

Innateness in language: still a viable hypothesis

Mini-course
Spring 2022
Tel Aviv University & Hebrew University
Iris Berent

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Nature or nurture?



2

Innateness in language

Issues

- What are the debates about?
- Does the question even make sense?



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Innateness in language

My view

- Yes it does!
 - Regardless of one's own position, the question of innateness paints how we think about language
- It's urgent!
 - The vagueness of the debate prevents progress in the field
- So let's take a look, shall we?
 - That's what this mini-course is about



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How we will approach it...

- "Intellectual psychotherapy"
 - Clarify foundational issues: *concepts and questions*
- Method:
 - Familiar examples
 - Focus on broader questions
- Interdisciplinary approach:
 - Linguistics
 - Cognitive science
 - Computer science
 - A bit of neuroscience and genetics (maybe)
 - Humans and nonhumans, adults and infants

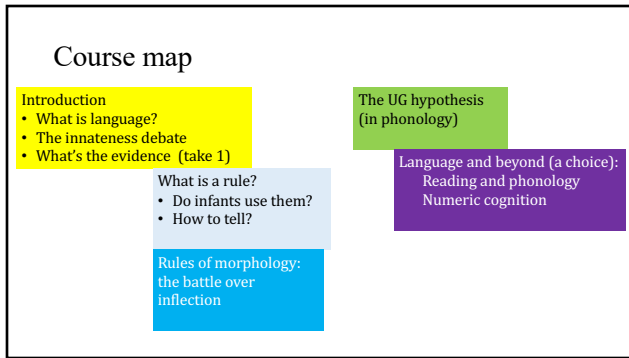


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What it means...

- For the linguist
 - The examples are familiar
 - The *approach* might be new
- For non-linguist...
 - Everything will be explained...

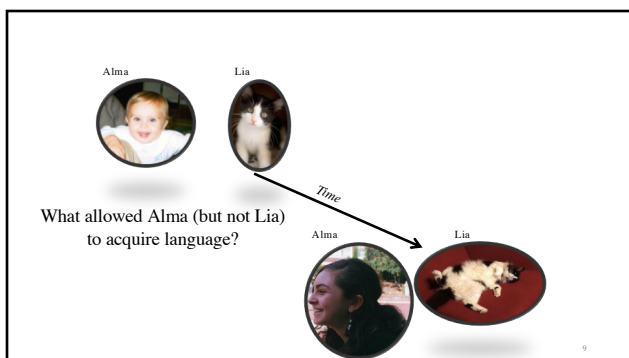
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More Specific Questions...

- What is *language*
 - *What Alma has (and Lia lacks)...*
- What allows language to emerge ?
 - *Who* can have language?
 - Humans
 - Other animals?
 - *Why*?
 - Is input & social context necessary?
 - Is it sufficient?
 - can language emerge spontaneously, in isolated deaf children?

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Plan for today

- Describe what language is..
 - Tacit knowledge
 - Defined by shared principles (natural kind)
- Consider why we have it:
 - Domain-specificity (innateness)
 - Domain-generality (learning)
- Some evidence
 - Is language a natural kind
 - Are there features that define all languages—actual and potential?
 - Only to human languages?
 - Is language natural to humans: emerges spontaneously?

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Tacit knowledge of language: some examples

What you know, without even realizing you do...

Part 1

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מה נשמע יותר טוב?

- Hitbabagnu
- hitgababnu
- Bbg
- gbb

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Julia child and her husband

One day, John told his wife, Mary, that he was inviting some new friends over for dinner. The two couples had a great time. As the guests were leaving, Mary asked them for their full name. It turns Mary has just fed Julia Child and her husband. Yet the _____ were gracious guests, and said the food was great!



- Children
- Childs

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משפחת נהר	משפחת תמר
יוסי ועירית נהר גרים בקומה מעלי...	יוסי ועירית תמר גרים בקומה מעלי.
הם לא מפסיקים להרעיש בלילה והם מעירים אותי משנתי. ה-----	הם לא מפסיקים להרעיש בלילה והם מעירים אותי משנתי. ה-----
הם שכנים מעצבנים	הם שכנים מעצבנים.
נהרים	תמרים
נהרים	תמרים
נהרות	תמרות
נהרות	תמרות

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איזה כדור נמצא ליד הקופסא?

- Which ball is near the box?

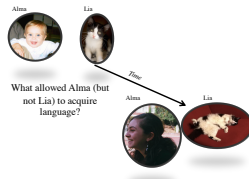


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What Alma has... (but not Lia the cat)

- Tacit knowledge of language
 - You aren't aware of your knowledge
- Next question:
 - what *kind* of knowledge?

