Ling 151/Psych 156A: Acquisition of Language II

Lecture 2

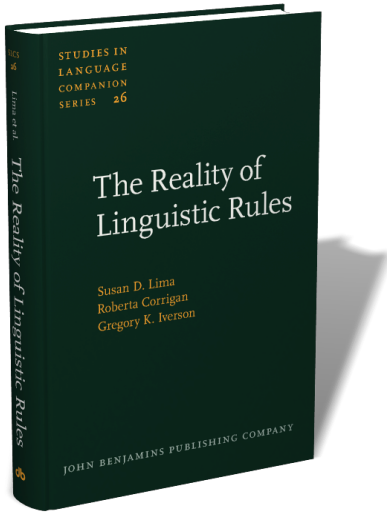
Introduction II

Announcements

Be working on HW1 (due: 1/17/18)

Be looking over the review questions for introduction

Linguistic rules

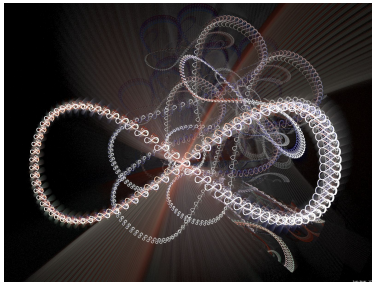


Linguistic productivity means we need rules

"The expressive variety of language use implies that a language user's brain contains unconscious grammatical principles" - Jackendoff (1994)

Example: Most sentences we have never seen or used before, but we can still understand them.

Question: Can speakers simply memorize all the possible sentences of a language the way they learn the vocabulary of their language? Not if there are an infinite number of them…

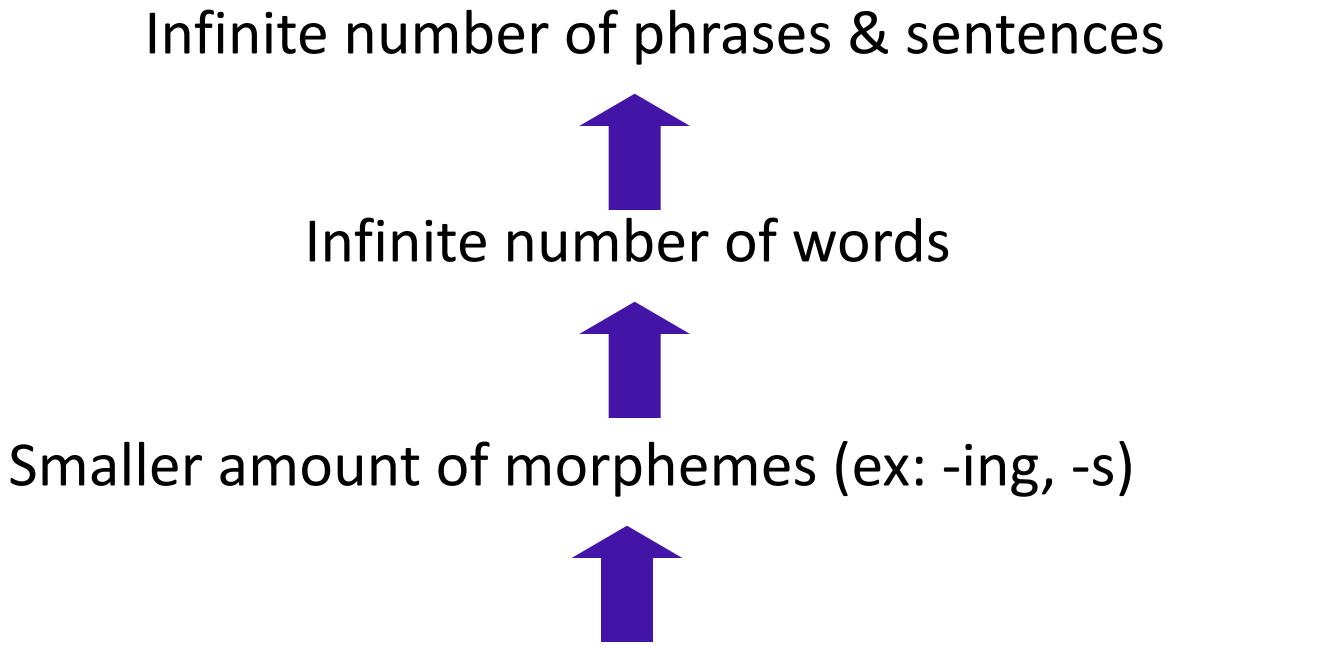


Linguistic infinity

Hoggle has two jewels.
Hoggle has three jewels.
Hoggle has four jewels.
…
Hoggle has forty-three million and five jewels.
…

One (dumb) way to get infinity

Linguistic productivity means we need rules



Phonemes

Basic perceptual units of which speech is composed: /b/, /p/, … (Liberman 1970)

Units that are used to build morphemes: /b/ + /ɪ/ + /g/ = ‘big’

Languages have a finite inventory of these units.

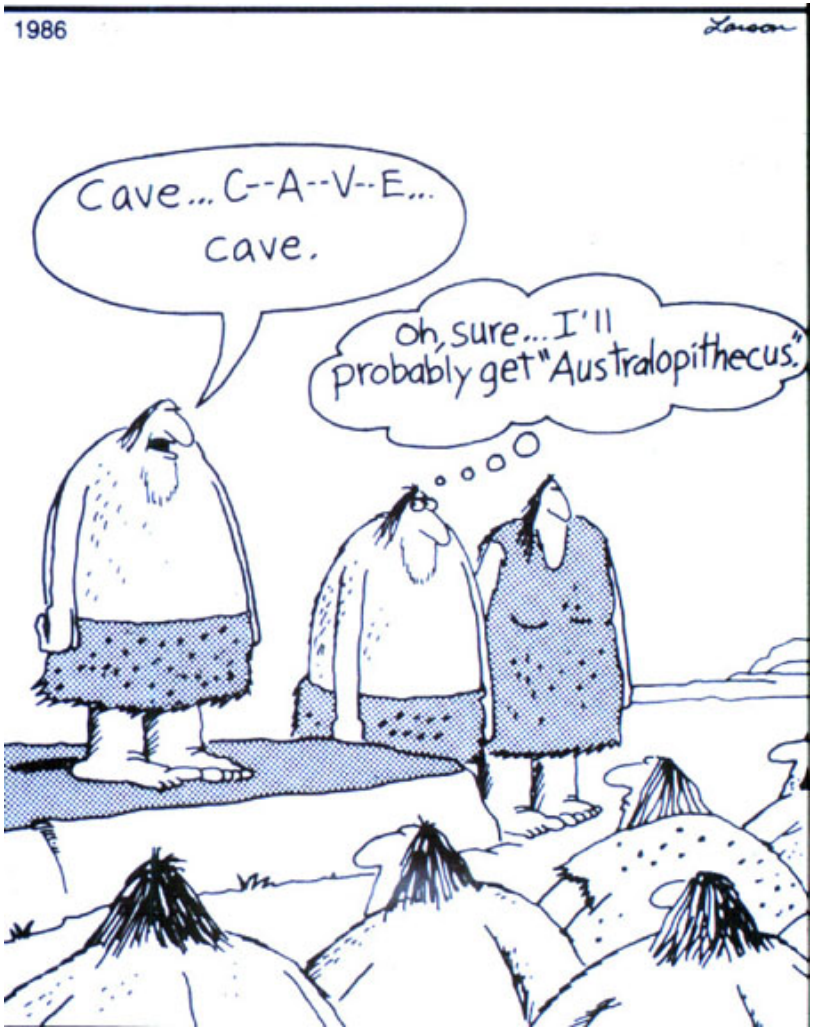
They are not units of meaning.

They are contrastive: changing a phoneme can change meaning (pig vs big).

Structure permits creativity

We are capable of combining existing phonemes to form new words

- “email”, “IM”, “xerox”
- Also, usernames!



Morphemes

Morphemes are the smallest meaningful units of language

Free morphemes may stand alone

mail, movie, sensation, mother, gift

Bound (usually grammatical) morphemes cannot

-ing, -s, -ed, -er, re-

Morphemes combine to form the words of a language.

Ex: He's a regifter! (re + gift +er)

Combination is rule-governed: "Regifter" is okay but not

*Reergift, *Erregift, *Ergiftre, *Gifterre, *giftreer.

Structure permits creativity

We are capable of combining existing morphemes using different processes.

Compounding

mother

grandmother

great-grandmother

great-great-grandmother

great-great-great-grandmother

…

Compounding

https://www.youtube.com/watch?v=nQElBnBWExc

http://www.thelingspace.com/episode-76/

1:24-3:17 = compounding

4:09-4:57 = noun-noun compounds

Derivational morphemes

sensation	= noun
sensational	= adjective
sensationalize	= verb
sensationalization	= noun
sensationalizational	= adjective
sensationalizationalize	= verb

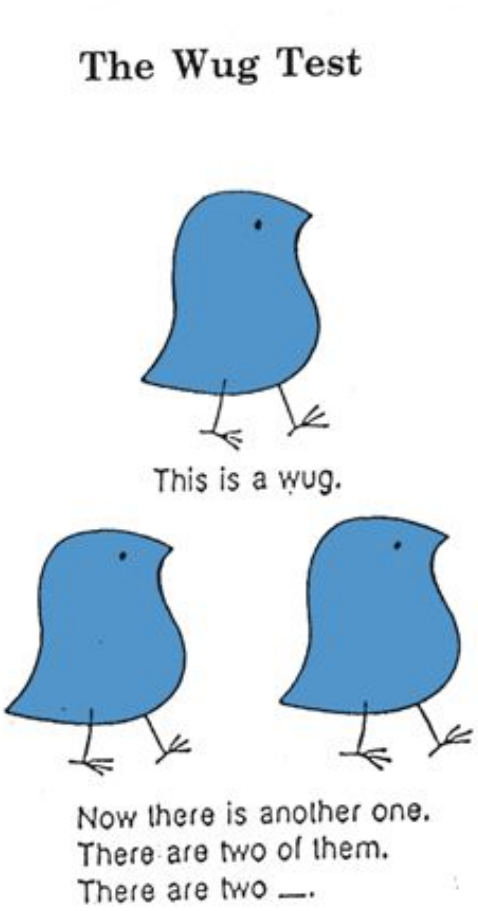
Derivational morphemes

https://www.youtube.com/watch?v=nQElBnBWExc

http://www.thelingspace.com/episode-76/

0:41-1:23 = derivational morphology

Inflectional morphemes



-s = plural

-s = present tense, 3rd sg
(he sings)

-ing = ongoing action
(he's singing)

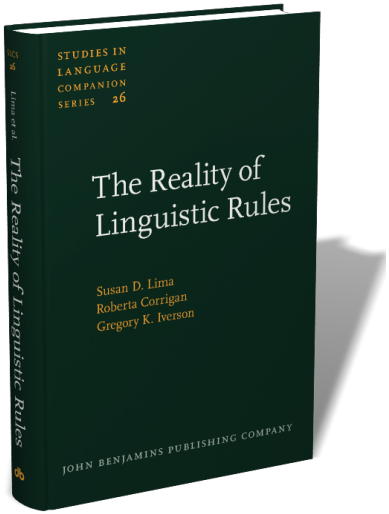
Structure permits creativity

We are capable of combining existing morphemes/words into new sentences

Through dangers untold and hardships unnumbered, I have fought my way here to the castle beyond the goblin city to take back the child you have stolen, for my will is as strong as yours and my kingdom is as great.

Linguistic rules

The point: our minds store words and meanings and the patterns into which they can be placed.

