

Ling 51/Psych 56L: Acquisition of Language

Lecture 2

Children's input &
Research methods

Announcements

Be working on review questions for intro material

Be working on HW1 (due 10/6/17 at 2:50pm, submitted through Canvas EEE)

Last time: How do children acquire the rules of their language?

We know they do it relatively quickly.

speech segmentation

phonology

syntactic categorization

syntax

syntax, semantics

pragmatics

Much of the linguistic system is already known by **age 4**.



Interesting: They do this **mostly without explicit instruction**.

What about learning by explicit correction?

Even if the knowledge is subconscious, couldn't parents teach children these rules of language by explicitly correcting them when they say something wrong?

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The problem: parents don't correct their children that often about the **form of the language**. Instead, they tend to correct when the **meaning is incorrect**.

Child: "Her curl my hair."

Parent: "Uh huh."

Child: "There's an animal farmhouse."

Parent: "No, that's a lighthouse."

Explicit correction problems

<https://www.youtube.com/watch?v=a7Un06tDOn0&feature=youtu.be>

1:33-4:33



What about learning by implicit correction?

Parents may provide implicit correction by offering alternative language forms when a child has said something incorrect. In effect, **the parents provide a good example of language use for children without explicitly correcting them.** This is called a **recast**.

Child: The dog **runned** really fast, Daddy.

Parent: Yeah, he **ran** really fast, didn't he?

Recasts?

<https://www.youtube.com/watch?v=a7Un06tDOn0&feature=youtu.be>

4:33-5:31



What about learning by implicit correction?

However, parents don't provide recasts all the time or all that consistently. One study looking at interactions between 2-year-olds and their mothers showed that they **only made recasts after 26.3% of incorrect sentences**. The rest of the time, they didn't bother.

Also, sometimes parents will **repeat children's incorrect utterances** if they agree with the meaning of them! This would seem to reinforce the incorrect language usage.

Child: Read book.

Mother: Alright, you **read book**.

(instead of *read the book*)

What about learning by implicit correction?

Still, recasts can be very helpful when they offer a direct and immediate contrast between the child's way of saying something and the correct way. Saxton et al. (1998) found that children learned more quickly when they were given recasts.

Taumoepeau 2016: The percentage of utterances caretakers expanded (and recast) when their children were between the ages of 24 and 33 months had a strong impact on children's vocabulary development.

Recasts may help speed up learning, but probably aren't responsible for learning all knowledge about language.

The nature of the input



About the input

"**Motherese** has interpretable melodies: a rise-and-fall contour for approving, a set of sharp, staccato bursts for prohibiting, a rise pattern for directing attention, and smooth, low legato murmurs for comforting." – Pinker, *The Language Instinct*



About the input

Properties of *motherese* (speech adults use with children):

(1) prosodic features are exaggerated, and pauses tend to occur at phrase boundaries (helping to identify how words cluster together into larger units like phrases)

“The brave older *sister* (pause) went to *rescue* (pause) her *little baby brother* Toby.”

“The brave older sister” = noun phrase

“her little baby brother Toby” = noun phrase

Noun phrase indicator: Can replace with pronoun

“The brave older sister” = *she*

“her little baby brother Toby” = *him*

What about “fatherese”?

VanDam, DePalma, & Strong (2015):

Fatherese may serve as a bridge intonation-wise

“...the mothers used higher pitch and varied their pitch more when interacting with their child than with adults. The fathers, on the other hand, did not show the same pattern, and instead talked to their children **using intonation patterns more like when they talked to other adults**...The data support what VanDam refers to as the bridge hypothesis -- that fathers, by speaking to their children more like adults, **might act as a link to the outside world by helping them to deal with unfamiliar speech.**”



<http://www.sciencedaily.com/releases/2015/05/150519083257.htm>

About the input

Properties of **motherese** (speech adults use with children):

(2) topics are about the **here and now** (easier to link words to meanings) (Hills 2013)

Note: There is considerable individual variation in how well and how much caretakers do this, but children of caretakers who do this more learn vocabulary faster (Cartmill et al. 2013).

When talking about objects, English adults tend to **say the name of the object last** (“*this is the [object]*”) and **precede it with a small set of reliable cues** (ex: *the, a*) (Yurovsky et al. 2013).

About the input

Properties of **motherese** (speech adults use with children):

(3) **very few grammatical errors** (good example of correct grammar usage)

(4) adults tend to **use gestures to secure children's attention** (easier to link words to meanings) — in general, engaging children socially is very important for the input to have an impact



About the input

More on **securing children's attention**

“Screen time” interactions



About the input

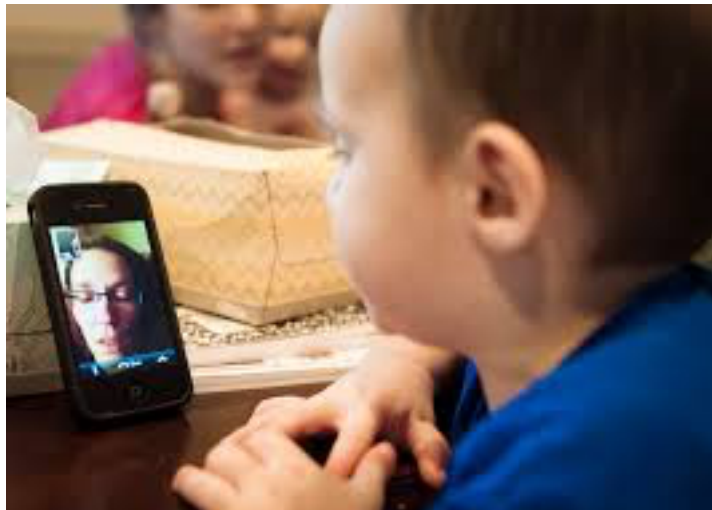
More on **securing children's attention**



