of Africa. More specifically, he observes a significant negative correlation between sound inventory sized and the (land-based) distance from West-Africa.

Following Wichmann et al. (2011, Linguistic Typology 15), sound inventory sizes where estimated as the number of different symbols in the transcriptions of the Swadesh lists from the *Automated Similarity Judgment Program* (ASJP).[1] The resulting distributions (using all doculects with a distinct ISO code) is visualized in Figure 1.

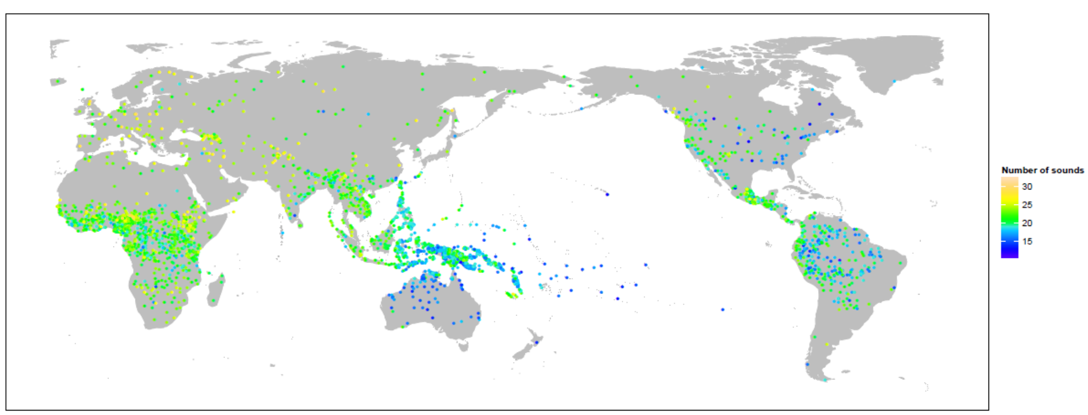

Figure 1: Distribution of sound inventory sizes

[1] http://email.eva.mpg.de/~wichmann/ASJPHomePage.htm

The map suggests that *language density* might be a determining factor for sound inventory sizes as well. This factor was quantified as the smallest area containing the four neighboring languages for a given language.

Quantitative biology has developed various methods for testing statistical dependencies across species while controlling for their (possibly shared) evolutionary history. The same logic applies to language change and diversification as well, so these methods are applicable. In this paper **Phylogenetic Generalized Least Squares** (Grafen, 1989, ProcRoy B 326) will be used. This is a method to carry out a linear regression while controlling for the phylogenetic dependency between the different data points.

As a perfect phylogeny for the world's languages is elusive, we tested the model with four phylogenetic trees:

A. the trivial star-shaped tree (which is equivalent to standard linear regression without phylogenetic information),

B. the expert classification provided by Glottolog,[2]

C. an automatically generated phylogeny using the method described in Jäger (2013, Language Dynamics and Change 3) and vocabulary data from ASJP, and

D. a hybrid tree using the genetic tree from Cavalli-Sforza (1997, PNAS 94) (shown in Figure 2) as skeleton and inserting an automatically computed (using Jäger's method) phylogenetic tree for the corresponding languages at the leafs.

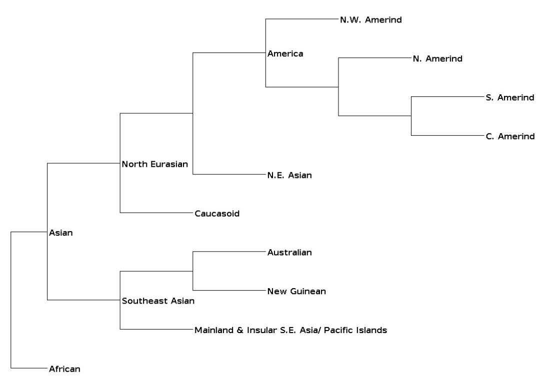

Figure 2: Genetic tree

The results are given in Table 1.