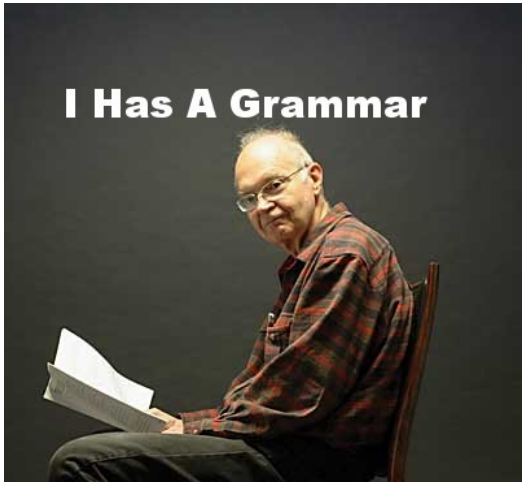


The mental grammar

"In short, in order for us to be able to speak and understand novel sentences, we have to store in our heads not just the words of our language but also the patterns of sentences possible in our language. These patterns, in turn, describe not just patterns of *words* but also patterns of *patterns*. Linguists refer to these patterns as the *rules* of language stored in memory; they refer to the rules as the *mental grammar* of the language, or *grammar* for short." - Jackendoff (1994)

What's being learned:

Patterns or "rules" of language = grammar



A distinction:
prescriptive vs. descriptive grammar rules

Prescriptive: what you have to be taught in school, what is prescribed by some higher "authority". You don't learn this just by listening to native speakers talk.

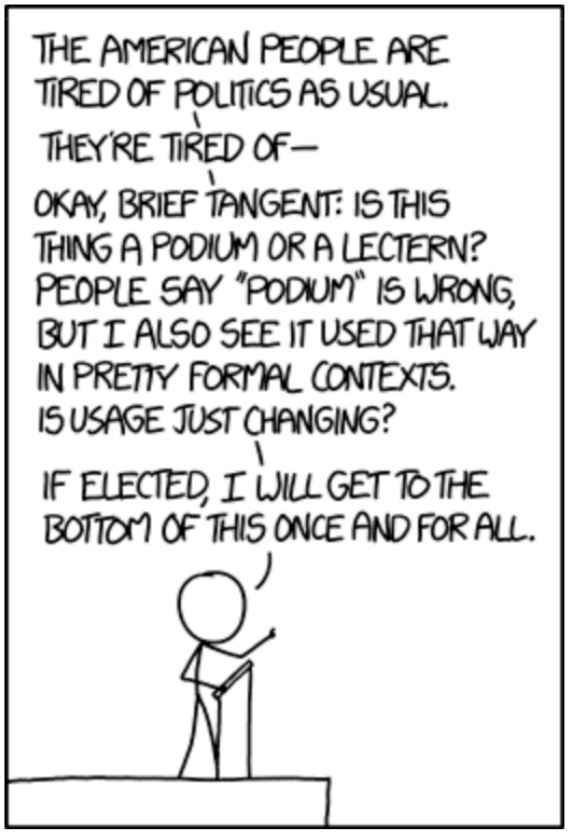
"Don't end a sentence with a preposition."
" 'Ain't' is not a word."

A distinction:
prescriptive vs. descriptive grammar rules

Prescriptive: what you have to be taught in school, what is prescribed by some higher "authority". You don't learn this just by listening to native speakers talk.

Word choice:
lectern vs. podium

"People say 'podium' is wrong…"



http://xkcd.com/1661/

A distinction:
prescriptive vs. descriptive grammar rules

Prescriptive: what you have to be taught in school, what is prescribed by some higher "authority". You don't learn this just by listening to native speakers talk.

Some of the grammar rules you learned in school could be messing up your writing. Flickr / Patrick Gage Kelley

http://www.businessinsider.com/harvard-steven-pinker-debunks-10-grammar-myths-2015-8

A distinction:
prescriptive vs. descriptive grammar rules

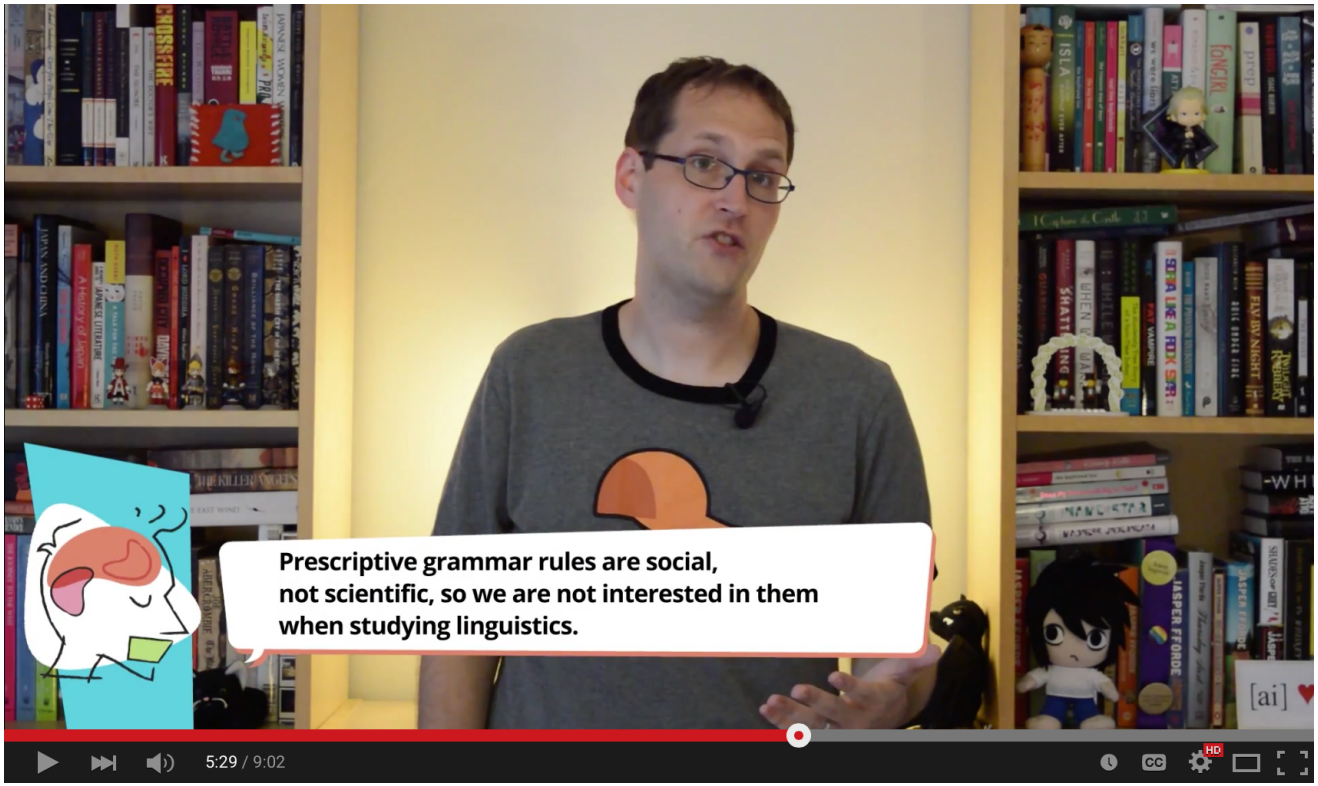
Descriptive: what you pick up from being a native speaker of the language, how people actually speak in their day-to-day interactions. You don't have to be explicitly taught to follow these rules.

The dwarf is who Sarah first talked ***with***.

"You're horrible!" "No, I ***ain't*** - I'm Hoggle!"

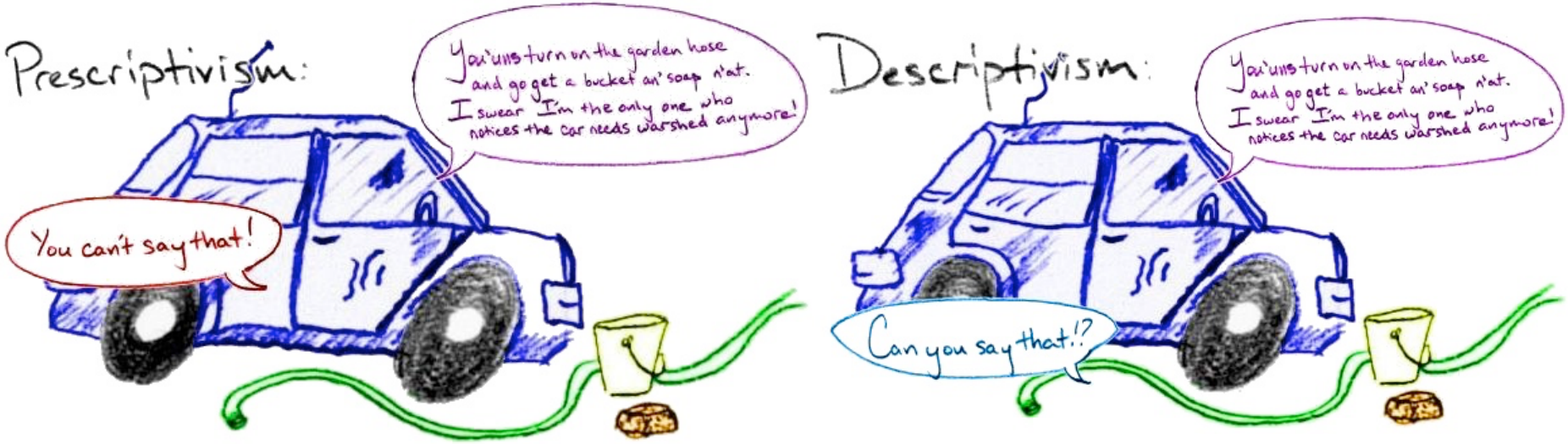
A distinction:
prescriptive vs. descriptive grammar rules

The LingSpace: Word Crimes & Misdemeanors
~0.26 up through ~8:26



http://www.thelingspace.com/episode-3 (+ commentary)
https://www.youtube.com/watch?t=85&v=eFlBwBwL_iU

In a nutshell:
prescriptive vs. descriptive grammar rules



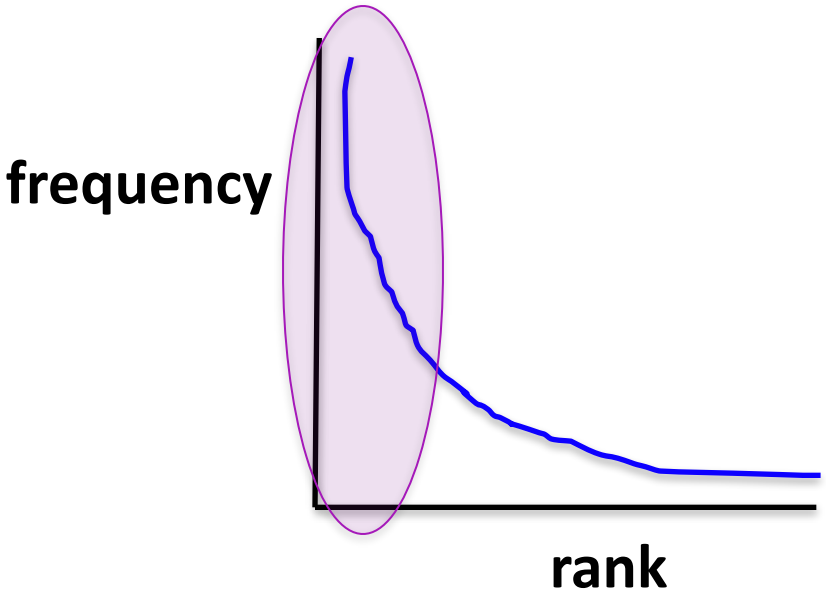
"You can't say that!" vs. "Can you say that!?"

http://specgram.com/CLIV.3/04.phlogiston.cartoon.xi.html

Learning grammars

One reason learning the rules of language is so difficult is that language follows a **Zipfian distribution**:

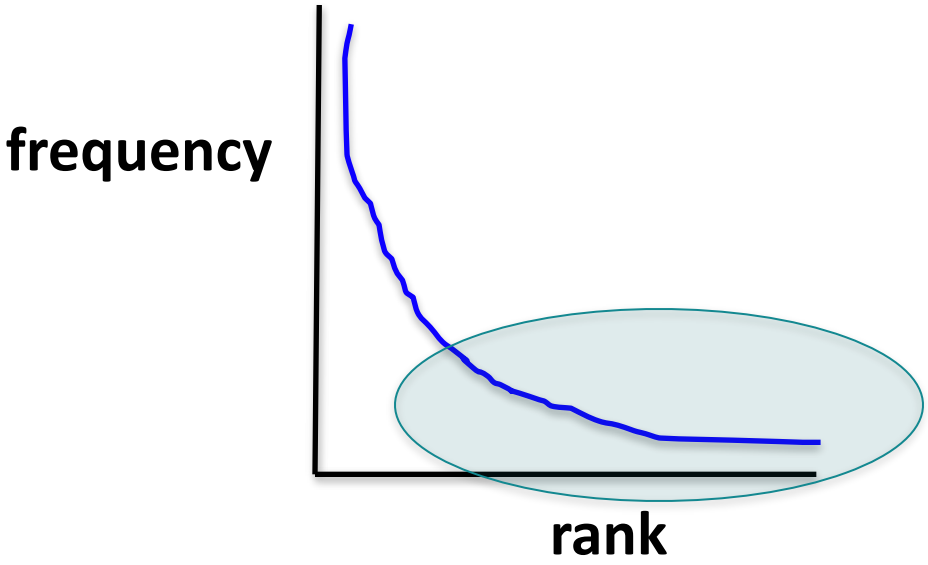
A few things are said very frequently…



Learning grammars

One reason learning the rules of language is so difficult is that language follows a **Zipfian distribution**:

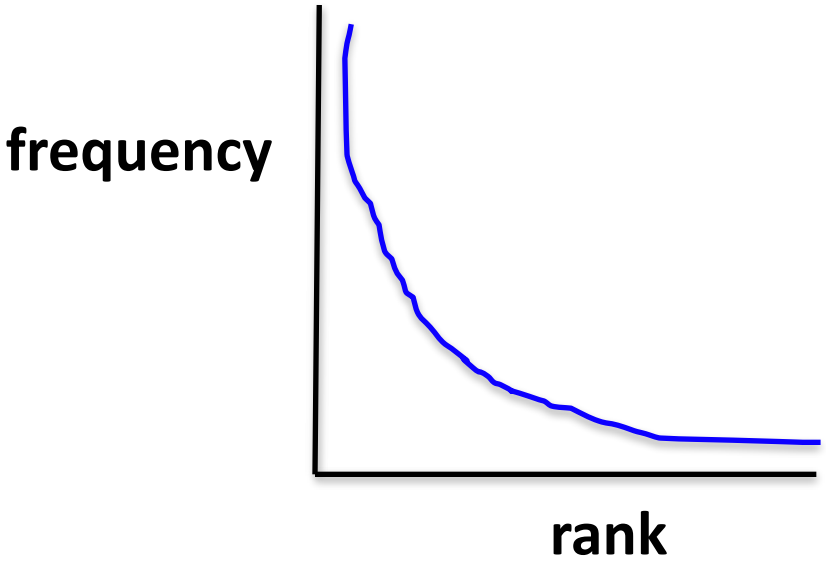
A few things are said very frequently and most things are said very infrequently.



Learning grammars

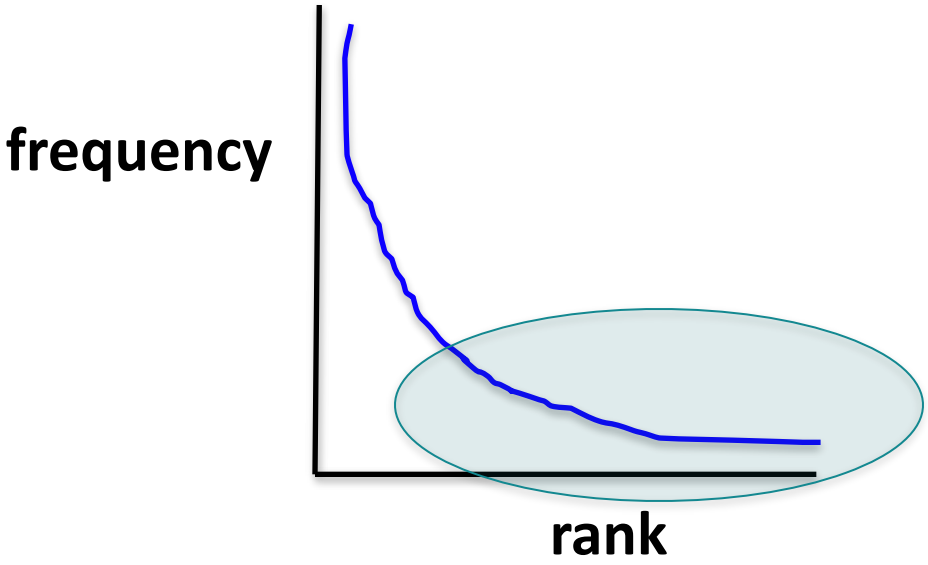
This means that children may only get a very few examples of any one linguistic structure spread out across years and years of input.

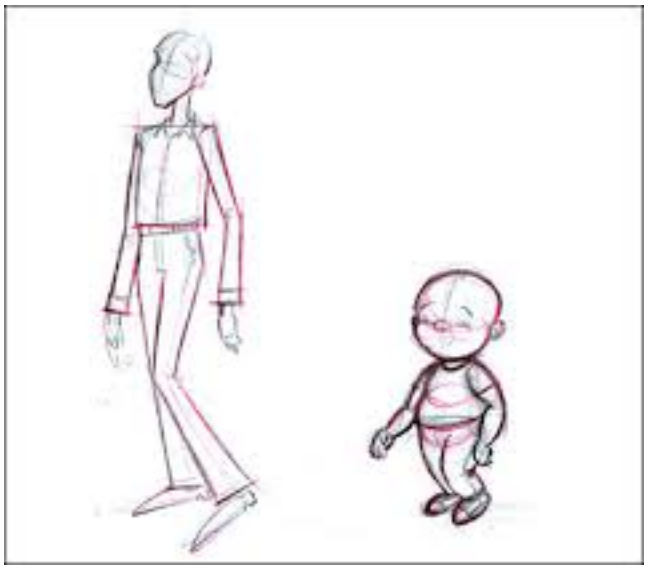
This makes acquisition particularly challenging.



Learning grammars

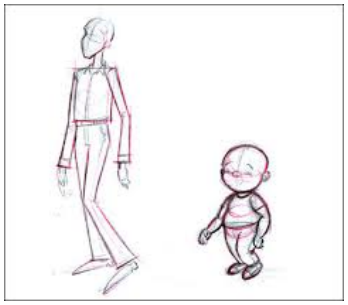
However, we do know that children are better at learning the mental rules of language than adults. One reason may be that they generalize from sparse and noisy data differently than adults do (Hudson Kam & Newport 2005, 2009, Hudson Kam 2015).





Some evidence that adults and children differ

Hudson Kam & Newport (2005), Hudson Kam (2015): Adults and 5- to 7-year-old children differ in their willingness to make generalizations.



Adults and children were presented with an artificial language that used certain words (determiners like “the” and “a” in English) inconsistently (ex: in noun phrases). Sometimes, the word would appear (maybe 60% of the time) and sometimes it wouldn’t.

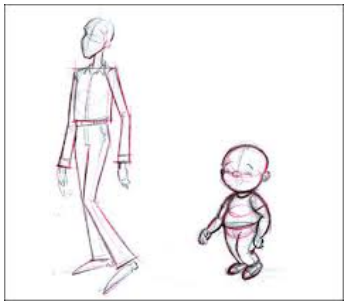
Example of inconsistent use in English (rather than an artificial language):

“I want the pirate to win.” (60%)

“I want pirate to win.” (40%)

Some evidence that adults and children differ

Hudson Kam & Newport (2005), Hudson Kam (2015): Adults and 5- to 7-year-old children differ in their willingness to make generalizations.



When presented with inconsistent input, adult learners matched the input and did not generalize usage to all phrases. So, for example, if they heard a determiner 60% of the time, they used a determiner 60% of the time when they produced sentences in this language.

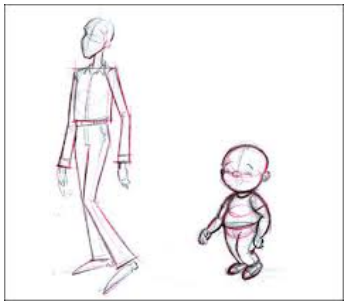
Adult production:

"I want the pirate to win." (60%)

"I want pirate to win." (40%)

Some evidence that adults and children differ

Hudson Kam & Newport (2005): Adults and 5- to 7-year-old children differ in their willingness to make generalizations.



When presented with inconsistent input, child learners often generalized determiner usage to all noun phrases. So, if they heard a determiner 60% of the time, they used a determiner either 100% of the time when they produced sentences in this language - or 0% of the time (they didn't generalize the right way necessarily).

Child production:

"I want the pirate to win." (100%)

"I want pirate to win." (0%)

…but maybe not as much as we think

Perfors (2016): Adults may probability-match because of pragmatic assumptions they bring to the learning task:

(1) they think the variation is predictable
(2) they think it's important to learn the variation

When these assumptions are removed, adults probability match much less often.

…but maybe not as much as we think

Hudson Kam (2015): Children also probability-match somewhat more when the variation is predictable.

Ex: If determiners are used a lot when nouns are Subjects, but not when nouns are Objects.

"The pirate should win." (80%)

"I like pirate." (20%)

…but maybe not as much as we think

Hudson Kam & Newport (2009): Adults can be made to generalize too, when given inconsistent input.

When presented with inconsistent input but with one determiner being dominant (used 60% of the time as compared to others used 20% or less of the time)…

Example input:

"I want the pirate to win."	(60%)
"I want pirate to win."	(20%)
"I want two pirate to win."	(20%)

…but maybe not as much as we think

Hudson Kam & Newport (2009): Adults can be made to generalize too, when given inconsistent input.

When presented with inconsistent input but with one determiner being dominant (used 60% of the time as compared to others used 20% or less of the time), adult learners often generalized only the dominant determiner and used it nearly all the time (90%).

Adult production:

"I want the pirate to win."	(90%)
"I want pirate to win."	(5%)
"I want two pirate to win."	(5%)

…but maybe not as much as we think

Hudson Kam & Newport (2009): Children still differ from adults in *what* they generalize.

When presented with inconsistent input but with one determiner being dominant (used 60% of the time as compared to others used 20% or less of the time), child learners often generalized one determiner (even if it wasn't the dominant one) and used it nearly all the time (ex: 90%).

Child production:

"I want the pirate to win."	(10%)
"I want pirate to win."	(90%)
"I want two pirate to win."	(0%)

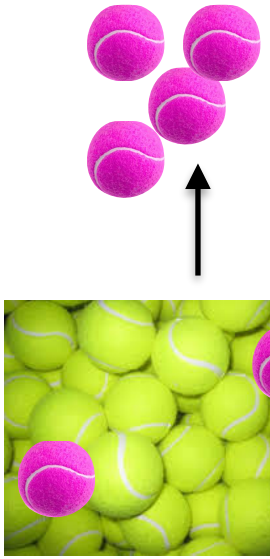
Children's learning abilities

11-month-olds don't probability-match in non-linguistic domains either, unlike adults (visual task: Yurovsky, Boyer, Smith, & Yu 2013)

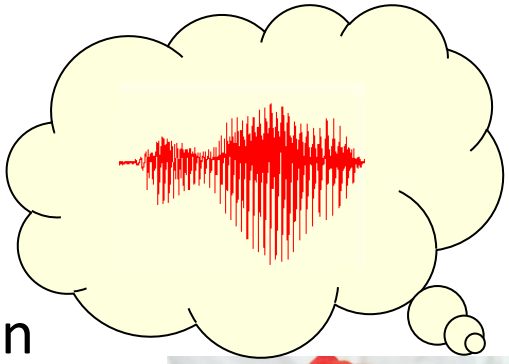
But children are very good with probabilistic information…

6-month-olds create probabilistic expectations about their environment, based on their observations of their environment. For example, after seeing that a box is mostly filled with yellow balls, they are surprised when someone pulls four pink balls in a row out of the box.