“Screen time” interactions



[https://www.sciencedaily.com/releases/
2016/07/160715115023.htm](https://www.sciencedaily.com/releases/2016/07/160715115023.htm)



“...children paid attention and responded to their on-screen partners, but **only children who experienced interactive video chat** responded in sync with the partner, such as clapping to imitate after the partner had clapped.”

About the input

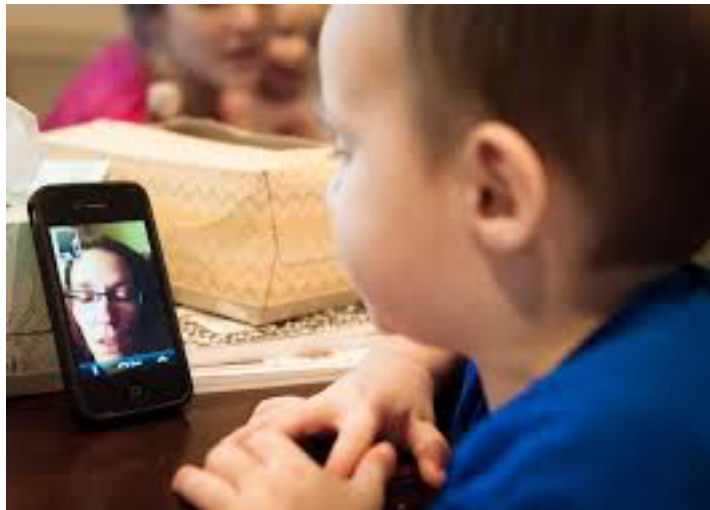
More on **securing children's attention**



“Screen time” interactions



[https://www.sciencedaily.com/releases/
2016/07/160715115023.htm](https://www.sciencedaily.com/releases/2016/07/160715115023.htm)



“...learning new words and patterns... occurred from video chat only when children talked to an on-screen ‘partner’ **who responded to them in real time.**”

About the input

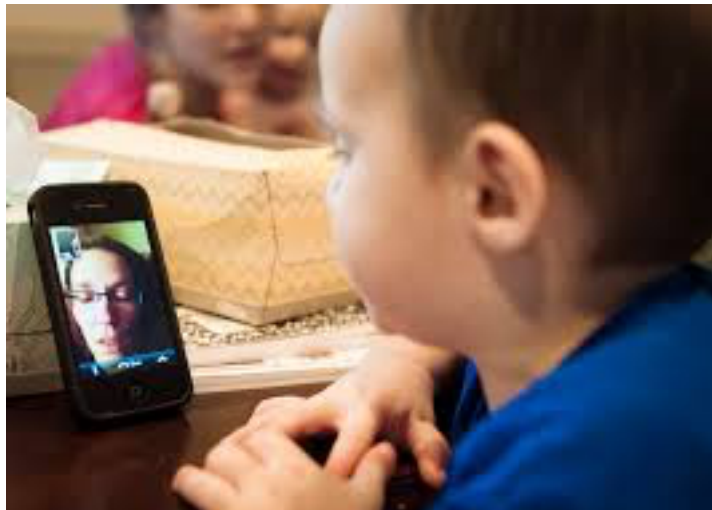
More on **securing children's attention**



“Screen time” interactions



<https://www.sciencedaily.com/releases/2016/07/160715115023.htm>



“....starting at about **17 months**, children begin to get something out of live video interaction with real people”

- Lauren J. Myers

Lauren J. Myers, Rachel B. LeWitt, Renee E. Gallo, Nicole M. Maselli. 2016. **Baby FaceTime: can toddlers learn from online video chat?** *Developmental Science*.

About the input

Properties of **motherese** (speech adults use with children):

(5) **speech is repetitious** (easier to remember when you have a short attention span) (Hills 2013)

(6) **adults will often expand children's utterances** (learning how to convey the meaning they want by example)

“Milk.” “**You want some milk?**”



About the input

Properties of **motherese** (speech adults use with children):

(7) **child-directed speech is tuned to the level of linguistic complexity the child can handle** until around age five (Yurovsky, Doyle, & Frank 2016) — it's easiest to absorb information if it's neither too simple or too complex



The importance of speech directed at children

Vouloumanos & Waxman (2014):

Child-directed speech scaffolds lots of knowledge

Vouloumanos: “...listening to speech promotes the babies' acquisition of the fundamental cognitive and social psychological capacities that form the foundation for subsequent learning.”

What kinds of things?

“...noticing patterns or regularities among the sounds or objects that surround them, recognizing partners with whom they can communicate, and establishing coherent categories of objects and events...”