phylogeny	*population (log)*		*distance from Africa*		*language density (log)*		*AIC*
	slope	*p*-value	slope	*p*-value	slope	*p*-value	
A	1.5e-1	<2e-16	-2.1e-4	<2e-16	2.6e-1	1e-8	15,961.04
B	8.9e-3	0.59	-2.4e-4	<2e-16	9.2e-1	<2e-16	14,543.44
C	-1.2e-2	0.45	-1.7e4	<2e-16	1.7e+1	7e-3	14,471.03
D	-2.5e-2	0.14	-1.2e-4	1.6e-2	1.8e+1	7.8e-3	14,406.66

Table 1: Results of PGLS

[2] http://glottolog.org/

The *Akaike Information Criterion* (AIC; given in the last column) is a measure of the quality of a statistical model, where better models have a smaller AIC. The results illustrate conclusively that the phylogenies from A – D successively lead to better models. In the best model, D, there is no significant correlation between sound inventory size and population size at all. Distance from Africa displays only a weakly significant correlation, while language density is highly significant and clearly the best predictor. This finding shouldn't be surprising as language density is a measure of the intensity of language contact; the most important system-external factor for sound inventory size thus turns out the be language contact.

These results provide evidence that language is autonomous. Apparent correlations of language structure with extra-linguistic factors can easily be deceptive; it is crucial to control for phylogenetic dependencies in statistical modeling. The relevant phylogenetic information can be obtained by a combination of biolinguistic and genetic methods.

Syntax as the Edge of Thought

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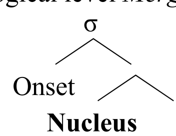
In the "All-you-need-is-merge" approach to the design of language (cf. Berwick 2011 and 2013) the operation Merge is taken to be the basic mechanism of Universal Grammar "for arranging items (sounds, words, word parts, phrases) into their possible permissible combinations in a language" (Berwick et al 2013:89, Glossary). Nevertheless, the pervasiveness of *Merge* as "combinatorial operation" obscures the pivotal role of Merge specifically at the syntactic level whose primacy can not be denied as we aim to argue for in our talk.

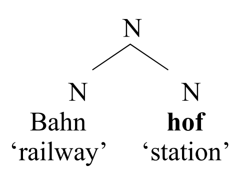
Capitalizing on the original idea proposed by Rizzi (2010), we assume that the combination resulting from the application of *Merge* shows a scalar degree of complexity depending on the nature of the items (i.e. the level of grammar) involved (cf. also Bidese *et al* 2012):

– at the phonological level *Merge* operates on phonemes and yields syllabic structures:

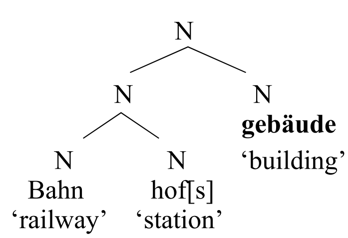


Crucially, a nucleus cannot take another syllable as its coda, a syllable not being a syllable-internal element, hence syllable structure does not instantiate hierarchical recursion but only linearization, i.e. strings of structured blocks (phonological *Merge*, comparable with *Primary Merge* as defined in Rizzi's 2010 complexity scale).

- at the morphological level, *Merge* operates on morphemes and yields words and word compounds. As regards e.g. endocentric nominal compounds in Germanic, a head merges with a modifier [[Bahn] hof]:



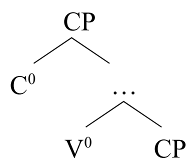
The result can in turn be merged with another head generating a compound more complex from a lexical point of view [[Bahnhofs] gebäude]:



Differently from syllable structure, the process of word formation (i.e. composition) crucially implies recursion, since a 'word' can be a word-internal unit (morphological *Merge* – Recursive *Merge* in

Rizzi's 2010 complexity scale). Recursion at this level is not compatible with movement operations and hence incompatible with predication (in Moro's approach to copular sentences), as incidentally noted, from a different perspective, in Cecchetto&Donati (2010: fn. 20).