(Denison, Reed, & Xu 2011)



But children are very good with probabilistic information…

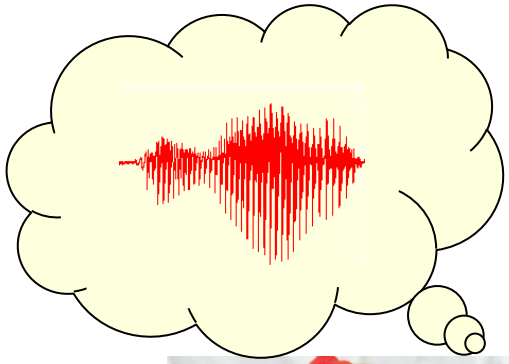


Saffran, Aslin, & Newport (1996): 8-month-olds can (unconsciously) track probabilities between syllables in order to identify words in fluent speech in an artificial language

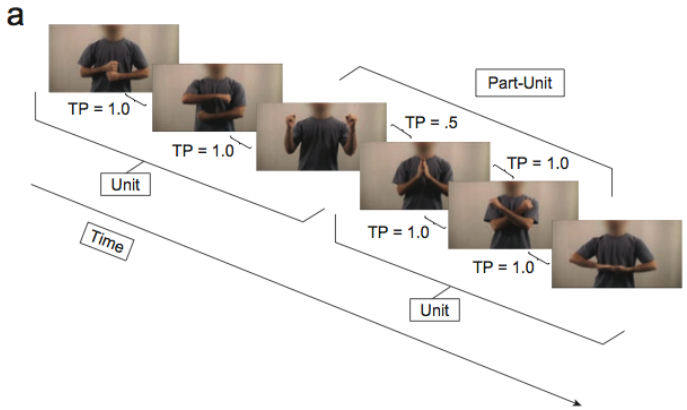
tu pi ro go la bu bi da ku pa do ti go la bu tu pi ro pa do ti…

http://whyfiles.org/058language/images/baby_stream.aiff

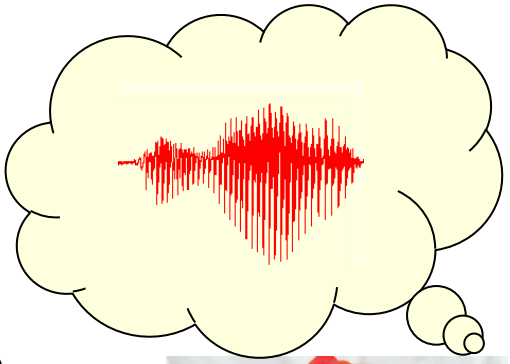
But children are very good with probabilistic information…



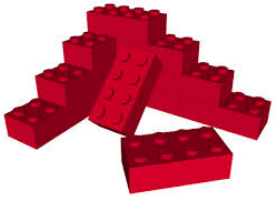
Roseberry, Richie, Hirsh-Pasek, Golinkoff, & Shipley (2012): 8-month-old infants are able to (unconsciously) track probabilities between dynamic events, such as a series of hand motions.



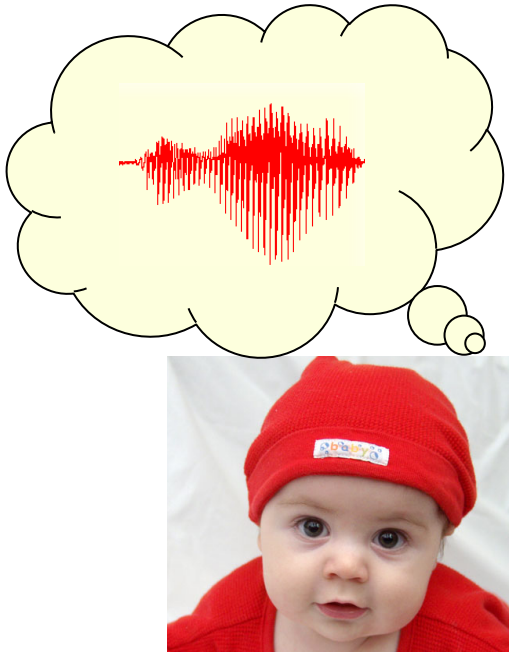
But children are very good with probabilistic information…



Denison, Bonawitz, Gopnik & Griffiths (2013): 4- and 5-year-olds select a hypothesis to evaluate against the data based on how probable a hypothesis is (called sampling a hypothesis). For example, when guessing which color block fell into a container from a box where 5 blue and 20 red blocks were, children guess blue 20% of the time (5/25) and red 80% of the time (20/25).



But children are very good with probabilistic information…



Yurovsky, Case, & Frank (2017): 4- and 5-year-olds can select the correct interpretation of an utterance by probabilistically weighting acoustic and pragmatic cues. For example, when interpreting an utterance that sounds like, “I ate carrots and bees”, they base their answer on whether the person generally says plausible or implausible things.

Children's learning abilities

Children selectively use their input: Children prefer to look at stimuli that are neither too boring nor too surprising, but are instead "just right" for learning, given the child's current knowledge state. This has been called the "Goldilocks Effect".

(Kidd, Piantadosi, & Aslin 2010, 2012)

Language acquisition = An information processing task

We can also think about this as an information processing task.

Given the available input,

Look at that kitty!
There's another one.

Input

Where did he hide?
What happened?

We can also think about this as an information processing task.

Given the available input, information processing done by human minds

Look at that kitty!
There's another one.

Input

Where did he hide?
What happened?

processing & generalization

We can also think about this as an information processing task.

Given the available input, information processing done by human minds to build a system of linguistic knowledge

Look at that kitty!
There's another one.

Input

Where did he hide?
What happened?

processing & generalization

- words & morphemes
- metrical phonology
- syntactic categories
- syntax
- semantics
- pragmatics

We can also think about this as an information processing task.

Given the available input, information processing done by human minds to build a system of linguistic knowledge whose output we observe

Look at that kitty!
There's another one.

Input

Where did he hide?
What happened?

processing & generalization

- words & morphemes
- metrical phonology
- syntactic categories
- syntax
- semantics
- pragmatics

Where's the kitty?

That one's really cute.

To understand how children solve this acquisition task, we need to think more about all the components involved.

Look at that kitty!
There's another one.

Input

Where did he hide?
What happened?

processing & generalization

words & morphemes

metrical phonology

syntactic categories

syntax

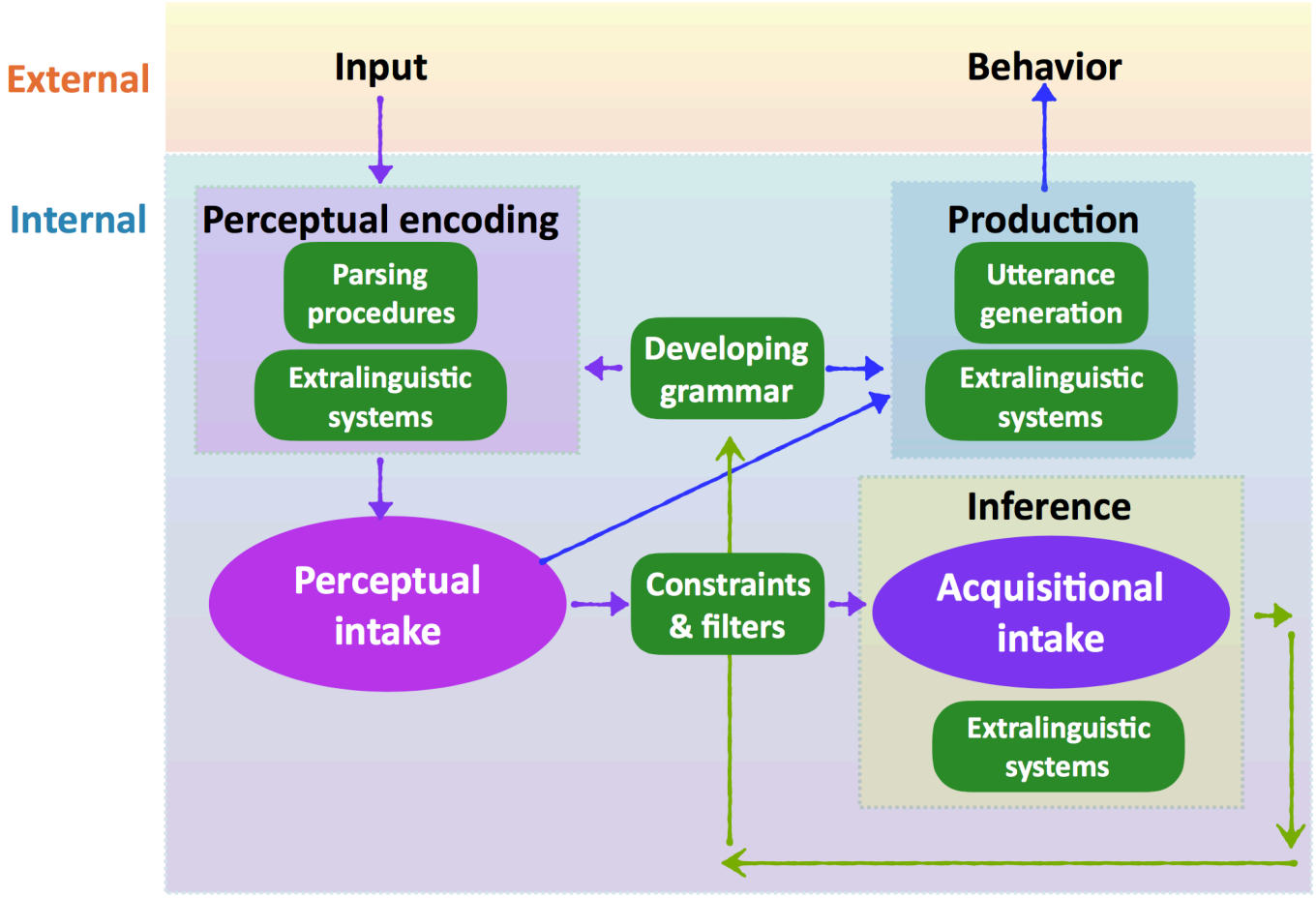
semantics

pragmatics

Where's the kitty?

That one's really cute.

A framework that makes components of the acquisition task more explicit



Adapted from Lidz & Gagliardi 2015

Distinguishes between things external to the child that we can observe (input signal, child's behavior) vs. things internal to the child (everything else).