<http://www.sciencedaily.com/releases/2015/01/150105141707.htm>

Helpful motherese

Motherese can help jumpstart the language parts of the brain:

Just 24 hours after birth, the sound of a mother's voice specifically activates the language processing and motor circuits of the brain (more so even than another female voice).

(Beauchemin et al. 2010)



Helpful motherese

Children who attend day care centers with more one-on-one contact with an adult acquire language more rapidly than children who get less one-on-one adult contact (Hoff 2006).

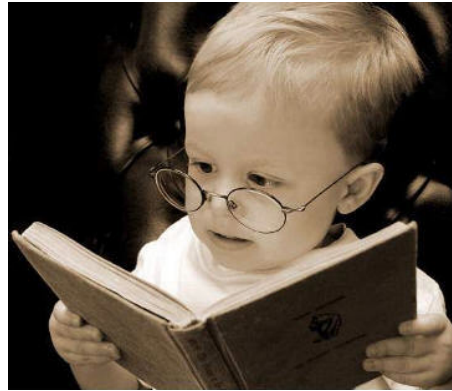
Older children (who receive all of their parents' child-directed speech) generally develop language earlier than later-born children (who have to share it with their siblings) (Hoff-Ginsberg 1998).

Helpful motherese

21-month-olds learn new words better from child-directed speech, as compared to adult-directed speech (Ma et al. 2011).

There's something special about words specifically directed at children, compared to words children simply overhear – **words that are simply overheard have very little impact** on vocabulary acquisition (Schneidman et al. 2013)...at least until children are preschool age (Foushee & Xu 2016). This may have to do with the relative complexity — **overheard speech is more complex than child-directed speech** until children are 30 months old (Foushee, Griffiths, & Srinivasan 2016).

Research methods



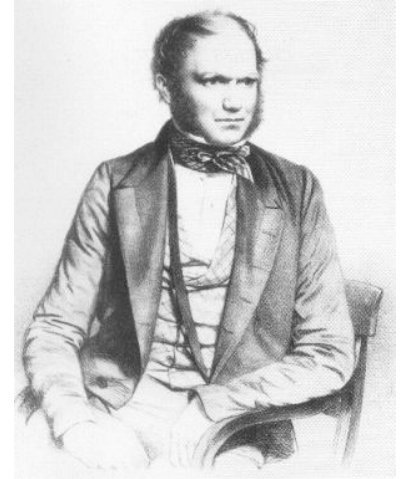
Research methods

Important: do cross-linguistic and cross-cultural research. Even if language is universal, there are individual differences in language development and there may be more than one route to acquisition success. Also, there may be influence from different cultures on the language learning environment for children.



Research methods

Diary studies: keeping diaries of children's development. Charles Darwin did this with his son (Darwin 1877), who seemed to follow the progression we now expect.



Other diary studies: Clara & Wilhelm Stern's 1907 *Die Kindersprache* and Werner Leopold's (1939-1949) four volume account of his daughter's acquisition of English & German.

Modern diary studies: Braunwald 1976; Bowerman 1985, 1990; Dromi 1987; A. Gopnik & Meltzoff 1987; L. Bloom, 1993; Naigles, Vear, & Hoff 2002

A very modern diary study

http://www.ted.com/talks/deb_roy_the_birth_of_a_word.html

Beginning through about 4:15 (full video is about 17 minutes total)



Research methods

CHILDES



Child Language Data Exchange
System

<http://chilDES.talkbank.org>

Video/audio recordings of spontaneous speech samples, along with transcriptions and some structural annotation. Extremely valuable resource to the language acquisition community.



```
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@Media: all2, video
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*MOT: you haven't seen this . >
%mor: pro|you aux|have~neg|not part|see&PASTP pro:dem|this .
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```

Research methods

CHILDES



Child Language Data Exchange
System

<http://chilDES.talkbank.org>

Difficulty: Have to transcribe recorded speech. May take between 5 and 20 hours to faithfully transcribe 1 hour of child speech.

Why?

Conversational speech does not often use complete sentences.

Child pronunciation is often not adult-like - and the non-adult-like parts are usually what researchers are interested in.

<http://chilDES.talkbank.org/browser/index.php?url=Eng-NA/Braunwald/1-05-09.cha>

Research methods

CHILDES



Child Language Data Exchange
System

<http://childes.talkbank.org>

Example from the Braunwald corpus

[http://childes.talkbank.org/
browser/index.php?url=Eng-NA/
Braunwald/1-05-09.cha](http://childes.talkbank.org/browser/index.php?url=Eng-NA/Braunwald/1-05-09.cha)