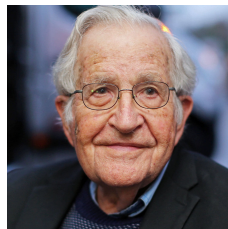


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Chomsky's big idea (1): rules

- Linguistic knowledge is *productive* (generative):
 - you can extend it to sentences you have never heard before
 - *Colorless green ideas sleep furiously*
- What you know must include (tacit) **rules**
 - E.g., English plurals: Noun+S



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More Specific Questions...

- ✓What is *language*
 - *What Alma has (and Lia lacks)...*
 - Answer: knowledge of tacit rules
- What allows (knowledge of) language to emerge ?
 - Who can have language?
 - Humans
 - Other animals?
 - Why?
 - Is input & social context necessary?
 - Is it sufficient:
 - can language emerge spontaneously, in isolated deaf children?

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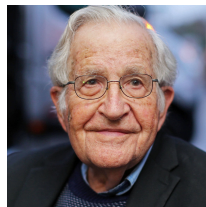
*What allows humans to have
productive knowledge of language?*

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Chomsky's big idea (2): UG

- Children have language (knowledge) for the same reason they have two hands
 - Language: a mental organ
- Both are biological capacities that are *innately* constrained
 - The innate aspect of language is called universal grammar (UG)



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People know how to talk in more or less the sense that spiders know how to spin webs. Web-spinning was not invented by some unsung spider genius and does not depend on having had the right education or having an aptitude for architecture or the construction trades. Rather, spiders spin spider webs because they have spider brains, which give them the urge to spin and the competence to succeed.

(Pinker, 1994, The language instinct, p 18)



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*Innate knowledge?
Seriously?*



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Our expectations about innateness



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A tacit intuitive mind-body bias

- We have tacit intuitions on what can and cannot be innate...
- We accept innateness of
 - Physical bodily traits
 - Psychological traits that we can readily link to the body
 - Seeing-eyes
 - Walking-legs
 - Emotions—face
- Why?
 - We are intuitive essentialist: we believe
 - There is an essence that makes us who it is
 - That essence must reside in the body



Gelman, S. A. (2003). *The essential child: origins of essentialism in everyday thought*. Oxford, New York: Oxford University Press.

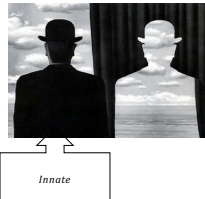
Berent, I. (2021). *Can we get human nature right? Proc Natl Acad Sci U S A*, 118(39), e2108274118.

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A tacit intuitive mind-body bias

Why "innate knowledge" seems such an oxymoron?

- We are intuitive Dualists
 - Mind seems separate from the body
 - Knowledge is "in the mind"
- What's innate *must* be in the body (per essentialism)
- Consequence: knowledge seems like it cannot be innate



Bloom, P. (2004). *Descartes' baby: how the science of child development explains what makes us tick*. New York: Basic Books.

Berent, I. (2021). *Can we get human nature right? Proc Natl Acad Sci U S A*, 118(39), e2108274118.

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But these intuitions are illusory... on two counts...

Quite likely, they are factually false

Knowledge can be innate

- Just look at the literature on newborn/young infant cognition
- Newborn infants have knowledge of...
 - Objects: they expect objects to be cohesive, and to move by contact, continuously
 - Number: they have a primitive number system that allows them to approximate numerosity in sets
 - E.g., 10 lights = 10 sounds (as distinct from 20)
 - 3 month old infants prefer "helpers" to hinderers

The logic is faulty

- The logic of "no innate knowledge" arises, in part, from intuitive Dualism
- But Dualism is false:
 - Knowledge is brain state—an attribute of the body
 - Just like "having two wings"
 - No reason to deny innate knowledge a priori

• Izard, Vénopique, Sam, Corda, Spelke, Elizabeth S., & Spelke, Alison. (2009). Newborn infants perceive abstract numbers. *PNAS: Proceedings of the National Academy of Sciences of the United States of America*, 106(21), 10382-10385.

• Hanks, R., Wynn, K., & Bloom, P. (2019). Three-month-olds show a negativity bias in their social evaluations. *Developmental Science*, 17(5), 923-929.

• Vachon, S., Lee, J., Gauthier, J., & Bloom, P. (2006). Perceptual completion in newborn human infants. *Child Development*, 77(6), 1810-1820.

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What to make of it?