External

Input

Behavior

Internal

Perceptual encoding

Parsing procedures

Extralinguistic

Developing grammar

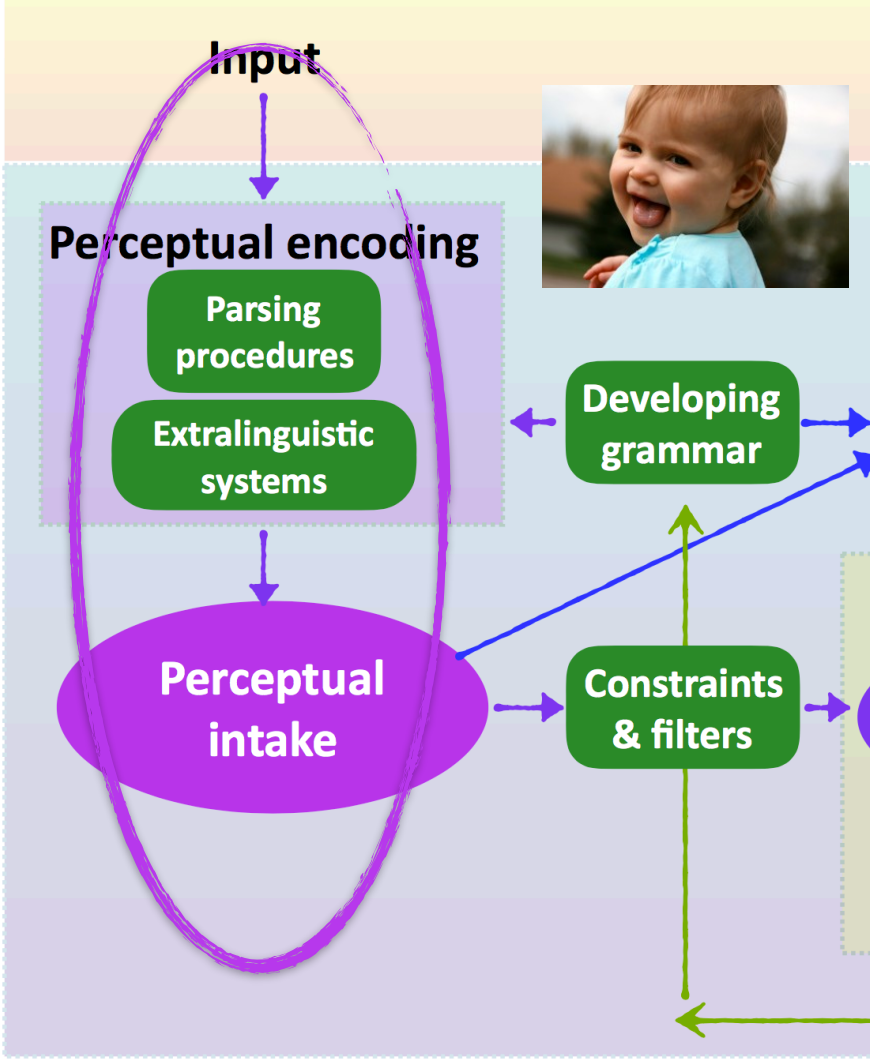
Production

Utterance generation

Extralinguistic

Perceptual encoding:

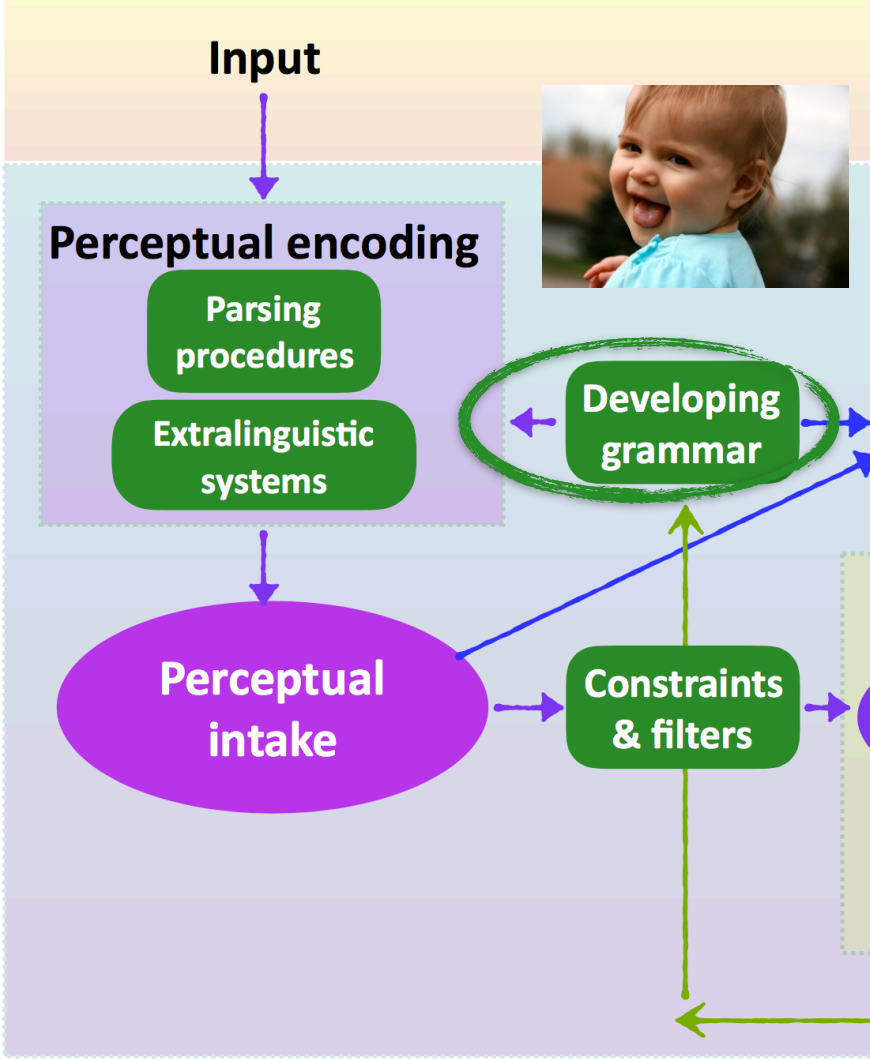
Turning the input signal into an internal linguistic representation = perceptual intake.



Ad

Perceptual encoding:

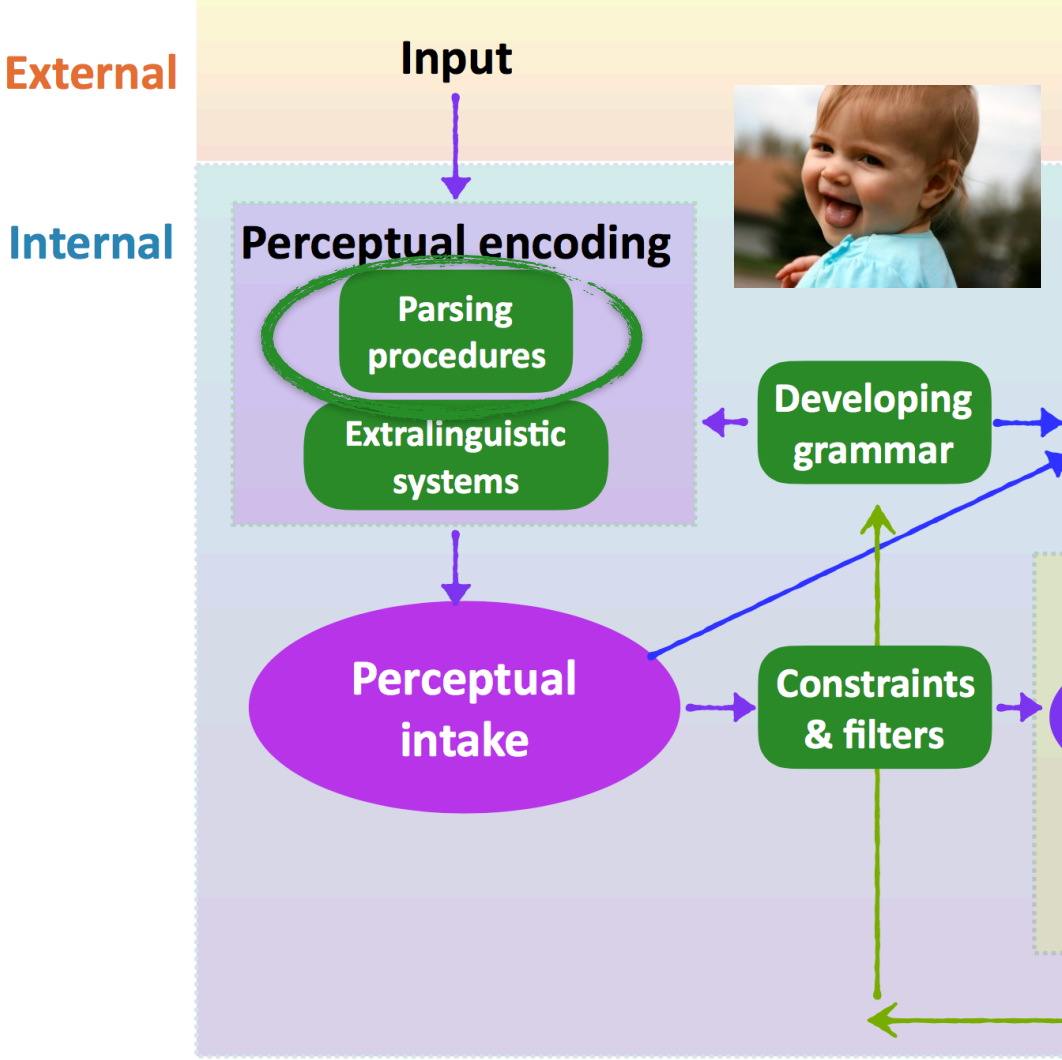
Involves using current knowledge of the language (the developing grammar)…



Ad

Perceptual encoding:

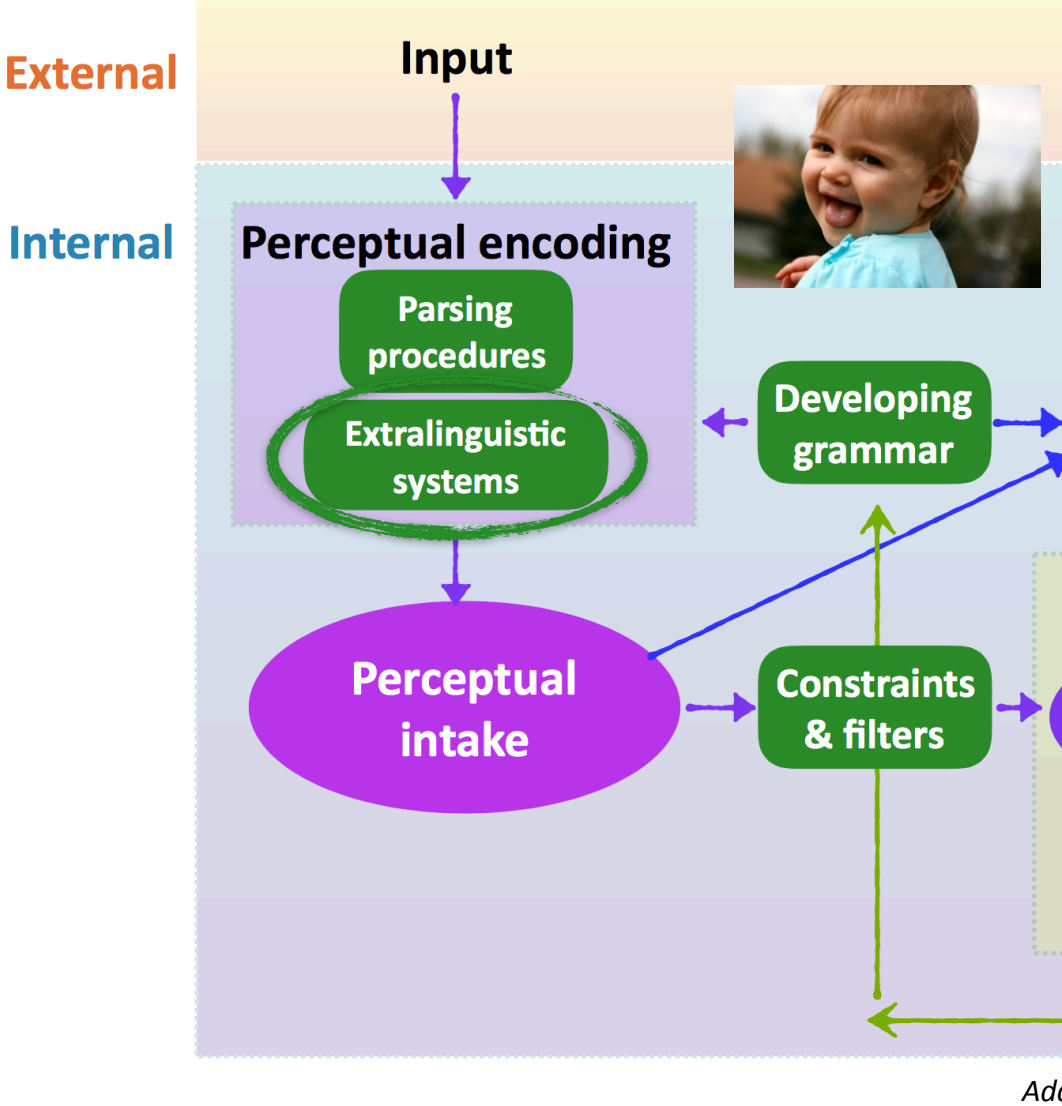
Involves using current knowledge of the language (the developing grammar) deployed in real time to parse the input…



Ad

Perceptual encoding:

Involves using current knowledge of the language (the developing grammar) deployed in real time to parse the input, often drawing on extralinguistic systems (like working memory, auditory processing, etc.)