```
62      *CHI: no . [+ SR]
63      %mor:  co|no .
64      %gra:  1|0|INCRROOT 2|1|PUNCT
65      *CHI: <get down> [?] .
66      %mor:  v|get adv|down .
67      %gra:  1|0|ROOT 2|1|JCT 3|1|PUNCT
68      *MOT:  what do you want to do , Laura ?
69      %mor:  pro:int|what mod|do pro:per|you v|want in
70           n:prop|Laura ?
71      %gra:  1|4|LINK 2|4|AUX 3|4|SUBJ 4|0|ROOT 5|6|IN
72           9|4|PUNCT
73      *MOT:  you wanna [: want to] go night_night ?
```

Research methods

CHILDES



Child Language Data Exchange
System

<http://chilDES.talkbank.org>

“In terms of its impact on the field of language development, **CHILDES is a game-changer**. It allows researchers with limited resources to test hypotheses using an extremely rich data set. It allows for comparison across many different languages, which makes it possible to look for universal cross-linguistic patterns in language development....because the transcripts also include language by the adults that the children are interacting with, it also allows researchers to test detailed quantitative predictions about the relationships between a child’s input and her language production.” — Sedivy 2014, p.224

Research methods

CHILDES



Child Language Data Exchange
System

<http://chilDES.talkbank.org>

Used to find out the nature of language children produce. Ideally, sample is representative of everything child says - but hard to do in practice. (Deb Roy's work is a notable exception.)

Because of this, it is hard to make claims that children don't use/know a particular structure based on its absence in spontaneous speech samples. It could be that they simply didn't say that structure when they were being recorded.

Research methods

Getting standardized assessments of children's performance

Use coding systems like **Mean Length of Utterance (MLU)**, which correlates with measures of children's grammatical and phonological development. This is done by tracking the average number of meaning-bearing units (morphemes) in the **child's speech**.

Ex: "He likes me" = 4 morphemes ("he", "like", "-s", "me")

Use estimates that caregivers provide of children's performance, such as the **MacArthur-Bates Communicative Development Inventories (CDIs)**: 8-16 months, 16-30 months, 30-36 months. These include checklists of words, gestures, and word combinations **children produce or comprehend**.

Research methods

Some ways to assess children's **comprehension** abilities:

(1) Use examiner-administered tests like the **Peabody Picture Vocabulary Test**, where the child points at a picture matching the word(s).

(2) **Act-out tasks**: The child is given toys and a linguistic description, and must make the toys act out the appropriate scenario.

“The wolf is happy to bite the lion.”



<https://www.youtube.com/watch?v=UY04SEjZJSw&list=PL95604CD0326F659A&index=2>

Research methods

Some ways to assess children's **comprehension** abilities:

(3) **Pointing tasks**: The child points at the picture that matches the linguistic description (words or sentences).

(4) **Grammaticality judgment tasks**: Child indicates whether spoken utterance sounds “okay” or “silly”.

Grammaticality: Is this a silly thing to say?



Every penguin ate two fish. 

Every penguin went two fish. 

Research methods

Some ways to assess children's **production** abilities:

(1) **elicited production**:

“What’s Ernie doing?” “What happened to the ball?”

(2) **repetition/imitation elicitation**:

“Say this: ‘After she ate the peach, Sarah fell asleep.’”

(3) **syntactic priming**: Modeling a syntactic construction with one utterance, and having the child produce a novel utterance that uses that same construction

Passive example:

“...the ball is being bounced by Ernie...Oh look! What’s happening to that peach?”

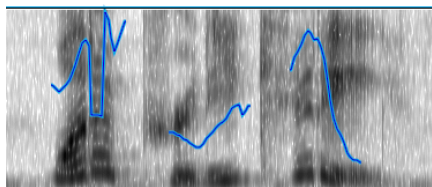
(Intended response: “The peach is being eaten by Sarah.”)

Research methods

Computational modeling (Digital children)

Create a computer program that implements some learning theory's ideas about how acquisition works (ex: what learning strategies children might use), and therefore test that theory empirically.

Ex: Learning to segment units in fluent speech (speech segmentation):
Swingley 2005, Gambell & Yang 2006, Pearl, Goldwater, & Steyvers 2011,
Phillips & Pearl 2012, 2014a, 2014b, 2015, Pearl & Phillips in press



= wʌɹəpɹɪkɪɹɪ

wʌɹ ə pɹɪ kɪɹɪ

speech segmentation

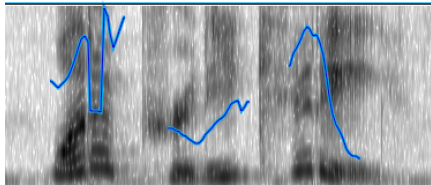
what a pretty kitty!



Research methods

Computational modeling (Digital children)

An example with speech segmentation



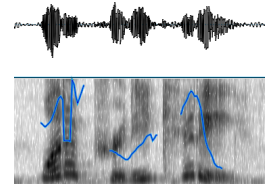
= wʌtəpɹɪkɪtɪ

wʌt ə pɹɪtɪ kɪtɪ

speech segmentation

what a pretty kitty!





what a pretty kitty!

(1) Decide what kind of learner the model represents

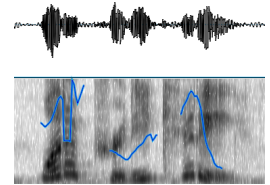
For the first stages of speech segmentation:

Typically developing 6- to 8-month-old child learning first language



speech segmentation

Research methods



what a pretty kitty!

(2) Decide what data the child learns from (input)

Example empirical data: CHILDES database

<http://childes.talkbank.org>

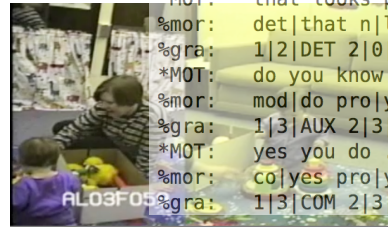
CHILDES Child Language Data Exchange System

Video/audio recordings of speech samples, along with transcriptions and some structural annotations.

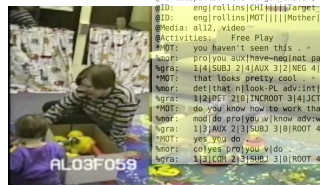
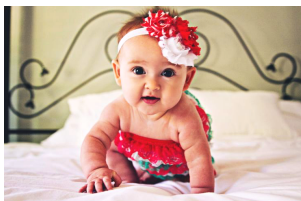
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@Begin
@Languages: eng
@Participants: CHI Target_Child , MOT Mother
@ID: eng|rollins|CHI|||||Target_Child|||
@ID: eng|rollins|MOT|||||Mother|||
@Media: al12, video
@Activities: Free Play
*MOT: you haven't seen this . >
%mor: pro|you aux|have-neg|not part|see&PASTP pro:dem|this .
%gra: 1|4|SUBJ 2|4|AUX 3|2|NEG 4|0|ROOT 5|4|OBJ 6|4|PUNCT
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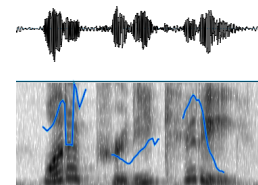
```