- What it **doesn't mean**
 - It doesn't mean that there *is necessarily* an innate knowledge of language
- What it **does mean**
 - We better be aware of the bias
 - Look harder....

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But what does innateness mean?

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What innateness *doesn't* mean

- **Language does not develop**
 - Everything develops...
 - No hands in the zygote, still we consider "having hands" as innate
- **Language is fully-formed at birth**
 - Having beard is innate in males, but not present at birth
- **Language does not require any type of experience**
 - People do not develop language "in the closet", just as they don't develop physically without food

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What innateness *does* mean

- Cognitive primitive:
 - It does not arise from other *cognitive* mechanisms
 - Learning
 - inference
- It arises in human spontaneously, in the normal course of development
 - Note: Innateness *is* defined at the **cognitive** level of analysis

Samuels, R. (2004). Innateness in cognitive science. *Trends Cognitive Sciences*, 8(3), 136-141

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Examples:

Not innate

- Words: linking form and meaning
 - *Dog* vs. *perro*
- Principles:
 - Head position:
 - First (English): *Ate* an apple
 - Last (Japanese): Apple *ate*
 - Attested syllable types:
 - English: *bla*
 - Hebrew: *bla, bna, bda*
 - Russian: *bla, bna, bda, lba*
- Cognitive systems
 - Recursive number

Possibly innate

- "Concepts"
 - Object
 - noun, syllable
- Principles:
 - Head: all phrases are headed
 - Syllables must have an onset
- Cognitive systems
 - Early numeric systems

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Example: *Bla > lba*

- This preference is...
 - Found across languages
 - In newborns
- Problem: deaf people don't have it...
- Given the definition we use, can this possibly be innate?

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Not everyone agrees with Chomsky ☺

What the critiques say:

- No such thing as rules
- No innate knowledge
 - In general
 - Of language....



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Not everyone agrees with Chomsky ☺

Against innate knowledge of language

Michael Tomasello:

The idea of a biologically evolved Universal Grammar with linguistic content is a myth, perpetuated by three spurious explanatory strategies of generative linguists. To make progress in understanding human linguistic competence, cognitive scientists must abandon the idea of an innate Universal Grammar and instead try to build theories that explain both linguistic universals and diversity and how they emerge. (p. 470)

Moreton Christiansen and Nick Chater

The origin of language requires no genetic leap, but the cumulative cultural evolution of language itself.

Against innate knowledge/constraints of any kind

Margaret Mead:

We are forced to conclude that human nature is almost unbelievably malleable, responding accurately and contrastingly to cultural conditions.

Yuval Noah Harari:

Natural selection may have provided Homo sapiens with a much larger playing field than it has given to any other organism, but the field has still had its boundaries. The implication has been that, no matter what their efforts and achievements, sapiens are incapable of breaking free of their biologically determined limits.

But at the dawn of the twenty-first century, this is no longer true. Homo sapiens is transcending these limits. It is now beginning to break the laws of natural selection, replacing them with the laws of intelligent design. (p. 35)

- Tomasello M. Universal grammar is dead. *Behav Brain Sci*. 2009;32(S):470-471.
- Christiansen M, Chater N. Towards an integrated science of language. *Nature Human Behaviour*. 2021.

- Mead M. *Sex and Temperament in three primitive Societies*. New York: Harper Collins; 1935/2001.
- Harari YN. *Sapiens: a brief history of humankind*. First U.S. edition. ed. New York, NY : Harper, an imprint of HarperCollinsPublishers; 2015.

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A broader problem: how the mind/brain is organized

Domain-generality



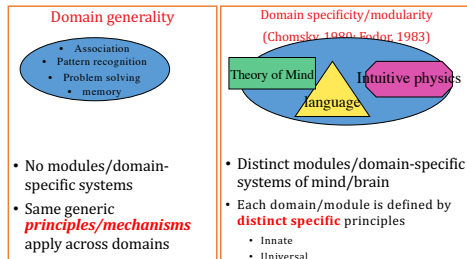
Domain specificity/modularity (Chomsky, 1980; Fodor, 1983)



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How is the mind/brain organized?



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Competing predictions

	Empiricist/domain-generalist	Nativist domain-specificity
Where does the human capacity for language come from?	- Culture - general intelligence - sensorimotor skills	a specialized language system
Where does English (or Hebrew) structure come from?	Structure is arbitrary Defined by culture	Structure is partly determined by biology

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Why it matters?

- At stake: two different views about how the mind works (language is just a case study)
 - Are there innate, specialized mechanisms?
 - Is there innate knowledge?
- A question that has been at the center of human intellectual history for ages
 - Direct implications to cognitive, brain and computer science

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Modularity/domain specificity has a bad reputation in psychology...