- at the syntactic level *Merge* operates on words yielding phrasal structures and on already built phrases giving rise to sentence structures (syntactic *Merge* – Phrasal *Merge* in Rizzi's 2010 sense) implying both movement (internal merge) and potentially CP recursion (sentence embedding, i.e. subordination):



Revisiting Rizzi's *Merge* complexity scale, i.e. extending it to the different levels of grammar, prompts a new approach to the question concerning the design of UG. In fact, it shifts the focus from the definition of *Merge* as basic combinatorial mechanism to its role in molding the shape of the faculty of language itself, which turns out to be uniquely defined (i) through the instantiation of phrasal *Merge*, and consequently (ii) through the nature of the interfaces, which have to be compatible with it.

In fact, syntactic recursion crucially defines sentence structure (via internal *Merge*) and hence sentence embedding (via CP recursion). The activation of the interfaces concerns both the externalization process (linearization of syntactic structures) and the optimal mapping with the conceptual-intentional system. If we are on the right track, externalization, i.e. the sensorimotor interface, is possible without assuming syntactic *Merge* (possibly in animal communication systems), but it is only by means of syntactic *Merge* that pure syntactic devices like internal *Merge* and CP recursion can 'operate' on concepts (propositions) at the C-I interface.

As a matter of fact, internal *Merge* and the role of CP in syntactic generation (cf. Chomsky 2007) represent the 'core' of the Strong Minimalist Thesis (SMT) which revisits the 'radical autonomy of syntax' in a new perspective and acknowledges the primacy of syntax in language design. The role of *Merge* at the C-I interface discloses syntax as the 'edge of thought'.

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Comparing Causative Recursion in Kinematic Grammar with Sentence Embedding in Human Grammar

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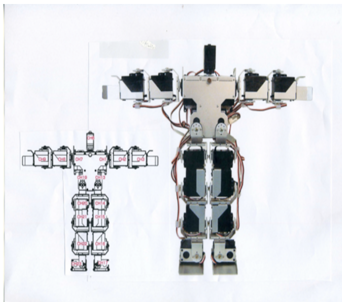
The involvement of action in language as a cognitive process has been recently emphasized by not a few researchers. Corbalis (2003) proposed that language originated in the gestures hominids had evolved to achieve. Purvermüller, Härle, and Hummel (2001) concluded that verb types of action can differ in their processing speed, which can be related to lexical semantic access, and in his (2010)'s paper, etc. observed that action and perception are not stand-alone processes but are functionally interwoven in basic and cognitive neuroscience. From a neural-psychological point, Balari et al. (2013) pointed out that symbol manipulation is the means whereby mental activity becomes capable of governing intentional and goal-oriented behavior of organisms. The theory of "mirror neurons" by Rizzolatti, Fadiga, Gallese & Fogassi (1996), etc. led to a human semantic analysis in which listening to sentences expressing the mouth, hand, and foot actions activates different sectors of the premotor cortex, which coincide with those active during observing those actions (Aziz-Zadeh, Wilson, Rizzolatti & Iacoboni 2006). Rizzolatti & Arbib (1998) and Arbib (2005) made a claim that the parity requirement for language in humans is met because brain mechanism supporting language evolved from mirror system for grasping. We have attempted to construct a kinematic grammar from actions simulated by a humanoid robot, so that we can measure its complexity by the hierarchy proposed by Chomsky (1956). A suggestive observation was made by Calvin in Calvin & Bickerton (2000) that "embedding of actions" is seen in human kinematics. Due to centrifugalness, vertebrate kinematics can be viewed as a joint's successive "causation" of another to move, via embedding from the center to the periphery. This reminds us of the expressive power of a PSG with recursive rules. Throwing was described as a tree, where the angular velocity at a point of application is represented as the sum of those at the joints reaching that point. Another interesting tree representation, but in robotics, was proposed for a self-evolving machine, in its skeleton, whose whole development was represented as a sequence of transitions of edges in a single tree (Lipson 2005). Such trees are generated by a PSG including a rewrite rule with a recursive symbol on its both sides. Shiever (1985) concluded that Swiss German has the complexity of weak non-context-freeness $wa^m b^n x c^m d^n y$, where w, x, y are variables. It is definitely true that there are some languages whose grammatical complexity supersedes that of PSG. As for "recursion", necessary for human language, as was proposed in Hauser, Chomsky, and Fitch (2002), an evidence was found that a Bengalese finch's song for mating has a Regular Grammar (Okanoya 2004), thus having no recursion. Cotton-top tamarins were demonstrated to be able to learn the strings of symbols generated by a finite state grammar, but are unable to learn those generated by a PSG (Fitch & Hauser 2004). While Berwick, Okanoya, Beckers and Bolhuis (2011) affirmed the striking similarities between bird song and human language, they characterized birdsong structure as phonological syntax, lacking in semantics. As approximate substitutes for human action data, we resort to the motion planning of a humanoid robot, KHR-1 (Kondo 2000), on whose skeleton human complex joints are simulated in terms of series of adjacent simple servo-motors. Each motion of the humanoid, assumed to be compatible to a human "action", consists of a sequence of around 20 positions in Figure 1. Each position, expressing the posture of the robot for a specific motion at each time point, consists of a combination of the joint angles at the point. In Diagram 1, the original motion planning for push-up was converted to show a time sequence of angle differentials for each of 17 joints. Each data set includes, at that time point, the angle differentials for the joints. Each differential is calculated as the present angle minus the previous angle. The skeleton can be viewed as a centrifugal structure of joints and endpoints in which the head and the limbs extend from a virtual center. We can map it into a tree structure as the root of which, the virtual center dominates the head joint, the shoulder joints, which dominate the arms, and the hip joints, which dominate the legs, while maintaining a joint's causative relation of another or an endpoint to "move" on the edges they connect.

