

Language Acquisition

9.85 – Infant cognition 11/29/2012

With many thanks to and slides from Melissa Kline

Mini-lectures

- Do we teach children to speak?
- Do we help children to speak?

What's amazing about language?

- Productive (potentially infinite)
 - The Red Sox beat the Yankees.
 - Mario said that the Red Sox beat the Yankees.
 - Jill thought that Mario said that the Red Sox beat the Yankees...
 - Used in everyday communication...
 - i hope you did not say i told you he thought your chances were bad

- Productive (potentially infinite)
- Context-independent: We can talk about things that aren't...
 - Present
 - Visible
 - Tangible
 - Real

- Productive (potentially infinite)
- Context-independent
- Uniquely human

Chimp vocalizations...

- Pant-hoot food enjoyment, social excitement, and sociability feelings
- Pant-grunt directed towards dominant individuals by submissive individuals
- Distance calls
 - To draw attention to danger
 - To draw attention to food sources
 - To establish location of other groups in the area
- Short bark when hunting
- Tonal bark "given in the presence of large snakes"



Alex (Avian Learning/Language Experiment)

- "Which one Two?"
- "How many Red?"
- "How many Wood?"







What's missing?

- Productive (potentially infinite)
- Context-independent
- Uniquely human
- Richly structured

(not prescriptive rules)

Don't say "ain't"

Don't end sentences in prepositions:

That is something which I can't put up with.

*That is something up with which I cannot put. Don't split infinitives:

> To boldly go where no man has gone before. ? To go boldly where no man has gone before. ? Boldly to go where no man has gone before.

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Human language is richly structured

Colorless green ideas sleep furiously

* Furiously green sleep ideas colorlessly

The big grey cat

* The grey big cat

"British left waffles on Falklands"



"British left waffles on Falklands"



- Productive (potentially infinite)
- Context-independent
- Uniquely human
- Richly structured
- LEARNABLE

In fact, everyone learns it...

"It is a very remarkable fact that there are none...that they cannot arrange different words together, forming of them a statement by which they make known their thoughts; while on the other hand, there is no other animal, however perfect and fortunately circumstanced it may be, which can do the same."

Renee Descartes

In fact, everyone learns it...

(barring very extreme situations) ...On roughly the same timescale ...In roughly the same order ...Making similar errors ...Across all languages studied

Progression of language acquisition

- Vocal play (16wks-6 months)
- Babbling (6-10 months)
- "Single-word stage" (10-18mo)
 - Kitty, dada, up!, allgone, wassat?, bye-bye
- "Two-word stage" (~18mo)
 - Byebye plane, See baby, More hot, I shut
 - Vocabulary growth increases rapidly
- Telegraphic speech (~2yo)
 - Where wrench go?
 - Grammatical elements start to appear, in a relatively fixed order
- Full, adultlike sentences (~2.5yo)

For full slides, videos, etc. Please contact Kim at kimscott@mit.edu

Levels of structure

- Children must learn:
 - Phonetics & Phonology
 - Lexicon
 - -Syntax & Morphology
 - -Semantics
 - Pragmatics/Discourse

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Minimal units of meaning: cat, dog, mouse, see, watch, -s, -ing

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Structure of words (combining lexical items)

Structure of sentences (combining words)

Syntax vs. Semantics

Syntactically correct / * Syntactically incorrect:

- Colorless green ideas sleep furiously.
- *Furiously sleep ideas green colorless.
- *The keys to the cabinet is on the counter
- I wiped the counter clean
- *I cleaned the counter shiny
- The fish swam/*I swam the fish
- The lamp broke/I broke the lamp
- Jabberwocky

Pragmatics/Discourse

Bill hid Dave's car keys -- he was drunk. It wasn't the first time that Dave had gotten that drunk.

*Bill hid Dave's car keys -- he hates spinach. It wasn't the first time that they had seen the movie.

Plan for today



The input

Infants get a wide variety of language experience.

- Overheard adult conversations
- Motherese / child directed speech
- Interaction
- Responses to own utterances
- Corresponding events, contexts

What is it that they really need?

Motherese

- Child-directed speech is
 - Slower
 - More animated
 - Wider pitch variation
 - Wider vowel contrasts
 - Prefered by newborns (Cooper and Aslin 1990)
 - ~60% grammatical sentences, the rest well-formed clauses and stock phrases (Newport, Gleitman, & Gleitman 1977)
- Near-universal: Used by parents and non-parents, in almost all cultures

Is motherese a specialized teaching language?