Modularity has been linked to strong claims

- Encapsulation:
 - Modules are "immune" to external influences
- "brain island"
 - Modules must correspond to a specific "island" in the brain
- They are *orthogonal* to the **main** question: innate domain specific problem —the *raison d'être* for modules

These claims are highly controversial

- Encapsulation:
 - Much research in the 1990's challenged the notion of encapsulation
 - Encapsulation defines automaticity generality (isn't diagnostic of modules)
- Brain islands/special genes
 - Most neuroscientists challenge the view of Broca's/Wernicke's as "language areas"
 - but see work by Ev Fedorenko et al.
 - No "language gene"
 - Generally: there is no "gene for X"

Fedorenko, E., & Blank, I. A. (2020). Broca's Area Is Not a Natural Kind. *Trends Cogn Sci*, 24(4), 270-284.

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The denial of innate knowledge is costly...

- People often say "let's just not talk about innateness", but doing so meddles with our science
 - Leads to to wrong conclusions
 - *"Everything depends on both nature/nurture"*
 - But: some things aren't 50/50
 - autism ~nature
 - Using "dog" vs. "kelev" ~nurture
 - Confuses our notion of nature
 - Innate is not "genetic"—all innate traits are also shaped by environment and experience
 - Confuses our notion of nurture:
 - Confuse "shared environment" with "home"
 - Ignore the role of peers
 - Ignore the role of chance

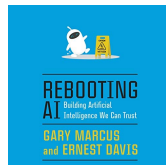
Pinker, S. (2004). Why Nature & Nurture Won't Go Away. 233(4). doi:10.1162/0011526042365591

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The denial of innate knowledge is costly...

- Blocks progress in linguistics and psychology
- May stall progress in AI

Gary Marcus



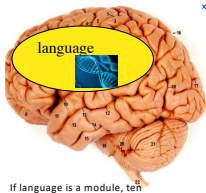
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How to advance the innateness/domain specificity debate?

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Common intuition about modularity

Language module

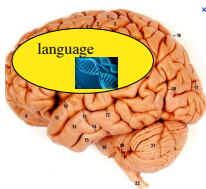


The "hardware segregation" idea...

- If language is a module, then we ought to find a specialized "language hardware"
 - "language island" in the brain
 - Does language and only language
 - A "language gene"—that codes *only* for language
- Who can decide the modularity debate?
 - Neuroscientists
 - geneticists

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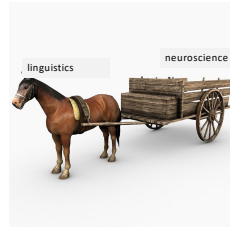
Several problems with this approach



- Modularity is a hypothesis about cognitive function, not "hardware"
- Specialized systems are not necessarily discrete and segregated
 - E.g., immune system is distributed
- There are reason to expect that the language module may
 - Partly overlap with nonlinguistic systems
 - No such thing as "gene for X" only....
- Neuroscience/genetics may not be able to decide the question right now

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How linguistics can save the day....



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Note: structure can tell us about innateness In biology....



- Birds and bats both have limbs
- Question: Are they related, evolutionarily (i.e., common genetic basis)?
- Answer: Look at the anatomy: it's quite different
 - These limbs have evolved independently
- Note: anatomy offers clues to innate origins of traits
- **By the same token: the structure of communication systems can tell us whether they are distinct**

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Note: structure can tell us about innateness In language....

- Common design suggests innate knowledge
 - If all languages arise from a specialized language system (Universal grammar; language system), then they ought to exhibit shared design
- Finding this design is suggestive of innate knowledge



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Competing empirical predictions

	Empiricist/domain-generalist predictions	Nativist domain-specificity predictions
• Shared design • Are there limits on all existing languages	No (except for obvious limits on memory, perception and action)	Yes (beyond the obvious limits on memory, perception and action)
• Re-gensis • Can language emerge spontaneously (similar in design to existing languages)?	No (language structure emerges from experience)	Yes (language structure partly innate)
• Amodality • Similar design across signed and spoken languages?	No (different sensorimotor demands—>different structure)	Yes (language structure is abstract—can be <i>partly</i> shared across modalities)

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Two tests of modularity/domain specificity

- Do languages share structure: common design principles
- Can this structure emerge spontaneously (regensis)
 - Even when one hasn't had the chance to learn this information from others...
 - Even across different modalities?

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1. Shared structure?

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Shared structure? Two ways to look at it...