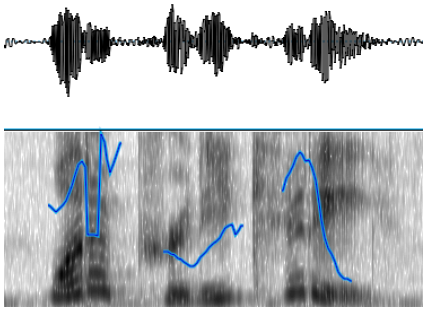


Ad

External

Internal

Perceptual encoding



***H**igh vs. **M**id vs. **L**ow relative pitch*

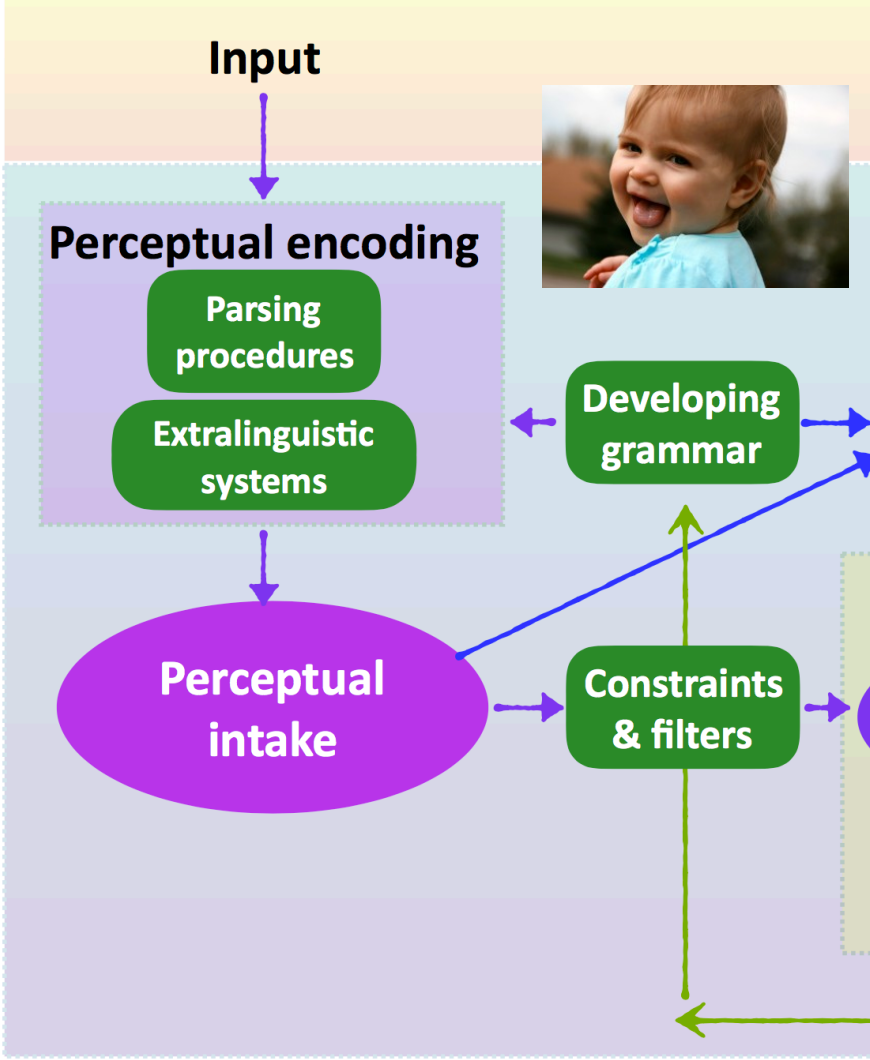
***M**ain vs. **s**econdary stress*

L	*L*	*H*	*H*	*M*	*M*
s		***s***		***M***	
wˈʌ	ɾə	pɹˈɪ	ɾi	kˈɪ	ɾi

(Mom)

syllables with stress

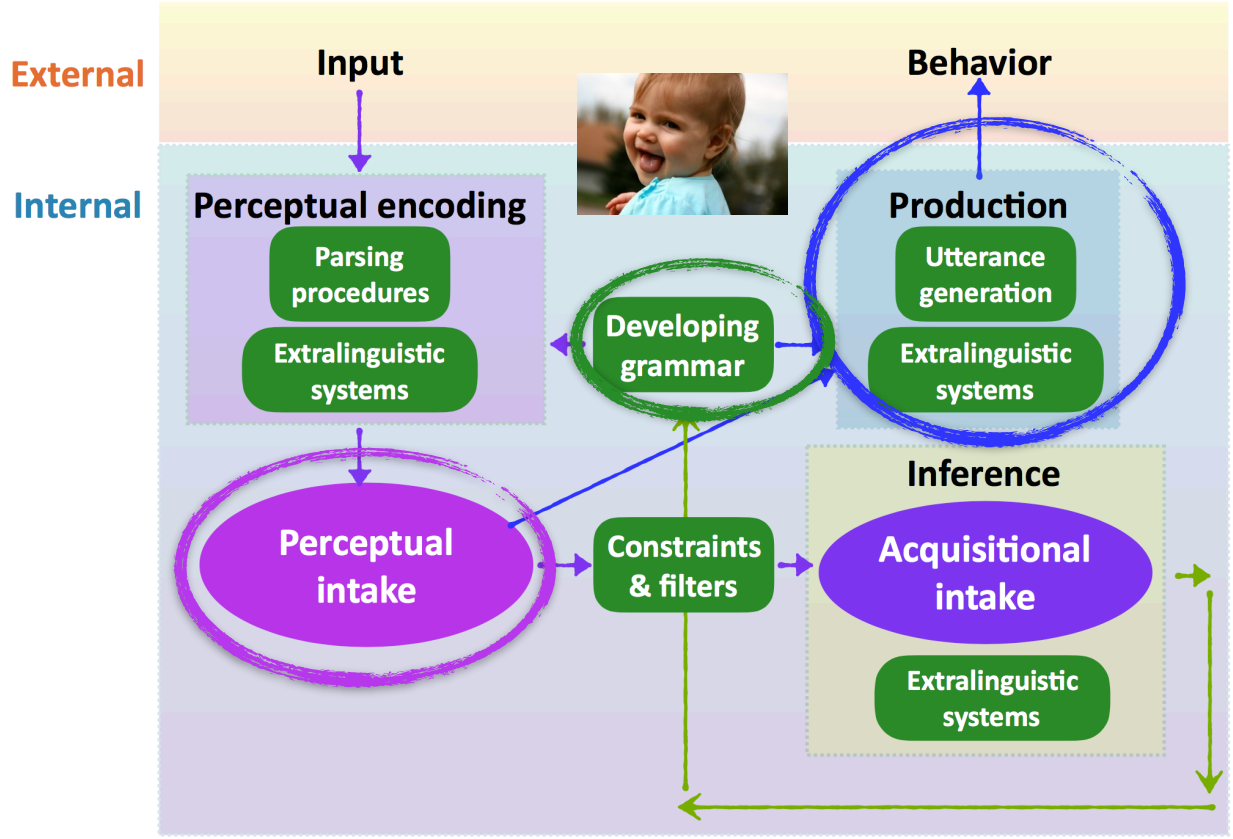
speaker identity



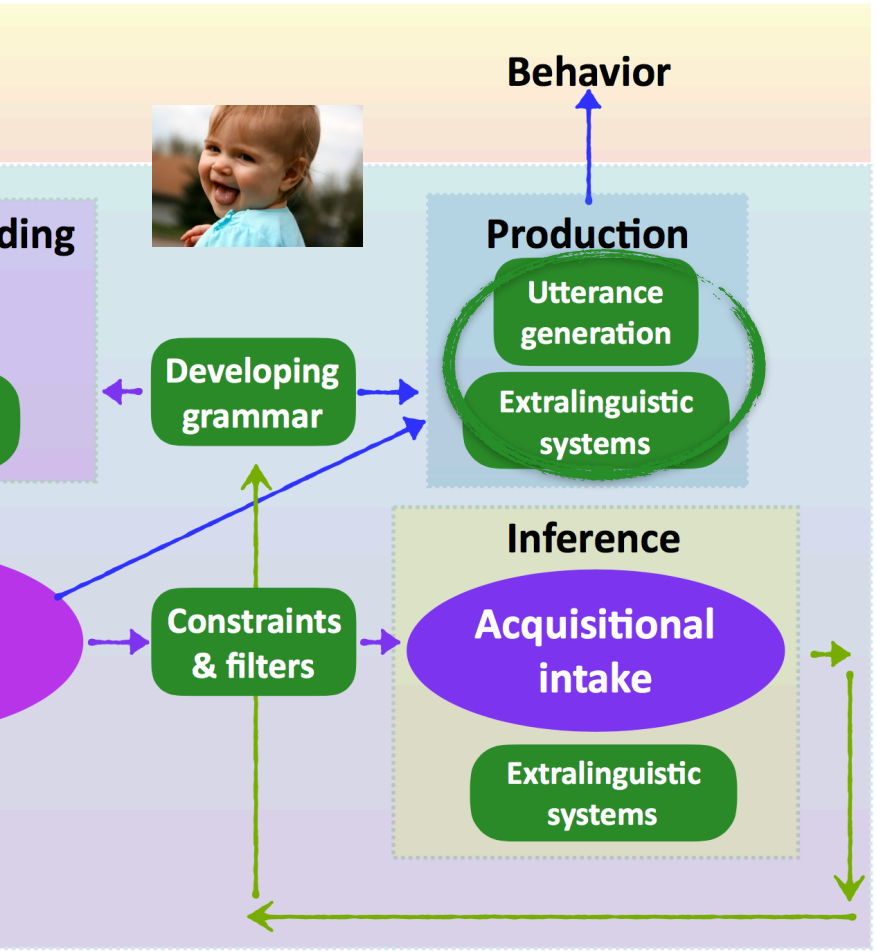
Ad

Generating observable behavior

Involves the current linguistic representations and the developing grammar being used by the production system.