- Grammatical features
 - Heavy on questions ("Where's your nose?) and commands ("Get your feet out of the laundry!"); only ~30% declarative sentences
 - Syntactic structures not introduced sequentially
 - Some tuning to what the child can understand (receptive language), but not what the child can produce
- Hard to find independent effects of quality/quantity of CDS on development
- Probably helpful in phonological and word learning, communicating affect and intention, drawing attention to speech ... but doesn't "teach" language.



Can imitation and reinforcement explain language learning?

Behaviorism (Skinner):

- Language is a behavior
- Language learning is like any other learning... behavior shaping
- What are some challenges for this approach?



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What are some challenges for this approach?

- Creativity and error
- Absence of (use of) appropriate corrections
- Enrichment of the input (deaf children of hearing parents, creoles)

How dependent is language learning on the input?



Creativity in language

- Who deaded my kitty cat?
- Don't giggle me!
- I undarked it.
- Could you write a small downercase E?
- I'd like to go laundrying.
- Remy: I want MAMA to put it in the fridge. Mama: Okay, fine.

Remy: Mama's nice. Mama's a nice put-er in fridge.

- It is not a hanger. It is missing parts so it can't be a hanger. It is just a HANG.
- There's a wack in there!
- Oh, you mean there's wax?
- No, just one wack!

Creativity in language

- Remy's full long name is Remington Malakai Scott. What is...
- Uncle Idan's full long name?
- Uncley Uncley Uncley Don Scott Mama's full long name?
- Mamaton Malakai Scott
- Uncle Max's full long name?
- Maxican Maxican Scott

Kids say (meaningful) things they've never heard before

- When Kenzo gets here, I'm gonna go all the way to the door and I'm gonna ask Kenzo's papa why did I break the jellyfish necklace?
- It's important Grandma only has one head... not two, not three.
- The mama rabbit wants to hop while the baby rabbit holds on tightly to the mama rabbit's back!
- If you picked me up I wouldn't get squashed by you.
- I don't know why anybody loves me.
- I think the bee kissed me with his toes. He wasn't gentle enough with me.
- Going round and round in a circle... chasing the OTHER steam! (1;11)
- I'm working hard to get up the Mama. (1;10)

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Adults generally correct meaning

- I need to save him. He needs to be saven!
- Mama smells like playdough. Mama doesn't LOOK like play-dough. Yellow is play-dough.
- Are all liquids can be poured?
- [Holding up Meefo] Which of one animals would you like?
- Uncle Julian's water bottle has some eyes on HIS water bottle...
- What do I see blue for spraying out of?

- I think cheese is inside wood chips.
- I didn't like my clementine because it was turning into an orange.
- I wanted Mama because I screamed a little bit.
- Mama will grow up like Grandpa, and then Mama will have a scratchy face!
- I'm a Remy, but I'm not a human. Also I'm a toddler!
- You took a long shower! Sometimes people's computers break.
Adults generally correct meaning

Child: Mamma isn't a boy, he a girl.
Adult: That's right.
Child: Draw a boot paper.
Adult: That's right, draw a boot on paper.
Child: Her curl her hair.
Adult: Mm-hmm.

Child: There's the animal farmhouse. **Adult:** No, that's a lighthouse.

 Those not Mama feet. Those Mama FOOTS. That pretty silly! (2;0)

- Remy (2;7): Do gooses have feet?
- Me: Uh, yes, geese have feet.
- Remy: But do gooses?

Adult: He's going out.

Child: He go out.

Adult: Adam, say what I say: Where can I put them?

Child: Where I can put them?

Child: Want other spoon, Daddy.

Father: You mean you want THE OTHER SPOON?

Child: Yes, I want other one spoon please Daddy.

Father: Can you say "the other spoon"?

Child: Other... one... spoon.

Father: Say... "other".

Child: Other.

Father: "Spoon."

Child: Spoon.

Father: "Other ... spoon."

Child: Other... spoon. Now give me other one spoon?