- Design features (more general)
- UG principles (refer to linguistic structure)

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Some design principles of language

- Words are discrete arbitrary symbols
- Words can signify concepts that are absent (displacement)
- Language is productive
- Language is a discrete combinatorial system
- Words take part in two levels of patterning (duality of patterning)

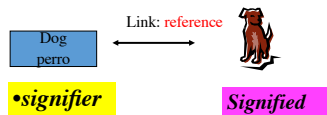
Hockett, C. F. (1960). The origin of speech. *Sci Am*, 203, 89-96.

Uniquely human!
Not present in any natural
system of animal
communication

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Words are signs



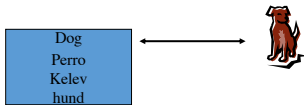
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words

- *kelev*

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Most linguistic signs are arbitrary and conventional



- *Arbitrary*: form (e.g., sound of "kelev") does not resemble meaning
- *Conventional*: form-meaning link is established by convention

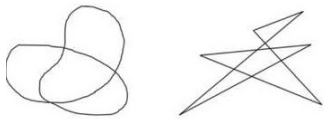
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Some challenges to arbitrariness

- *Onomatopoeias*:
 - *Cock-a-doodle do*
- Sound symbolism

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Takate vs. maluma?



Kohler W. Gestalt Psychology: An Introduction to New Concepts in Modern Psychology. New York: Liveright; 1947

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[illegible]

Pokemon names

Garagara No.105 Garagara はねずきポケモンタイプ、いかに



Karakara



1 Kawahara, S., *et al.* (2016) Sound (Symbolic) Patterns in Pokemon Names: Focusing on Voiced Obstruents and Mora Counts. PLoS ONE

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[illegible]

What to make of this?

- Two types of links between sound-meaning:
 - Arbitrariness
 - Sound symbolism
- *All* languages can form arbitrary links between form and meaning
 - However: languages can also exhibit non-arbitrary links (i.e., sound symbolism is not the *only* form of sound-meaning link)
- Conclusion: arbitrariness is universal, but not "the only game in town"

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Displacement

- Words can refer to referents that are not present here and now
 - *What is it like to be a bat?* (Thomas Nagel)
 - *A dog cannot tell you its parents were honest, though poor* (B. Russell)



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Productivity

- *Colorless green ideas sleep furiously*

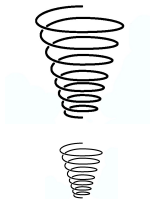


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How is meaning expressed: two possibilities

- Describe each of these shapes using
 - Your hands
 - English words
- What's the difference?
 - How many "signs" per shape?
 - How does the sign convey meaning?



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Linguistic signs are discrete and digital

	Language	Charade
Signifier (form): does it have clear boundaries?	Discrete: clear boundaries <i>Dog <u>dog</u>dog.</i>	continuous 
Signified (meaning): how does form signal meaning	Digital: either on/off	Analog: changes with form e.g., larger handshape, larger spiral

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A physician asks his patient to indicate her condition by tapping her finger. One tap=no pain; two taps=pain. This system is:

- A. Continuous/analog
- B. Continuous/digital
- C. Discrete/analog
- D. Discrete/digital

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Combinatorial

There are two types of systems in nature...

• Combination without blending

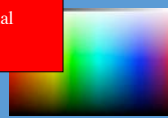
- lego
- 10, 01, 110, etc.
- DNA bases
- *The green pea*



• Blending of ingredients

e.g., *charade*, color-coding,

baking a cake,



Language is a combinatorial system

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Summary

	Language	Character
Signifier	Discrete	Continuous
Signified	Digital	Analog
System type	Combinatorial	Blending

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Duality of patterning

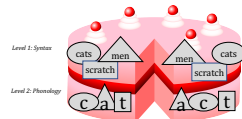
- All languages exhibit two levels of patterning

Level 1: Patterns of meaningful units

- Complex words
 - Blackboard
- Sentences
 - Colorless green ideas...

Level 2: Patterns of meaningless units

- Pat, tap, apt
- Cat, tack, act
- Black vs. *lback



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Consider the following two languages: duality of patterning?

Language A (buk, ubk...)

- Words
 - buk=man
 - kub=woman
 - ubk=love
- Sentences
 - buk ubk kub
 - kub ubk buk

Language B (a i e)

- Words
 - a=man
 - e=woman
 - i=love
- Sentences:
 - a i e
 - e i a

Which language exhibits duality of patterning?

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Consider the following two languages:
duality of patterning?

Language A (buk, ubk...)