Figure 1. Humanoid Robot KHR-1 **Diagram 1. Converted Motion Planning for Push-up**



NO	Angle Diff	CH1(Sh)	Ch2(S)	Ch3(E)	Ch6(N)	Ch7(Sh')	Ch8(S')	Ch9(E')	CH13(I)	Ch14(H)	Ch15(K)	Ch16(A)	Ch17(An)	CH19((I')	CH20(H')	Ch21(K')	Ch22(A')	Ch23(An')
0	Home Pos																	
1	DATA	3	16	−90	0	−175	−197	−90	−91	−150	−167	−69	−92	−92	−30	−13	−111	−88
2	DATA	74	0	0	0	−78	0	0	0	−65	0	−31	0	0	66	0	32	0
3	DATA	72	0	0	0	−72	0	0	0	8	110	−41	0	0	−8	−112	42	0
4	DATA	−59	−11	0	0	51	11	0	0	70	−73	122	0	0	−69	−78	−128	0
5	DATA	0	0	0	0	0	0	0	0	0	0	−69	−2	0	0	0	72	0
6	DATA	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0
7	DATA	0	60	90	0	0	−55	89	0	0	0	0	0	0	0	0	0	0
8	DATA	0	−60	90	0	0	55	−89	0	0	0	0	0	0	0	0	0	0
9	DATA	0	60	−90	0	0	−55	89	0	0	0	0	0	0	0	0	0	0
10	DATA	0	−60	90	0	0	55	−89	0	0	0	0	0	0	0	0	0	0
11	DATA	0	60	−90	0	0	−55	89	0	0	0	0	0	0	0	0	0	0
12	DATA	0	−60	90	0	0	55	−89	0	0	0	0	0	0	0	0	0	0
13	DATA	0	60	−90	0	0	−55	89	0	0	0	0	0	0	0	0	0	0
14	DATA	0	−60	90	0	0	55	−89	0	0	0	0	0	0	0	0	0	0
15	DATA	0	60	−90	0	0	−55	89	0	0	0	0	0	0	0	0	0	0
16	DATA	0	−60	90	0	0	55	−89	0	0	0	0	0	0	0	0	0	0
17	DATA	0	0	0	0	0	0	0	0	0	0	69	2	0	0	0	−72	0
18	DATA	59	0	0	0	−51	0	0	0	−78	75	−121	0	0	76	−78	125	0
19	DATA	−124	9	0	0	124	−11	0	0	0	−112	40	0	0	1	112	−39	0
20	DATA	−22	0	0	0	26	0	0	0	65	0	31	0	0	−66	0	−32	0