- Child: A teatop, teatop, teatop, teatop
- Mother: It's a teapot
- Child: Teatop
- Mother: Teapot, not teatop. Teapot
- Child: Sugar (Howe, 1993)

...despite usual sensitivity to correction! Remy: Why not is Mama happy about that? (2;11)

If reinforcement is what's going on, how come it (a) generally doesn't happen and (b) doesn't seem to work?

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The Forbidden Experiment

 Consider situations in which children lack access to some critical piece of information for language learning...

Herodotus (484-425 BCE)

"Now the Egyptians, before the reign of their king Psammetichus, believed themselves to be the most ancient of mankind. Since Psammetichus, however, made an attempt to discover who were actually the primitive race, they have been of opinion that while they surpass all other nations, the Phrygians surpass them in antiquity. This king, finding it impossible to make out by dint of inquiry what men were the most ancient, contrived the following method of discovery:- He took two children of the common sort, and gave them over to a herdsman to bring up at his folds, strictly charging him to let no one utter a word in their presence...

Herodotus (484-425 BCE)

"His object herein was to know, after the indistinct babblings of infancy were over, what word they would first articulate. It happened as he had anticipated. The herdsman obeyed his orders for two years, and at the end of that time, on his one day opening the door of their room and going in, the children both ran up to him with outstretched arms, and distinctly said "Becos." ... He informed his lord, and by his command brought the children into his presence...."

Herodotus (484-425 BCE)

"Psammetichus then himself heard them say the word, upon which he proceeded to make inquiry what people there was who called anything "becos," and hereupon he learnt that "becos" was the Phrygian name for bread. In consideration of this circumstance the Egyptians yielded their claims, and admitted the greater antiquity of the Phrygians."

The Forbidden Experiment

 Consider situations in which children lack access to some critical piece of information for language learning...

Language and the deaf child

- Many deaf children have hearing, non-signing parents
- Oralist tradition
- Goldin-Meadow & colleagues studied 10 children in this situation from ages 1-4
 - Single manual gestures around 12 months
 - Two- and three-word sign sequences at 2 years
 - With syntactic organization!
 - No development of functional morphemes, tense, case, etc.

Language and the blind child

- Lack of access to word *reference*
- How could blind child learn the meanings of *mountain, bird, cloud?*
- Language acquisition by blind children is unexceptional: same timeline, same character
- Even for the verbs *look* and *see*

– "touch the table but don't look at it"

• Landau & Gleitman (1985)

The Forbidden Experiment

- "Isabelle" removed from abusive home at age 6; ageappropriate language by 7
- Helen Keller blind and deaf from age 2, started learning sign language at 7
- "Genie" removed at age 13
 - Acquired some language: "Another house have dog"; "No more take wax"
 - But no progression past telegraphic stage:
 - "Where is may I have a penny?"
 - "I where is graham cracker on top shelf?"
- "Chelsea" rediagnosed at age 31!
 - "Breakfast eating girl"; "Banana the eat"

Children Inventing Language

- Late ASL exposure affects acquisition (Newport 1990)
 - 50-year-olds who started learning from birth, age
 4-6 or after age 12
 - Late learners are inconsistent with syntax
- But their children enrich the language!
 - "Simon" ASL input came from 2 late-learners
 - Simon's own language developed structures not in the input

Pidgins and Creoles

- Pidgin a lingua franca created for communication
 - Shares some features with early child speech
 - Single clauses, few if any function words
- The children of pidgin speakers create creoles
 - Multiclausal sentences
 - Grammaticization
 - Function morphemes

Nicaraguan Sign Language

- Schools opened in the 1970s & 1980s bring together populations of deaf children for the first time
- Transition from a shared pidgin to a much more complex sign language
- Syntactic complexity emerges
- Interesting cognitive effects of learning only the simplified language!

Can training account for language learning?

- No: Evidence for the child's role...
 - Generalizations that couldn't have been learned from direct experience
 - Success across a wide range of inputs (some very impoverished)
- Children go beyond the input, but not all on their own.





Output: what do kids figure out?