- Words
 - buk=man
 - kub=woman
 - ubk=love
- sentences
 - buk ubk kub
 - kub ubk buk

Language B (a l e)

- Words
 - a=man
 - e=woman
 - i=love
- sentences:
 - a l e
 - e i a

Which language resembles a natural language?

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Summary

- ✓What defines a human language?
 - Do you human languages exhibit *universal* design features?
- Are these features *unique* to language?

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Natural animal communication

Part 2

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Example 1: Vervet monkeys and bee dance

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Natural systems of animal communication

- Vervet monkey

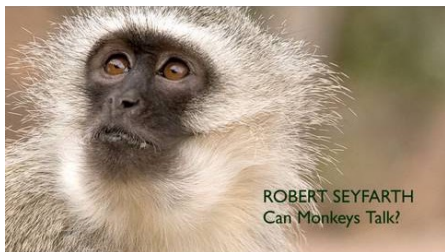


- Bee dance:



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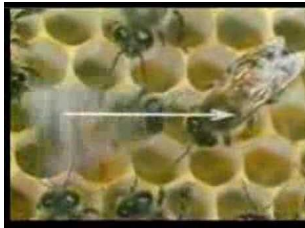


<https://www.youtube.com/watch?v=3lsF83rHKFc>

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Bee dance

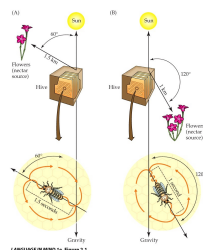


<https://www.youtube.com/watch?v=4NtegAOQp5s>

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How do bees convey information?



- Direction of food relative to sun~ angle of body relative to axis
- Distance of food~ distance of dance
- Amount of food~ liveliness

LANGRISH & WERNER, 1999, Figure 2.1
© 2004 Sinauer Associates, Inc.

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Are these features present in animal communication?

	Bee dance	Vervet calls
symbols		
Discreteness		
Displacement		
Productivity		
patterning		
Duality of patterning		

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Are these features present in animal communication?

	Bee dance	Vervet calls
symbols	Yes	Yes
Discreteness	No	Yes
Displacement	Yes	No
Productivity	•Yes	No
patterning	•Yes	No
Duality of patterning	•No	No

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Example 2: two types of call
sequences
Campbell monkeys and swamp
sparrows

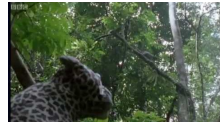
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Call sequences: Campbell Monkeys

- Campbell monkeys (and Diana monkeys) show patterning in their calls to indicate predators

Diana monkeys calls



Call	Response
Eagle	Eagle
Leopard	Leopard
"boom"-eagle	-
"boom"-leopard	-

Zuberbühler, K. (2002). A syntactic rule in forest monkey communication. *Animal Behaviour*, 63(2), 293-299.

<https://www.youtube.com/watch?v=boPLFt1vI&t=31s>

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Call sequences: swamp sparrows

Swamp sparrows:

- Calls made from different "notes": I, IV, VI
- Each bird community has different note sequence:
 - New York: I-V-VI
 - Minnesota: VI-V-I
- Also
 - Middle note can vary—even novel notes
 - External notes: fix sequence
 - *No known meaning to call or sequence*



<https://www.youtube.com/watch?v=PkOnpk8Wmow>

Robinson, E. (1988). Bird song syntax: learned into specific variation is meaningful. *Proceedings of The National Academy of Sciences of The United States of America*, 85(15), 3657-3660.

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Summary: sequences in two species

Campbell monkeys

Call	Response
Eagle	Eagle
Leopard	Leopard
"boom"-eagle	-
"boom"-leopard	-

Swamp sparrow birds

- Calls made from different "notes": I, IV, VI
- Each bird community has different note sequence:
 - New York: I-V-VI
 - Minnesota: VI-V-I
 - Middle note can vary—even novel notes
 - External notes: fix sequence
- *No known meaning to call or sequence*

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Are these features present in animal communication?

	Monkeys	Birds
symbols		
Discreteness		
Arbitrariness		
Productivity		
Patterning (what level)?		
Duality of patterning		

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Are these features present in animal communication?

	Monkeys	Birds
symbols	Yes	?
Discreteness	Yes	yes
Arbitrariness	Possibly	yes
Productivity	?	yes
Patterning (what level?)	Yes (meaningful)	Yes (meaningless)
Duality of patterning	No!	No!

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Conclusion

- Language is not the only system of communication with patterning
- It's the only system with *duality* of patterning
 - Animals: patterning in *one* level only, *either*
 - *Form*
 - *meaning*
 - Language: patterning at *two levels*

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Why did duality of patterning evolve?