speech segmentation



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@Participants: CHI Target Child , MOT Mother
@ID: engrollins[MOT]|||Mother|||
@Media: a112, video
@Activities: Free Play
*MOT: you haven't seen this . -
@Tags: *FO you AUX[have-mo]INDL part[see6PASTP pro:den]this .
@Tags: 1[6]SUBJ 2[4]AUX 3[2]NEG 4[0]ROOT 5[4]OBJ 6[4]PUNCT
*MOT: that looks pretty cool .
@Tags: det[the:n]book-PL adv[is]pretty adj[cool]
@Tags: 1[0]DET 2[0]INCRROOT 3[4]CCT 4[2]XMOD 5[2]PUNCT
*MOT: do you know how to work that .
@Tags: not do pro[you] w[how] adv[re]how inf[to v]work pro:den[that]
@Tags: 1[3]AUX 2[3]SUBJ 3[0]ROOT 4[3]OBJ 5[6]INF 6[4]XCOMP 7[6]OBJ 8[3]PUNCT
*MOT: yes you do
@Tags: col[yes]pro[you] v[do]
@Tags: 1[2]COL 2[3]PRP 3[0]ROOT 4[3]PUNCT
```



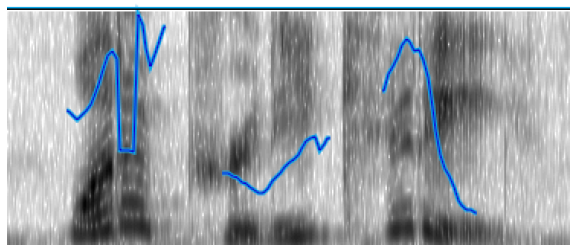
what a pretty kitty!

(3) Decide how the child perceives the data,
and which data are relevant (intake)



syllables with stress

= w¹Λ rə pɪ¹i ri k¹i ri



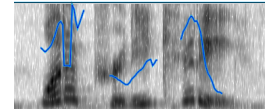
Many models will try to make **cognitively plausible** assumptions about how the child is representing and processing input data

speech segmentation



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*CHI: ʔʔo you ɹɔkʰɪvə-ɦəj nɔt sɪn pæst pɹɔ:ðɪn [this .
*GRA: 1[4]SUBJ 2[4]AUX 3[2]NEG 4[0]ROOT 5[4]OBJ 6[4]PUNCT
*MOT: that looks pɹɛtʰi kʊl .
*CHI: dɛt lʊk n [look PL adv:ɪn] pɹɛtʰi ɔdʒ [cool .
*GRA: 1[0]DET 2[0]INCRDPT 3[4]CCT 4[2]XMOD 5[2]PUNCT
*MOT: do you know hɔw tʊ wɜ:k θæt .
*CHI: nɔt dʊ pɹɔ:ʒə w lɹɔw əbrəʊn hɔw ɪnf[to V] wɜ:k pɹɔ:ðɪn [that .
*GRA: 1[3]AUX 2[3]SUBJ 3[0]ROOT 4[3]OBJ 5[6]INF 6[4]XCOMP 7[6]OBJ 8[3]PUNCT
*MOT: yes you dʊ .
*CHI: jɛs ʔʔo yʊ w dʊ .
*GRA: 1[2]COJ 2[3]PRK 3[0]ROOT 4[3]PUNCT
```

= w'ʌ rə pɹ'ɪ ri k'ɪ ri



what a pretty kitty!