- Output ≠ production!
- Even very early on, have abstract notions of syntactic categories
- ...not just the ability to interpret sentences based on current vocabulary, but expectations about new words!
- Preferences for grammatical sentences by ~16 months, although these are driven by function words

• Syntactic priming (3yos):

Hearing "Give the lion the ball!" makes it easier to understand "Show the horse the book!" and harder to understand "Show the horn to the dog" (Thothathiri & Snedecker, 2008)

Some early abstract knowledge

At:	Infants		
10 months	 Are sensitive to the word order of determiners and nouns. 		
	 Detect when function words are replaced by nonsense words. 		
12 months	 Can learn function-content word-like pairings in an artificial grammar. 		
	 Can use frequent frames to group words into categories. 		
14 months	Use determiners to classify nouns (German).		
	 Detect when the locations of function words are interchanged. 		
16 months	• Fail to detect when content words are replaced with nonsense words.		
	• Use determiners as indicators of common versus proper nouns.		
18 months	• Are sensitive to auxiliary/inflection dependencies (English).		
	 Begin to form content word combinations in their own productions. 		
	• Use word order of simple noun-verb-noun sentences to determine agent and patient.		
	• Are sensitive to presence of -s inflection.		
	• Are sensitive to auxiliary-inflection dependencies (German).		
21 months	• Can determine agent or patient in noun-verb-noun sentences with unfamiliar verbs.		
24 months +	 Use verb inflections in their own productions. 		

(Overview reproduced from Soderstrom et al., 2007)

Gertner, Fisher, & Eisengart (2006)



"The duck is gorping the bunny!"

21-month-olds identify abstract participant roles (agent/patient)...

and use word order to interpret a novel transitive verb

...Even before they know what a word MEANS!



Transitive dialogue A: Guess what? Jane blicked the baby! B: Hmm. She blicked the baby? A: And Bill was blicking the duck. B: Yeah, he was blicking the duck.

Intransitive dialogue A: Guess what? Jane blicked! B: Hmm. She blicked? A: And Bill was blicking . B: Yeah, he was blicking.

28-month-olds succeed!

Two-participant test event







Experimental condition: Where's blicking? Control condition: What's going on?



Not just transitive/intransitive...



Contact-activity test event

Causal dialogue

A: Matt dacked the pillow.

B: Really? He dacked the pillow?

A: Yeah. The pillow dacked.

B: Right. It dacked.

Unspecified-object dialogue A: Matt dacked the pillow. B: Really? He dacked the pillow? A: Yeah. He dacked. B: Right. He dacked.

Causal test event





Same-verb: "The girl is dacking the boy. Find dacking." Different-verb: "The girl is pimming the boy. Find pimming."



Last time....

Output: 3 Input: Abstract Learning Adult speech, syntactic mechanism: interaction; categories, **Constructive**, motherese productive goes beyond helpful but not grammatical the input critical rules

SYLVESTER MCMONKEY MCBEAN'S STAR-BELLY SNEETCH MACHENE

Dr. Seuss



Clearly children learn language from their parents...

"There is a massive correlation between being born in England and coming to speak English and being born in France and speaking French." (Gleitman & Newport 1995)

...but this learning MUST be constrained.

The induction problem

- Children need to (and as we've seen, they do!) generalize from the input.
- But which generalizations? An analog of the "gavagai" problem:

My cat <u>is</u> fuzzy.

<u>Is</u> my cat fuzzy?

The induction problem

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- But which generalizations? An analog of the "gavagai" problem:

My cat <u>is</u> fuzzy. <u>Is</u> my cat fuzzy?

• Take some more complex sentences...

Buttons <u>is</u> a cat who <u>is</u> fuzzy. Buttons ,who <u>is</u> a cat, <u>is</u> fuzzy.

	Move first "is"	Move second "is"	Move "is" from main clause
Buttons <u>is</u> a	<u>Is</u> Buttons a	*Is Buttons	<u>Is</u> Buttons a cat who <u>is</u> fuzzy?
cat who <u>is</u>	cat who <u>is</u>	is a cat who	
fuzzy.	fuzzy?	fuzzy?	
Buttons ,	* <u>Is</u> Buttons,	<u>Is</u> Buttons,	<u>Is</u> Buttons,
who <u>is</u> a cat,	who a cat, <u>is</u>	who <u>is</u> a cat,	who <u>is</u> a cat,
<u>is</u> fuzzy.	fuzzy?	fuzzy?	fuzzy?

Language is structure-dependent

- The only rule that works for both sentences refers to the <u>structure</u> of the sentence, not the order of words
 - Requires a representation of something like 'clause' and 'main clause'
 - Input for this kind of question is rare at best
- And all rules of language operate in this way
- Where does the structure bias come from?

