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"Universal Grammar" and Language Universals

- UG: "Formal Universals" NOT properties found in all languages
- Examples Chomsky gave:
 - 'that proper names . . . must designate objects meeting a condition of spatio-temporal contiguity'
 - 'colour words of any language must subdivide the colour spectrum into continuous segments
- Greenberg's "implicational universals""



Recent Critiques

- "The Myth of Language Universals" Nick Evans & Steve Levinson (2009)
- Christiansen & Chater (2008) "We conclude that a biologically determined UG is not evolutionarily viable"
- Both talking about absolute language universals!

"Universal Grammar" My (personal) interpretation

- "Biological constraints on perceivable patterns"
- *Constraints and biases* on our capacity to acquire language. May be:
 - Perceptual
 - Structural
 - Conceptual
 - Language-specific or multi-domain





So What *Could* be Innate in the Language Faculty?

- Glossogeny: Each language is a "moving Target"
- Obviously, no word for "cow" or similarly concrete terms will ever evolve
- Contra Christiansen & Chater (2008) this *does not* imply that innate priors can't evolve!
- "Fish evolution will not track every wave in the sea" (Mark Pagel)

Bayesian Viewpoint: What's Innate?

- Evolution should track the reliable, consistent aspects of data <-> structure mapping
- These may include **general principles** of the model (e.g. syntactic structures are trees, not webs)
- Biology may also specify the *priors* on particular cues (e.g. some hypotheses more likely than others, because the child "tries them first")



The Bayesian Approach: Bayes' Rule

$p(\theta|D) \propto p(D|\theta)p(\theta)$

Calculate the probability of "hidden" explanatory variables based on the probability of the data given the model, and *a priori* guesses about likelihood of different parameters.



The Comparative Approach (sensu Biology)

<u>Components of Language</u>			
	Humans	Other Species?	
Speech Perception	~	?	
Speech Production	v	?	
Syntax Perception	V	?	
Syntax Production	V	2	
Pre-Linguistic Concepts	~	?	
Theory of Mind	V	2	











Italian-Speaking Mynah Bird

Hoover, a talking seal





















General Conclusion: Comparative Cognitive Biology Provides a Powerful Tool for Testing Hypotheses!

Both **Evolutionary & Mechanistic** Hypotheses Are Testable: And many more species available!









captured with finite state (regular) grammars: **no** evidence for context-free rules. (ten Cate & Okanoya (2012) Phil Trans B 367: 1984) But what about perception?







Miller's Supra-Regular <u>Hypothesis</u>

- Psychologist George Miller (1967) "Grammarama"
- Humans attribute **tree-structures** to sentences, *even* when there is little evidence for it
- Miller suggested that humans have a high "prior" on context-free, rather than finite-state, rules.







- For practical reasons we must focus on *string sets* (weak generative power), not inferred *structure* (strong generative power)
- Test with simplified "artificial grammars"























The Dendrophilia Hypothesis

Our Current Working Hypothesis:

Humans have a species-typical, but **domain general**, ability and propensity to infer treeformed, hierarchical structures from patterns. This entails computational resources above the finite state level and applies across music, language and the arts

Why Dendrophilic Cognition Matters

- Ability to infer "hidden nodes" of tree structures
- Generativity: A few example trees allow generation of many more via symmetry operations
- Can build both symmetrical and asymmetric (pruned) tree structures



Part 3: The Future: Phonology, Semantics, Pragmatics

Animal Cognition From Animal Syntax -> Animal Phonology

Animal Phonology?



- Surprisingly, we know very little!
- **Phonetics**: Animals can perceive vowels, consonants, show categorical perception, perceive pitch, duration, intensity... like humans
- But stress patterns, phonotactic constraints, rhyme or alliteration, phonological classes etc remain essentially unstudied. Moira Yip (2006) TICS (10): 442



Semantics: Animal Cognition and Language

- Animal Concepts: Animals have memories, categories, emotions, plans, goals, rules...so *concepts* predated language by many millions of years
- Human language is built upon these cognitive precursors
- Main difference in humans is that we can *share* our concepts freely with language

State of the Art		A.	
Speech Perception	~	~	V
Speech Production	~	×	~
Syntax Perception	~	×	×
Syntax Production	~	×	×
Pre-Linguistic Concepts	~	~	~
Theory of Mind	~	~	2



Predicts good word learning by animals.



Consistent: Animals easily acquire 100- to 1000-word vocabularies

Alex (grey parrot): Irene Pepperberg Kanzi (bonobo): Sue Savage-Rumbaugh Rico (border collie): Juliane Kaminski

Pragmatics and Theory of Mind

- Grice/Sperber & Wilson: Proper pragmatic inference is cognitively challenging.
- Requires well-developed "Theory of Mind"
- For decades, evidence for ToM in animals was lacking
- But new data strongly supports *limited* theory of mind (knowing what others can and have seen) in chimpanzees and corvids.







- Cognitive Biology: Comparative studies of a wide variety of vertebrates are relevant to construct cognitive phylogenies;
- **Signal**: Speech is about neural control and not vocal tract anatomy
- Syntax: Humans have an unusual propensity to infer tree-structures from strings; phonology more promising
- Semantics: The conceptual groundwork was laid down before language, but **pragmatics** remains a serious challenge.

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