(4) Decide what **hypotheses** the child has

Example hypotheses: what the words are

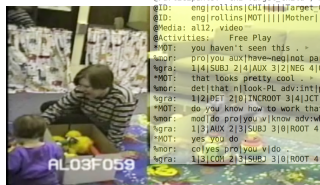
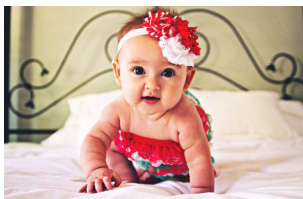
w'ʌrə
pɹ'ɪri
k'ɪri

w'ʌ
rə
pɹ'ɪrik'ɪri

w'ʌrə
pɹ'ɪrik'ɪri

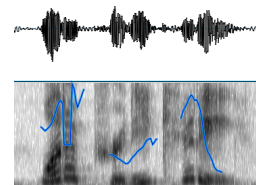
speech segmentation

Research methods



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*MOT: that looks pretty cool .
*GRA: 1[0]DET 2[0]INCRROOT 3[4]ICT 4[2]NMOD 5[2]PUNCT
*MOT: do you know how to work that .
*GRA: 1[3]AUX 2[3]SUBJ 3[0]ROOT 4[3]OBJ 5[6]INF 6[4]XCOMP 7[6]OBJ 8[3]PUNCT
*MOT: yes you do .
*GRA: 1[2]COJ 2[3]PRP 3[0]ROOT 4[3]PUNCT
*MOT: collyers ʔɔʊ ɹɔʊ ɹɔʊ .
*GRA: 1[2]COJ 2[3]PRP 3[0]ROOT 4[3]PUNCT
```

= w'ʌ rə pɪ'ɪ ri k'ɪ ri



what a pretty kitty!

w'ʌ rə pɪ'ɪ ri k'ɪ ri



w'ʌrə
pɪ'ɪri
k'ɪri

w'ʌ
rə
pɪ'ɪrik'ɪri

w'ʌrə
pɪ'ɪrik'ɪri

(6) Decide how belief in different hypotheses is updated

Example: based on **transitional probability** between syllables

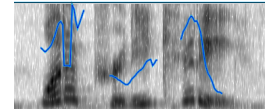
speech segmentation

Research methods

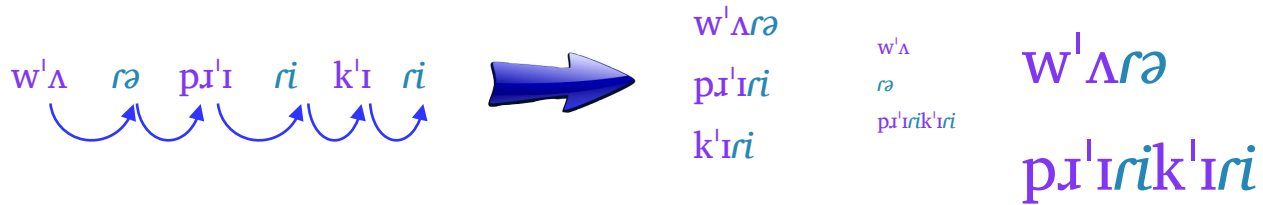


```
@Loc: Eng-NA-MOR/rollins/all2.cha
@PID: 11312/c-00017262-1
@Begin
@Languages: eng
@Participants: CHI Target Child , MOT Mother
@ID: engrollins[MOT|||||Mother|||
@Media: a112, video
@Activities: Free Play
*MOT: you haven't seen this .
*CHI: ʔo you ʔuXʔhəvə-ɦəʔnɪt sɪnθɪsPASTP prɔ:deɪn[θɪs .
*GRA: 1[4]SUBJ 2[4]AUX 3[2]NEG 4[0]ROOT 5[4]OBJ 6[4]PUNCT
*MOT: that looks pretty cool .
*CHI: dɛt lʊkz n[br]kʊk ʔl ədʒɪvɪz[prɛtɪ]dʒi kʊl .
*GRA: 1[0]DET 2[0]INCRDPT 3[4]CCT 4[2]NMDD 5[2]PUNCT
*MOT: do you know how to work that .
*CHI: nɔ: dʊ ɪnəʊ ɦəʊ tʊ wɜ:k θæt .
*GRA: 1[3]AUX 2[3]SUBJ 3[0]ROOT 4[3]OBJ 5[6]INF 6[4]XCOMP 7[6]OBJ 8[3]PUNCT
*MOT: yes you do .
*CHI: jɛs ʔu dʊ .
*GRA: 1[2]COJ 2[3]PRK 3[0]ROOT 4[3]PUNCT
```

= w'ʌ rə ɪrɪ k'ɪ rɪ



what a pretty kitty!



(6) Decide how belief in different hypotheses is updated

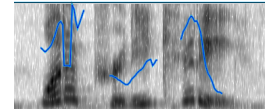
Example: based on **transitional probability** between syllables

speech segmentation



```
@Loc: Eng-NA-MOR/Rollins/all2.cha
@PID: 11312/c-00017262-1
@Begin
@Languages: eng
@Participants: CHI Target Child , MOT Mother
@ID: engrollins[MOT|||||Mother|||
@Media: a112, video
@Activities: Free Play
*MOT: you haven't seen this .
*CHI: ʔʔ you ʌdʌI have-NEG|not|part|see6PASTP pro:den|this .
*GRA: 1[4]SUBJ_2[4]AUX_3[2]NEG_4[0]ROOT_5[4]OBJ_6[4]PUNCT
*MOT: that looks pretty cool .
*CHI: det|the:n|look-PL|adv:in|pretty|adj|cool .
*GRA: 1[0]DET_2[0]INCRDPT_3[4]CCT_4[2]XMOD_5[2]PUNCT
*MOT: do you know how to work that .
*CHI: not|do|pro|be: ʌ|know|adv:how|how|inf|to|v|work|pro:den|that .
*GRA: 1[3]AUX_2[3]SUBJ_3[0]ROOT_4[3]OBJ_5[6]INF_6[4]XCOMP_7[6]OBJ_8[3]PUNCT
*MOT: yes you do .
*CHI: coll:yes|pro|you|do
*GRA: 1[2]COL_2[3]TRK_3[0]ROOT_4[3]PUNCT
```

= w'ʌ rə pɪ'ɪ ri k'ɪ ri



what a pretty kitty!

w'ʌ rə pɪ'ɪ ri k'ɪ ri



w'ʌrə
pɪ'ɪri
k'ɪri

w'ʌ
rə
pɪ'ɪrik'ɪri

w'ʌrə
pɪ'ɪrik'ɪri

(7) Decide what the measure of success is

This can be based on your theory or empirical data about behavior

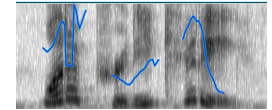
speech segmentation

Research methods