- INNATE **EARLY-ABSTRACTING Bayesian inference Universal grammar** (Chomsky) and approaches to "Poverty of the grammar stimulus" argument **Bootstrapping** approaches for categorizing words. DOMAIN-DOMAIN-**SPECIFIC GENERAL** LATE-ABSTRACTING Verb island hypothesis, itembased learning (Tomasello)
 - Distributional approaches

Chomsky: Poverty of the stimulus

- 1. There are patterns in language that can't be learned just from positive evidence.
- 2. Children only GET positive evidence.
- 3. But they all learn these patterns.
- ...Hence, they must be using additional innate knowledge about language.
- Universal grammar: an innate, language-specific set of cognitive structures that limits the possible languages a child can learn

Chomsky: Poverty of the stimulus

- 1. There are patterns in language that can't be learned just from positive evidence.
 - But some successes of statistical approaches
- 2. Children only GET positive evidence
 - Remy: Was the one [which] near my house was blinking?
 - Me: Probably, but you should say "Was the one [which was] near my house blinking?"
 - Disagreement about WHAT would be count as negative evidence and what would be "enough"
 - Failures of expectation and implicit negative evidence
- 3. But they all learn these patterns.
 - Children don't appear to consider the linear hypothesis... but we may not all learn exactly the same grammar, and maybe not right away.

Principles and Parameters



So what drives language acquisition?

Universal grammar (the principles) are **genetically determined.**

- Experience/exposure
 - Triggers correct settings of the parameters
- Maturation
 - ...A-chain movement is like permanent teeth coming in innate but late
- Evidence interpreted in adult-like terms!

How do children avoid overgeneralization without negative feedback?
But how do children categorize words?

Even if we innately expect language to have rules based on abstract parts of speech, we have to figure out which words are nouns, verbs, prepositions, etc.



 $S \rightarrow VP NP_{SUBJ}$ $NP \rightarrow N (det)$ $VP \rightarrow NP_{OBJ} V$ the: N boy: V threw: N rocks: det

(Pinker 1984)

But how do children categorize words?

Some proposals for linking universal grammar to input...

- Semantic bootstrapping/innate linking rules (Pinker, Grimshaw, Macnamara):
 - Make use of connections between semantic (e.g. object, action) and syntactic categories (e.g. noun, verb)

Grammatical element

Syntactic Categories

Noun Verb Adjective	Name of person or thing Action or change of state Attribute
Preposition	Spatial relation, path, or direc- tion
Sentence	Main proposition
	GRAMMATICAL FUNCTIONS ¹³
Subject	Agent of action; cause of causal event; subject of an attribution of location, state, or circum- stance; argument with "auton- omous reference"
Object and Object2	Patient or theme
Oblique	Source, goal, location, instru- ment
Complement	Proposition serving as an argu- ment within another proposi-
	tion (Pinker 1984

But how do children categorize words?

Some proposals...

- Fisher et al. (2010)—Verb learning by structure mapping:
 - Bias to expect the number of NOUNS in a sentence to equal the number of PARTICIPANT ROLES in its meaning
 - Not unique to verbs (learning transitive/intransitive): any predicate
 - I'm happy for you
 - It's under the table
 - Two-year-olds also use the number of nouns to learn new prepositions!
 - Appears to be unlearned: present in homesign, children speaking languages that have a much less reliable correspondence

This is a corp!





This is a corp! What else is a corp?

This is acorp my box!





This is acorp my box! What else is acorp my box?

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 - I'm <u>happy</u> for you
 - It's <u>under</u> the table
 - Two-year-olds also use the number of nouns to learn new prepositions!
 - Appears to be unlearned(!):
 - present in homesign
 - Present in children speaking languages that have a much less reliable correspondence between # nouns and # participant-roles

Theory space

 Bayesian inference approaches to grammar

INNATE

EARLY-ABSTRACTING

 Universal grammar (Chomsky) and "Poverty of the stimulus" argument



ŠPECIFIC

Bootstrapping approaches for categorizing words... DOMAIN-

DOMAIN-GENERAL



LATE-ABSTRACTING

- Verb island hypothesis, itembased learning (Tomasello)
- Distributional approaches

LEARNED

A domain-general possibility

- Language is an induction problem: it may be strictly "unlearnable," but could a rational learner make good guesses from the input?
- Maybe what we have is "poverty of the imagination"

An early attempt: Bayesian inference of grammar



Perfors, Tenenbaum, & Regier (2006)

Perfors, Tenenbaum, & Regier (2006)

- Instead of learning how one rule words (e.g. is-movement)
- Learn how the whole grammar works...