- Adaptive feature: improves the reproduction of their carriers
- Duality of patterning is adaptive
 - Communication (generally) is adaptive
 - *Duality of patterning* improves communication
 - Nemenk, M. A., & Krakauer, D. C. (1999). The evolution of language. *Proc Natl Acad Sci U S A*, 96, 8020-8033.
 - Patterning within sentences: flexibility in communicating new ideas
 - Patterning within words: reduces confusion among words
 - Duality of patterning is adaptive



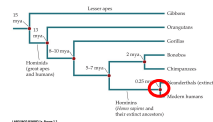
Martin Nowak, Harvard
Evolutionary game theory

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Conclusion

- All human languages share general principles of design
- At least one feature—*duality of patterning*—is **unique** to humans
 - Evolved late
 - Has an adaptive value
- Conclusion: an adaptation for language, unique to the human lineage



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Why design matters?

- Design signals the design-maker:
 - If all languages follow the same design, they are likely the product of the same cognitive system: a language module



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Summary

- All natural languages exhibit certain design features
 - At least one feature—*duality of patterning*—is unique to humans
- All human beings exhibit a systematic language
- Conclusion: language is a universal human capacity with universal design

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Two tests of modularity/domain specificity

- ✓ Do languages share structure: common design principles
- Can this structure emerge spontaneously (regeneration)
 - Even when one hasn't had the chance to learn this information from others...
 - Even across different modalities?

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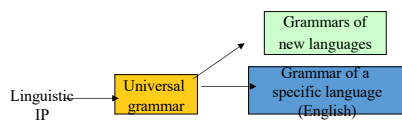
Language on a desert island?

Part 3

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The role of innate constraints

- Shape
 - Existing languages
 - Re-generated grammars



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Predictions

SSS model:

- Acquisition=imitation
- Prediction: no adult model → no grammar

Language instinct

- Language structure is **constrained** by UG
- Prediction: re-genesis of language
 - Systematic grammar
 - Resembles other language

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Tests

- Nicaraguan sign language
- Home sign language

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Case 1: Nicaraguan sign language

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The deaf children of Nicaragua

<https://www.youtube.com/watch?v=xHFLVFNZ24>



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NSL design

- Systematic structure
- Follows the design of other human languages
 - Broad design principles:
 - Discrete digital combinatorial system
 - Narrow principles:
 - Path vs. Manner

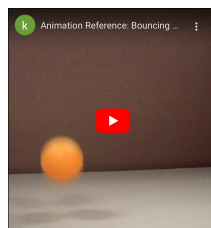
Senghas, A., & Coppola, M. (2001). Children creating language: how Nicaraguan sign language acquired a spatial grammar. *Psychol Sci*, 12, 323-328.
Senghas, A., Kita, S., & Coppola, A. (2004). Children creating core properties of language: evidence from an emerging sign language in Nicaragua. *Science*, 305, 1779-1782.

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Using language to describe spatial events

- What do you see?
 - Describe the event using gesture
 - Describe the event using English words
- What are the difference between linguistic signs and gestures?



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Gestures vs. linguistic signs

- Non-signers: gestures



Video: A cat, having swallowed a bowling ball, goes down the hill in a wobbling rolling manner

*What is the difference (hint: consider design features of language)
Why is it significant?*

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Gestures vs. linguistic signs

- Non-signers: gestures



Linguistic signs



Video: A cat, having swallowed a bowling ball, goes down the hill in a wobbling rolling manner

*What is the difference (hint: consider design features of language)
Why is it significant?*

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Gestures vs. linguistic signs

- Non-signers: gestures



Linguistic signs



- A single holistic sign
- Continuous (nonidiscrete)
- Analog

- Combination of two signs
- Discrete and consecutive
- Separate signs for
 - Manner of motion (wiggling)
 - Path of motion (down the hill)
- Meaning is Digital

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NSL design

- ✓ Systematic structure
- ✓ Follows the design of other human languages
 - ✓ Broad design principles:
 - Discrete digital combinatorial system
 - Narrow principles (possibly, UG):
 - Path vs. Manner

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Manner vs. path distinction

- Many languages use different linguistic devices to mark **manner** and **path** of motion
 - *Run down the hill*
 - *Fell down the cliff*
 - *Run into my friend*
- Languages differ on which aspect they emphasize
 - **English** verbs typically marks **manner**
 - *Run, jump, walk*
 - **Spanish** verbs typically marks **path**
 - *Entrar* (go inside)
 - *Salir* (go outside)
- All languages distinguish manner and path
- So does NSL...