```
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@PID: 11312/c-00017262-1
@Begin
@Languages: eng
@Participants: CHI Target Child , MOT Mother
@ID: engrollins[MOT]###[Target Child]
@SID: engrollins[MOT]###[Mother]
@Media: a112, video
@Activities: Free Play
*MOT: you haven't seen this .
@Lang: p[0] you a[UX]have+em[em]not part[see]PASTP proden[his] .
@Lang: 1[4]SUBJ 2[4]AUX 3[2]NEG 4[0]ROOT 5[4]OBJ 6[4]PUNCT
*MOT: that looks pretty cool .
@Lang: det[the] n[look] PL adv[is] pretty adj[cool]
@Lang: 1[0]DET 2[0]INCRDPT 3[4]CCT 4[2]XMOD 5[2]PUNCT
*MOT: do you know how to work that .
@Lang: not do pro[you] a[ know] adv[how] inf[to] v[work] proden[that] .
@Lang: 1[3]AUX 2[3]SUBJ 3[0]ROOT 4[3]OBJ 5[6]INF 6[4]XCOMP 7[6]OBJ 8[3]PUNCT
*MOT: yes you do .
@Lang: colves: p[0] you a[ do]
@Lang: 1[2]COJ 2[3]PRK 3[0]ROOT 4[3]PUNCT
```

= w¹ʌ rə pɪ¹ɪ ri k¹ɪ ri



what a pretty kitty!

w¹ʌ rə pɪ¹ɪ ri k¹ɪ ri



w¹ʌrə
pɪ¹ɪri
k¹ɪri

w¹ʌ
rə
pɪ¹ɪrik¹ɪri

w¹ʌrə
pɪ¹ɪrik¹ɪri

(7) Decide what the measure of success is

This can be based on your **theory** or empirical data about behavior

Example developing knowledge

Proto-lexicon of word forms

w¹ʌr what

ə a

pɪ¹ɪri pretty

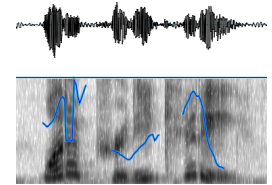
k¹ɪri kitty

speech segmentation

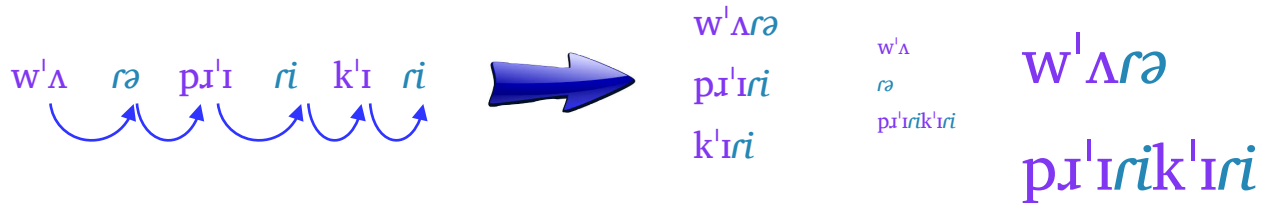


```
@Loc: Eng-NA-MOR/Rollins/all2.cha
@PID: 11312/c-00017262-1
@Begin
@Languages: eng
@Participants: CH1 Target Child , MDT Mother
@ID: engrollins10M####Forget-Child11
@SID: engrollins10M1111Mother111
@Media: a112, video
@Activities: Free Play
*MDT: you haven't seen this .
@tags: p[0] you AUX[have+em] had part[see] PASTP pro:den[this .
@gra: 1[4]SUBJ 2[4]AUX 3[2]NEG 4[0]ROOT 5[4]OBJ 6[4]PUNCT
*MOT: that looks PRETTY cool .
@tags: det[the] n[look-PL] adv[is] pretty adj[cool]
@gra: 1[0]DET 2[0]INCRDPT 3[4]CT 4[2]XMOD 5[2]PUNCT
*MOT: do you know how to work that .
@tags: root[do] pro[you] w[know] adv[how] inf[to] v[work] pro:den[that .
@gra: 1[3]AUX 2[3]SUBJ 3[0]ROOT 4[3]OBJ 5[6]INF 6[4]XCOMP 7[6]OBJ 8[3]PUNCT
*MOT: yes you do .
@tags: coll[yes] pro[you] w[do]
@gra: 1[2]COL 2[3]PRK 3[0]ROOT 4[3]PUNCT
```

= w'ʌ rə pɪ'ɪ ri k'ɪ ri



what a pretty kitty!



(7) Decide what the measure of success is

This can be based on your theory or empirical data about **behavior**

w'ʌr what

ə a

pɪ'ɪri pretty

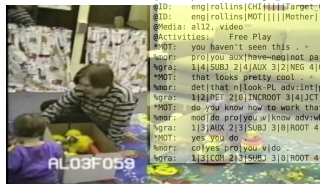
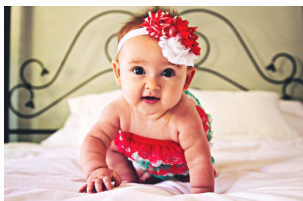
k'ɪri kitty

Example behavior indicating developed knowledge:



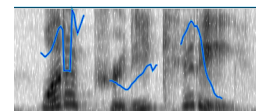
Recognizing useful units (such as words) in a fluent speech stream, as indicated by **looking time behavior**

speech segmentation