Perfors, Tenenbaum, & Regier (2006)

- Used corpus of sentences spoken by adults to children
- About 2300 unique sentence types
- Broke down into 6 levels based on frequency of sentence type

Three types of hypotheses:

- "Flat" grammar: all sentence types listed
- Regular grammar: rules for adding to the start of a sentence
- Context-free grammar

Context-free grammar		
$\rm NP \rightarrow \rm NP \ PP \mid \rm NP \ CP \mid \rm NP \ C \mid \rm N \mid \rm det \ \rm N \mid \rm adj \ \rm N$		
pro prop		
$N \rightarrow n \mid adj N$		
Regular grammar		
$NP \rightarrow pro \mid prop \mid n \mid det N \mid adj N$		
pro PP prop PP n PP det N_{PP} adj N_{PP}		
pro CP prop CP n CP det N_{CP} adj N_{CP}		
pro C prop C n C det N_C adj N_C		
$N \rightarrow n \mid adj N$ $N_{PP} \rightarrow n PP \mid adj N_{PP}$		
$N_{CP} \rightarrow n \ CP \mid adj \ N_{CP}$ $N_C \rightarrow n \ C \mid adj \ N_C$		

Table 1: Sample NP productions from two grammar types.

Perfors et al. discussion

Goal: Maximize P(Grammar | Corpus)

Results:

- a context-free grammar becomes the "simplest option" at stage 3
- CFGs also generalize better to additional input
- Maybe we don't have enough information to learn specific grammatical rules, but we could learn them as part of a bigger structure.
- The frequency of examples like "Is the dog which is in the corner hungry?" is irrelevant!

Some caveats:

- Computational-level approach: explains why the context-free grammar might be chosen, but not how.
- Agnostic about innateness

Theory space

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ŠPECIFIC

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LATE-ABSTRACTING

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LEARNED

How could we learn grammar without having syntactic categories first?

- Tomasello: Language learning depends on general cognitive mechanisms, and social abilities
- Adult language is too complex to be learned, right away – so children must be learning something else
- "Poverty of the child grammar"

Back to the two-word stage...

- Remember the two-word stage: children don't make word order errors
 - Two-word utterances as 'samples' from longer sentences
- Do young children organize their language in terms of categories of nouns, verbs, abstract syntactic relationships?

Maybe not...

- A diary study Tomasello (1990) recorded his daughter's early language (<2 yo): her language was 'grammatical' but item-based
 - Draw _____for ___; Draw ___ on ___; Draw on ____
 - Cut___
 - No transfer of structure: categories are "draw-er," "thing drawn on," "thing drawn with" rather than subject, object, instrument.
- Pine & Lieven (1997): 2-3 year olds start using "a" and "the" with distinct sets of nouns
- Young children in production studies tend to resist generalization (Toy blicked -> I blicked the toy)
- Remy says:
 - <u>I suspect</u> I wanted to wake up... <u>I bet</u> I want to look at some boats.
 - <u>It seems to me</u> I would like a strawberry.
 - No is not a good word. You don't want to is not a good word.

The Verb Island Hypothesis

- Early in development children use verbspecific representations to form sentences (kicker KICKS kick-ee)
- Gradually, representations merge and become abstract or general over different verbs (NP V NP)
- Classic overgeneralizations (*Don't giggle me!*) appear after this takes place, age 3 yo and later

Problems with the Verb Island Hypothesis

- Early syntactic awareness
 - Remember Gentner et al paper: even when children can't say these sentences, they still *interpret* them correctly
 - Children have at least broad syntax/semantics expectations by 18 months!
 - Gap between receptive and productive language: sensitivity to exactly the function words they skip
- Resisting production might be rational
- But the idea of usage-based grammar is important.

Other late-abstracting approaches

Distributional information: contexts where we find a particular word

 Maratsos & Chalkely, 1980: Classic distributional theory

- Learning e.g. gender classes from repeated frames

• Redington et al., 1988: clustering based on bigrams is surprisingly informative...