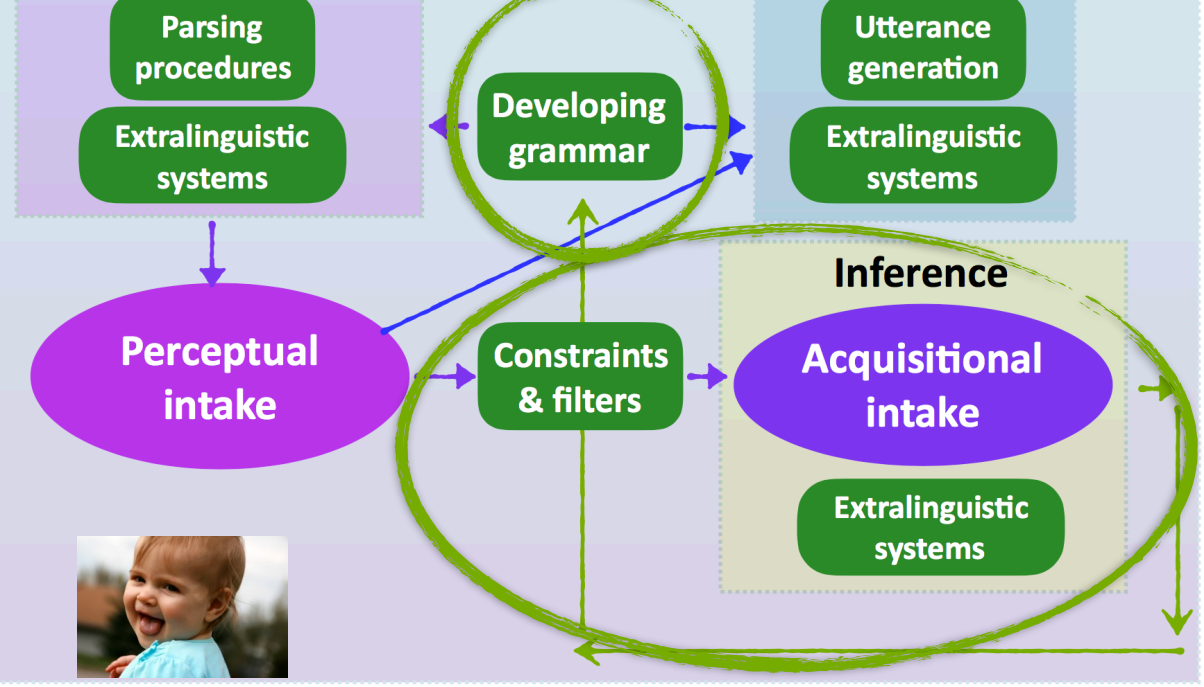
Adapted from Lidz & Gagliardi 2015



Adapted from Lidz & Gagliardi 2015

Generating observable behavior

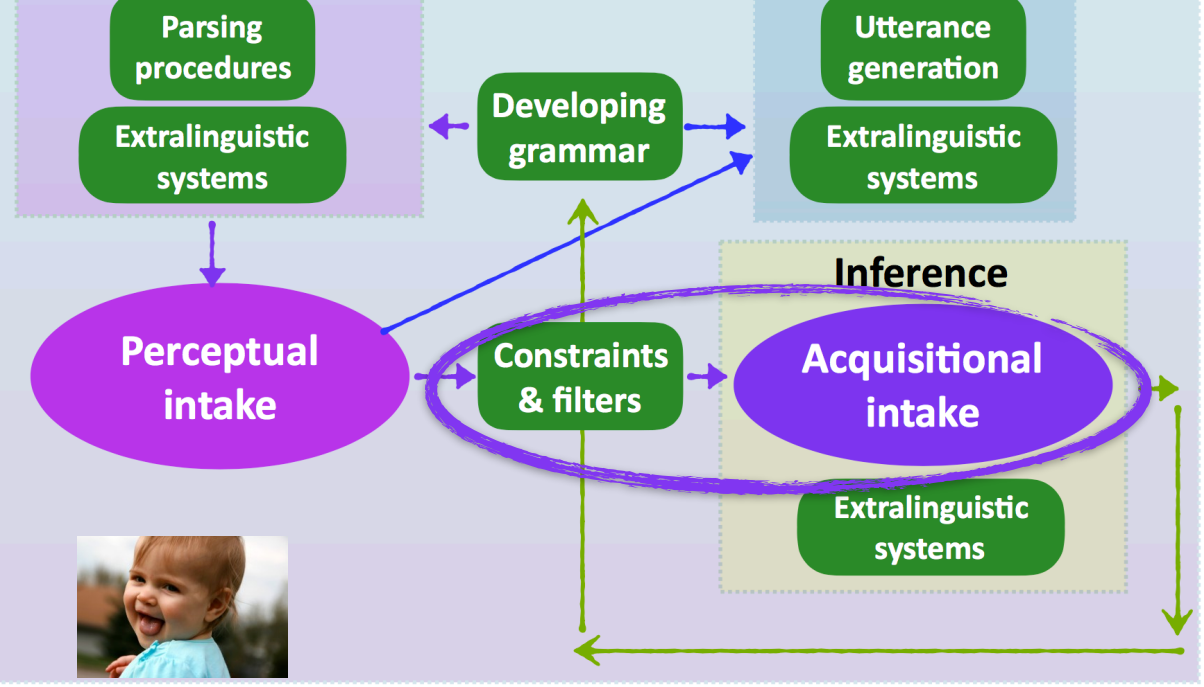
These are used in real time to generate linguistic behavior (utterances) and non-linguistic behavior (pointing, looking, etc.). These behaviors require linguistic systems (utterance generation) and extralinguistic systems (motor control, attention, decision-making, etc.)



Adapted from Lidz & Gagliardi 2015

Inference = learning

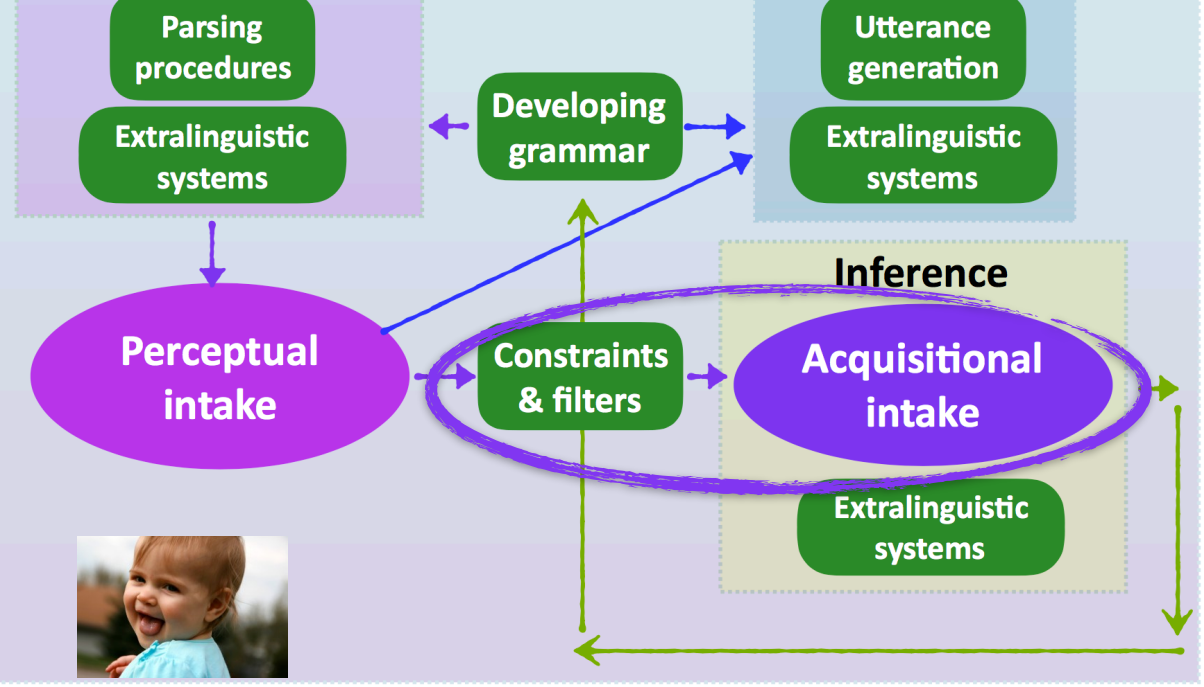
This is how children learn from the current data in order to update the developing grammar.



Adapted from Lidz & Gagliardi 2015

Inference = learning

Constraints on children's hypotheses and filters on their attention cause them to heed a subset of the perceptual intake — this is the acquisitional intake.



Adapted from Lidz & Gagliardi 2015

perceptual intake

***H**igh vs. **M**id vs. **L**ow relative pitch*

***M**ain vs. **s**econdary stress*

L	***L***	***H***	***H***	***M***	***M***
s		***s***		***M***	
wˈʌ	ɾə	pɹˈɪ	ɾi	kˈɪ	ɾi

(Mom)