The non-terminal symbols of the tree are: J, a cover term for specific joints; EN, a cover term for endpoint names; s and m, standing for "has moved and has stayed"; M and S, representing a motion in terms of joint rotation, and a halting state respectively. Its terminal symbols are angle differential in terms of degree number, specific joint names such as Sh, E, etc., and specific endpoint names such as Ha, F, etc. Kinematic trees are derived by the following rewrite grammar: at $[t_{i-1}, t_i]$, where $1 \leq i \leq n$: (1) S→S S S S S; (2) M→m J EN; (3) M→m J M/S; (4) S→s J EN; (5) S→s J S/M; (6) J→jn, where jn ∈{R, N, Sh, Sh', Sho, Sho', E, E', I , I', H, H', K, K' A, A', An, An'}; s→$\theta_i - \theta_{i-1}$, where $\theta_i - \theta_{i-1}=0$; m→$\theta_i - \theta_{i-1}$, where $-90 \leq \theta_i - \theta_{i-1} < 0$, and $0 < \theta_i - \theta_{i-1} \leq +270$; (7) EN → {He, Ha, Ha', F, F}. With M and S as recursive symbols, rules (3) and (5) transfer an moving/staying event (M/S) in which a joint moves (m)/stays (s) another joint (or an endpoint) to the lower (more peripheral) part of the sub-tree they derive, respectively, in terms of causation. A non-zero angle differential degree number is m's terminal symbol, while zero differential is s's terminal symbol. The representation for the whole push-up action is a sequence of kinematic trees, each of which represents a motion, a dynamic figure, cut out of the whole. For lack of space, we show only the labeled bracketing for KHR-1's first-interval motion of push-up as follows:

Diagram 2. Labeled Bracketing for First Interval Motion of Push-up

At $[t_0, t_1]$: [$_S$ [$_s$ 0] [$_J$ R] [$_M$ [$_m$ -92] [$_J$ I'] [$_M$ [$_m$ -30] [$_J$ H'] [$_M$ [$_m$ -13] [$_J$ K'] [$_M$ [$_m$ -86] [$_J$ A'] [$_M$ [$_m$ -90] [$_J$ An'] [$_{EN}$ F']]]]]]] [$_S$ [$_s$ 0] [$_J$ R] [$_M$ [$_m$ -175] [$_J$ Sh'] [$_M$ [$_m$ -197] [$_J$ Sho'] [$_M$ [$_m$ -90] [$_J$ E'] [$_{EN}$ Ha']]]]] [$_S$ [$_s$ 0] [$_J$ R] [$_M$ [$_m$ -90] [$_J$ N] [$_{EN}$ He]]] [$_S$ [$_s$ 0] [$_J$ R] [$_m$ [$_m$ 3] [$_J$ Sh] [$_M$ [$_m$ 16] [$_J$ Sho] [$_M$ [$_m$ -90] [$_J$ E] [$_{EN}$ Ha]]]]]] [$_S$ [$_s$ 0] [$_J$ R] [$_M$ [$_m$ -91] [$_J$ I] [$_M$ [$_m$ -150] [$_J$ H] [$_M$ [$_m$ -167] [$_J$ K] [$_M$ [$_m$ -69] [$_J$ A] [$_M$ [$_m$ -88] [$_J$ An] [$_{EN}$ F]]]]]]

The terminal string of symbols for this bracketing, which stands for the first motion of push-up, consists of degree values, specific joints and end parts, contributing to the strong generative power of the kinematic grammar like the lexical items natural language grammar derives. Aligning such strings to the end in the order of intervals makes one action. Suitably different alignment makes another meaningful action, in which sense each string of terminal symbols in an interval acts like a word in a sentence, which is completed as the whole sequence in the whole interval. The precise generative power of this grammar is not yet unclear, but it may possibly that of a regular grammar. Suppose, however, that we convert rules (3) and (5) into the following regular rules: S→s P/Q; M→m Q/P; P→J S; Q→J M. And suppose that we use specific joint and end part names like Sh, I, Ha, F, etc., and (non) zero $\theta_i - \theta_{i-1}$ as terminal symbols, abolishing J, and s and m, respectively. We can convert each of (2) and (4) into three regular rules. We may conclude that causative recursion in kinematic grammar is not sufficient enough to be compatible with embedding in human grammar, which can generate mirror image languages. We, therefore, need to find some key in order for kinematic grammar to reach the complexity of human grammar.