The cow jumped over the moon.

Redington et al. 1998







Remy says: statistical information is at least **part** of the story...

- Me: No, I'm taking my shower alone today.
- Remy: It's MY shower-alone-today!
- Me: What type of animal is a spider?
- Remy: A spider is a tiny spider. Down came the rain and washed the spider out!
- Ear... earwax... candlewax... candles... HAPPY BIRTHDAY!
- Take me out to the ball game, take me out to the crowd... Buy me some peanuts and crackerjacks, I don't care if I never get back for it's root, root root for the home team, if they don't win it's a shame... for it's one, two, three, four, five, six, seven...

Conclusions

- Language is complex, richly structured, and LEARNABLE
- Children construct language from the input – and sometime surpass it
- Language is an induction problem language learning must be constrained
 - Domain-general or domain-specific?
 - Initial representations?
 - What hypotheses will the child consider?

"So they clambered inside. Then the big machine roared And it klonked. And it bonked. And it jerked. And it berked And it bopped them about. But the thing really worked!"

In the case of language, though, the stars DO (may) matter...



New IAP class: Baby webcam!

9.S93 Baby webcam: Adapting development research methods for online testing

Laura Schulz, Kim Scott

MWF 10-11:30am first two weeks of IAP, then projects

U 3 units Graded P/D/F (OR not for credit! OR treat it as a UROP!)

Why put experiments on the Internet?

- More representative sampling
- Reduce (time) cost to researchers and families
- Improve retention in longitudinal studies
- Observe more natural behavior (e.g. toddler language)
- Access relatively rare populations (e.g. developmental disorders, genetic markers, specific family structures)
- Accountability and replication

New IAP class: Baby webcam!

9.S93 Baby webcam: Adapting development research methods for online testing

- Project-based course: each student will transform a protocol for a developmental into an experiment families can take part in over the Internet.
- Week 1: Practical view of developmental methods
 - Conditioning
 - Looking time
 - Habituation
 - Reaction time
 - Longitudinal studies
 - Counterbalancing
 - Recruitment
 - Communicating research to parents
 - What are kids at various ages LIKE?
- Week 2: Intro to baby webcam & matching students to projects
 - Workshop introduction to Javascript accessible to novice programmers

Spring term project class!

Special Topics, 9.52: Project-based seminar in Infant and Early Childhood Cognition Prereq: 9.85 and permission of the instructor (enrollment limited!) 3-0-9

Instructor: Laura Schulz

Actually run your experiment in a developmental lab course!

- First three weeks: students will narrow their empirical proposal to a single testable experiment. They will get IRB approval to run the study and get a training, orientation, and background checks to permit testing at our off-site laboratories at the Boston Children's Museum or at a local area preschool.
- Students will then enroll participants, and conduct and videotape the studies, sharing the raw data in class and troubleshooting any issues in their empirical design. We will discuss statistical analyses appropriate to each students' design and students will present preliminary results in a lab meeting.
- The final project for each class will be a 15 minute talk at the Cognitive Area Lunch the last Tuesday of the semester. Course work will consist of three hours a week of one-on-one mentorship and class discussion of individual student projects and nine hours a week out of class collecting and analyzing data and writing up the findings.
- As appropriate, students will be encouraged to complete journal papers and/or conference submissions for peer review.
- For all practical purposes, you'll be treated like graduate students for the duration of the course. You will collect data and meet with me weekly. You are welcome to attend weekly lab meetings with the graduate students and postdocs as well.

If you're interested:

- Submit **either** your final class paper in 9.85 (if it meets the requirements below) **or** a one-page proposal consisting of a few sentence description of a research question followed by a brief sketch of a possible experimental design.
- Students will only be admitted to the course if the key predictions of their proposal could be tested empirically within a single semester (< 50 participants, accessible methods). Talk to Laura or the TAs if you're not sure about your proposal!
- Because background checks are necessary, you must submit a copy of a valid ID (driver's license or equivalent) to the ECCL lab manager (Rachel Magid) as part of indicating interest in the class.
- You must be able to schedule some testing time during morning hours (9 AM – 1PM) for children 10 months-5 years or after school hours (4 PM – 7 PM) for school-age children. Weekend slots may be valuable as well.