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Significance of NSL

- Children's signs spontaneously encode structural distinctions without a model
- Those distinctions are present in other languages
- Might be due to UG

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How did NSL structure emerge?

- SSSM
- Language is the product of culture
- Adults transmit language to kids

- Language instinct
 - Children invent language and transmit it to other children
 - Each generation of children adds to language

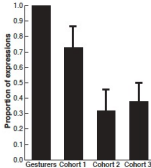


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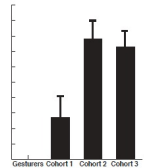
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The emergence of structure across cohorts of children

Proportion of signs indicating path & motion together



Proportion of signs using distinct signs for path and motion



With time, children increase the use of discrete combinatorial signs (*language*) and decrease the use of holistic signs (*gestures*)

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Does language emerge spontaneously?

- Partly yes
 - Some evidence for discrete combinatorial signs
 - already in cohort 1
 - Only in signers
- Partly no....
 - It arises only gradually
 - Cohort 1 still relies on many holistic gestures
 - No duality of patterning:
 - Phonology emerges, but later....



Sandler, W., Aronoff, M., Marc, L., & Padgug, C. (2011). The gradual emergence of phonological form in a new language. *Natural Language and Linguistic Theory*, 29, 505-543.

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Some questions

- Why *children*?
 - Why are new languages created by children (not adults)?
- Why *gradually*: is this consistent with (innate) UG?
 - E.g., the distinction between path and manner of motion emerge across generations, not at once

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Why *children*?

- Critical/sensitive period:
- language acquisition is at prime during a limited “window of opportunity” in development
- Why?
 - Brain plasticity is at prime (nature)
 - Free from previous knowledge (nurture)

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Some questions

- ✓ Why *children*?
 - Why are new languages created by children (not adults)?
- Why *gradually*: is this consistent with (innate) UG?
 - E.g., the distinction between path and manner of motion emerge across generations, not at once

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Why gradually? Let's learn from the birds...

- Normal Zebra Finch song acquisition
 - Requires exposure to a male adult as a model
 - Without a model: song is abnormal
 - Lots of repetition (unlike normal song)

• Zebra Finch



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Male zebra finch singing

- Notice the variation: sounds go "up and down"
- This song is partly learned from the adult tutor (model for learning)
- Question: is the song only obtained by imitating the model?

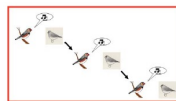


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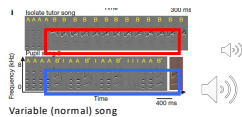
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What happens when the tutor (model) is deficient?

- Experiment:
 - Expose multiple generations of birds to "isolate" males
 - Model's song is deficient
- Result:
 - Across generations, the song gradually resembles normal song
 - Pupils surpass their model (like human children)!



Abnormal song: repetition



Source: Feiler, O., Wang, H., Saar, S., Mitra, P. P., & Tchernichovski, O. (2009). De novo establishment of wild-type song culture in the zebra finch. *Nature*, 459, 544-548.

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Why NSL emerges *gradually*?

Answer from birds!

- Innate traits do not self-assemble over night....
- Innate traits of require some *triggers*
 - Social interactions are a trigger for language
 - Encourage the emergence of language
- Don't confuse triggers with imitation!
 - Remember the model (bird tutor, first NSL generations) are deficient!
- Triggers encourage the expression of innate traits, but don't necessarily allow for imitation!



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Interim summary

- NSL presents evidence for UG
 - Emerges spontaneously, despite no opportunity to learn from a model
 - Resembles other languages
- NSL is created by children, gradually. Why?
 - Critical period: language acquisition is at prime in childhood
 - Innate constraints emerge gradually in other species as well—they require triggers!

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Conclusions (1)

- Innateness (in language) is still largely unresolved, but it is not an implausible hypothesis
 - Beware of our biases to the contrary
- Language as a module/domain-specific system
- How to evaluate innateness/domain specificity?
 - Domain-specificity is primarily a cognitive (functional) hypothesis
 - Neuroscience/genetics cannot currently evaluate this hypothesis fully
 - Linguistic/cognitive science can save the day
 - How? Test for ...
 - Common design
 - Spontaneous emergence

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Conclusions (2)

- Preliminary results
 - Natural languages share design features:
 - Discrete combinatorial systems
 - Exhibit duality of patterning
 - Duality of patterning is absent in nonhuman systems of communication
 - These design features emerge spontaneously in emerging sign languages
 - But this happens gradually, and over time