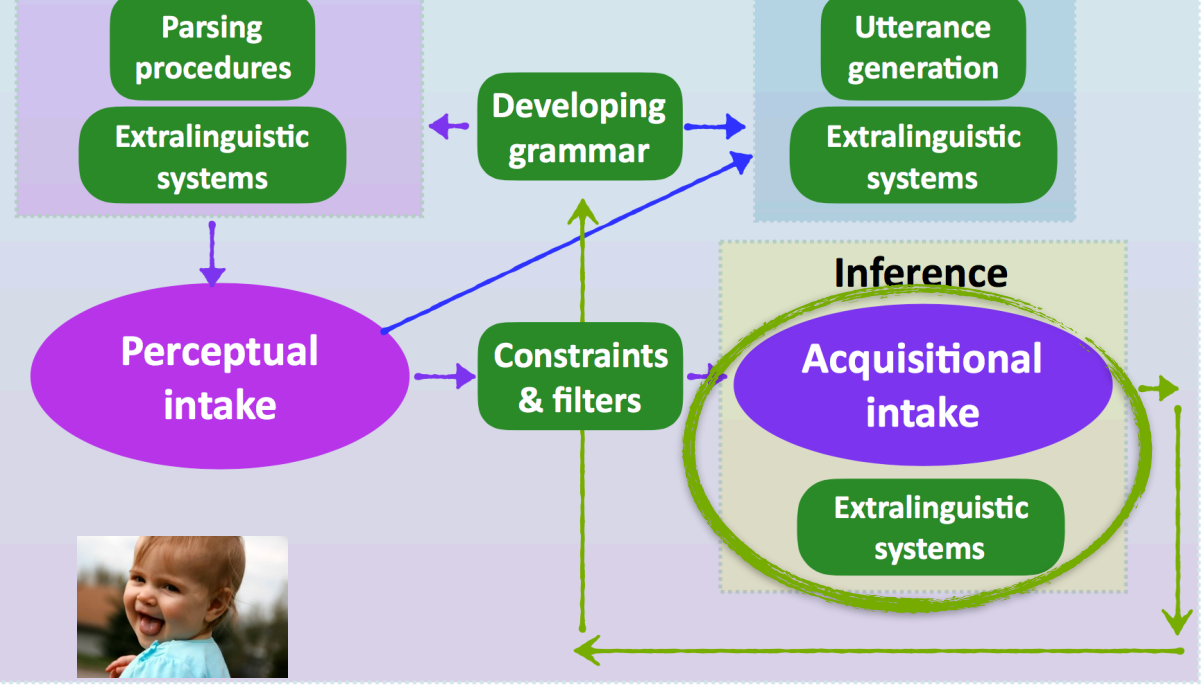
syllables with stress

speaker identity

acquisitional intake

syllables with stress

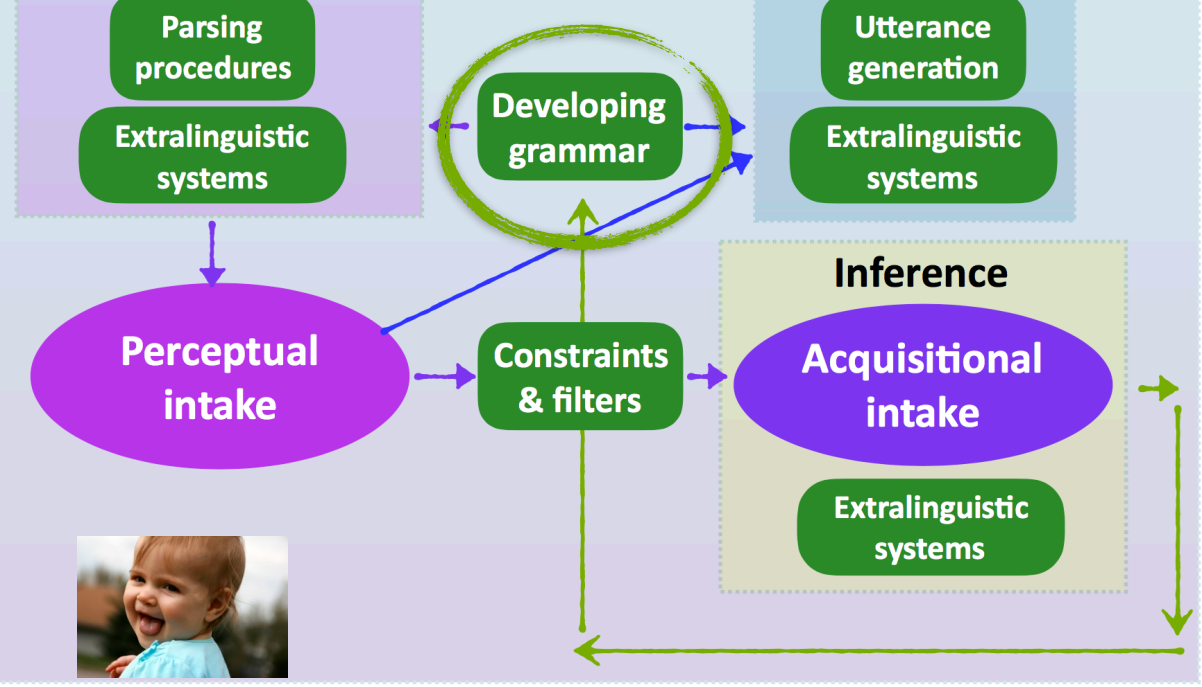
wˈʌ ɾə pɹˈɪ ɾi kˈɪ ɾi



Adapted from Lidz & Gagliardi 2015

Inference = learning

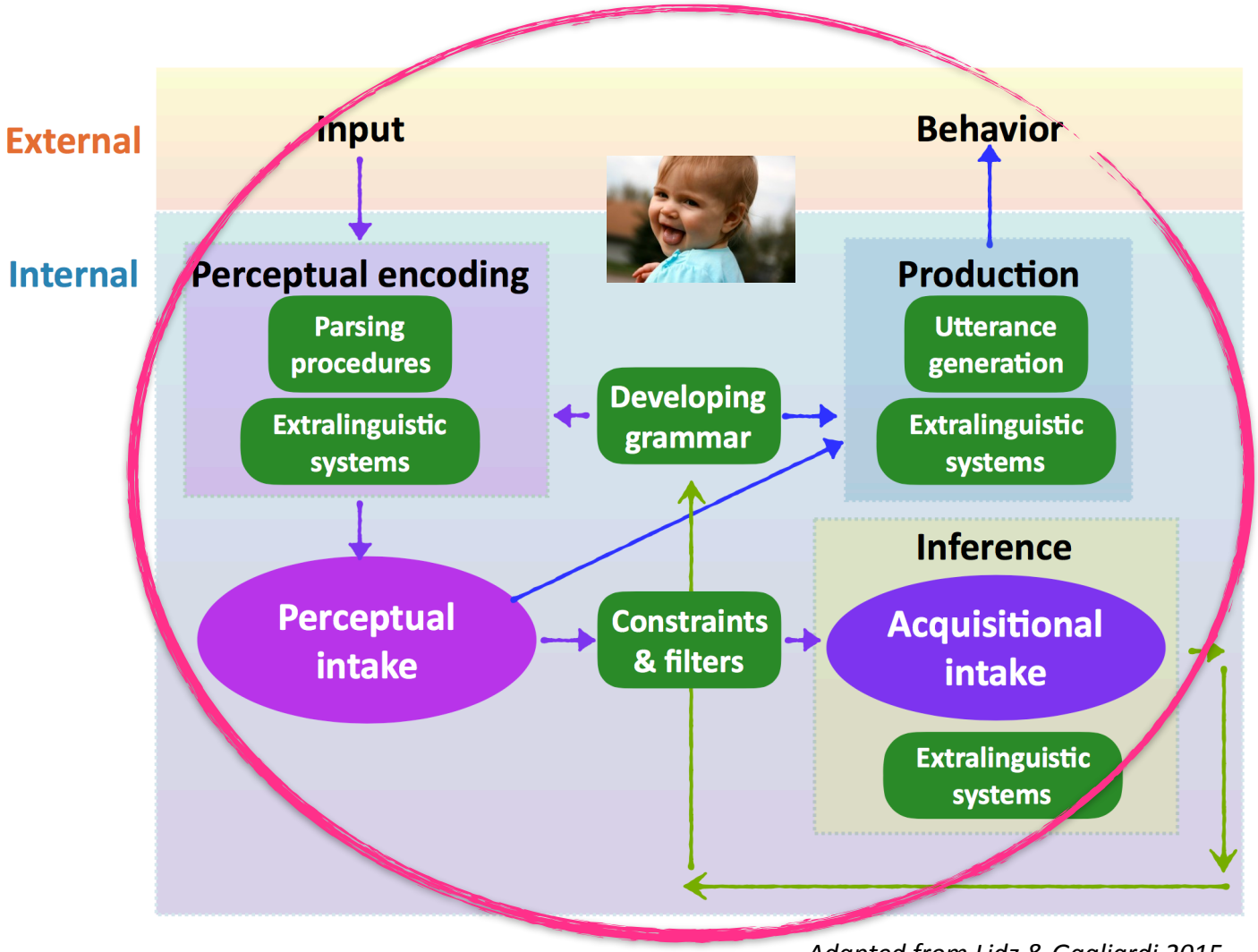
Inference happens over the acquisitional intake, using extralinguistic abilities (statistical learning, probabilistic inference, hypothesis testing, etc.) …



Adapted from Lidz & Gagliardi 2015

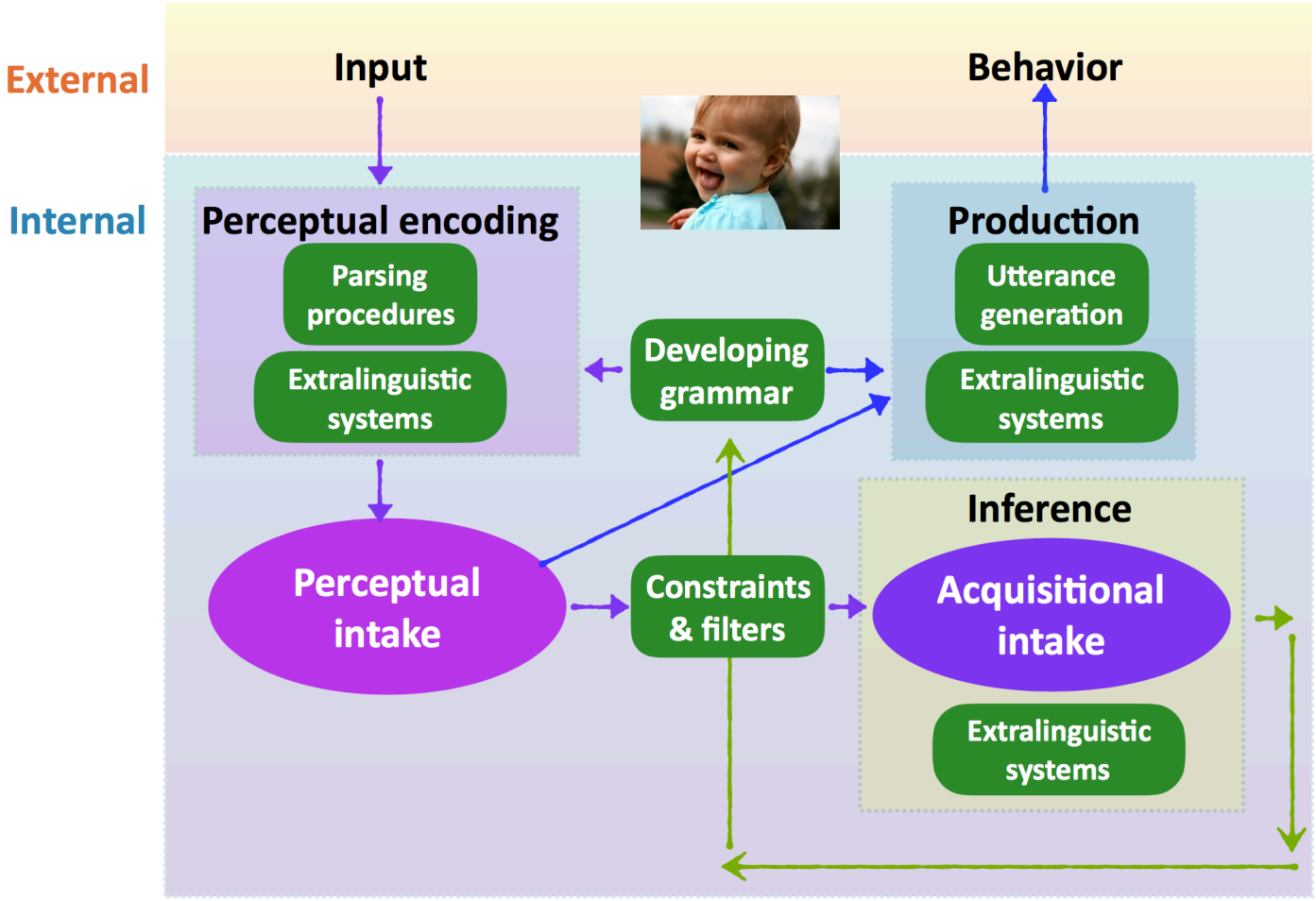
Inference = learning

Inference happens over the acquisitional intake, using extralinguistic abilities (statistical learning, probabilistic inference, hypothesis testing, etc.) to generate the most up-to-date ideas about the language's grammar.



Adapted from Lidz & Gagliardi 2015

This whole process **happens over and over again** throughout the **learning period**



Adapted from Lidz & Gagliardi 2015

This is language acquisition

Main points

The creativity and expressivity of language suggests that there is an underlying structured system that produces language as its output.

Language acquisition involves inferring a grammar of language rules — these are descriptive rules.

Because of the Zipfian nature of linguistic data, the acquisition task may be very hard indeed, since many structures appear very rarely in children's input. However children may use the data very effectively, based on different helpful learning biases they have.

The process of acquisition involves many different components, most internal to the child, which makes them hard for us to observe directly.

Questions?

You should be able to do up through 13 on the introductory review questions and up through question 3 on HW1.

Extra Material

Possible objections to a mental rule set

“Why should I believe I store a set of rules unconsciously in my mind? I just understand sentences because they make sense.”

Possible objections to a mental rule set

"Why should I believe I store a set of rules unconsciously in my mind? I just understand sentences because they make sense."

But why do some sentences make sense and others don't?

Hoggle has two jewels.
*Two Hoggle jewels has.

Possible objections to a mental rule set

Why can we recognize patterns even when some of the words are unknown?

‘Twas brillig, and the slithy toves
did gyre and gimble in the wabe...

Possible objections to an unconscious rule set

“When I talk, the talk just comes out - I’m not consulting any rule set.”

Possible objections to an unconscious rule set

"When I talk, the talk just comes out - I'm not consulting any rule set."

Analogy: wiggling your fingers

When you want to wiggle your fingers, you "just wiggle them".

But your finger-wiggling intention was turned into commands sent by your brain to your muscles, and you're never conscious of the process unless something interferes with it. Nonetheless, there *is* a process, even if you're not aware of it.