```
@Loc: Eng-NA-MOR/Rollins/al12.cha
@PID: 11312/c-00017262-1
@Begin
@Languages: eng
@Participants: CHI Target Child , MOT Mother
@ID: engrollins[MOT|||||TargetChild|||
@ID: engrollins[MOT|||||Mother|||
@Media: a112, video
@Activities: Free Play
*MOT: you haven't seen this .
*CHI: pɹɔ you ʌdʌn hæv-nd[nd] bɹt 1sɪs pʌst pɹɔ den[θɪs] .
*GRA: 1[4]SUBJ 2[4]AUX 3[2]NEG 4[0]ROOT 5[4]OBJ 6[4]PUNCT
*MOT: that looks pretty cool .
*CHI: dɛt lʌk n[ɪ]kʌk pɹɪ preti ʌdʌl kʊl .
*GRA: 1[0]DET 2[0]INCRDPT 3[4]CCT 4[2]NMDD 5[2]PUNCT
*MOT: do you know how to work that .
*CHI: nɔt dʌ pɹɔ bɪ ʌ kɹɔv ʌbrʌw hɔw ɪnf[ɪ]tʌ v[ɜ]k pɹɔ den[θɪt] .
*GRA: 1[3]AUX 2[3]SUBJ 3[0]ROOT 4[3]OBJ 5[6]INF 6[4]XCOMP 7[6]OBJ 8[3]PUNCT
*MOT: yes you do .
*CHI: jɛs jʌ dʌ .
*GRA: 1[2]COJ 2[3]PRP 3[0]ROOT 4[3]PUNCT
```

= w'ʌ rə pɹɪ'ɪ ri k'ɪ ri



what a pretty kitty!

w'ʌ rə pɹɪ'ɪ ri k'ɪ ri



w'ʌrə
pɹɪ'ɪri
k'ɪri

w'ʌ
rə
pɹɪ'ɪrik'ɪri

w'ʌrə
pɹɪ'ɪrik'ɪri

This is the heart of the model

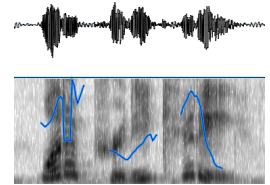
w'ʌr
ə
pɹɪ'ɪri
k'ɪri

what
a
pretty
kitty



speech segmentation

Research methods



= w'ʌ rə pɪ'ɪ ri k'ɪ ri

w'ʌ rə pɪ'ɪ ri k'ɪ ri



(8) Implement the model in a programming language of choice



Data Structure © click2study.net

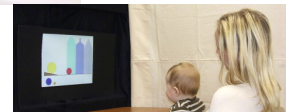
The height of a tree is defined as the number of edges on the longest path in the tree. The function shows us the particular below is invoked on the left (root) to compute the height of a binary tree rooted at the tree pointer root.

```

int height (TreeNode *T)
{ if (T == NULL) return (-1);
  if (T->R == NULL) return (0);
  else return (max ( // Max 1
    1 + height (T->left), // Max 2
    1 + height (T->right) ));
}
    
```

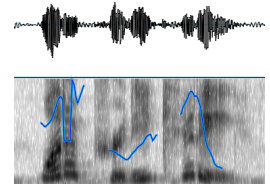
The appropriate responses for the two boxes are: **max** and **max(0, 1)**

Handwritten notes include a tree diagram with 'left' and 'right' labels, and a box containing 'max' and 'right'.



speech segmentation

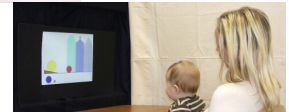
Research methods



= w¹ʌ rə pɪ'ɪ ri k'i ri



(9) See how well the model did w.r.t. the measure of success



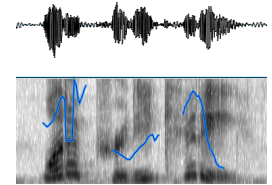
Example developing knowledge

Proto-lexicon of word forms

	w ¹ ʌr	what
	ə	a
???	pɪ'ɪri	pretty
	k'i'ri	kitty

speech segmentation

Research methods



= w'ʌ rə pɪ'ɪ ri k'ɪ ri

w'ʌ rə pɪ'ɪ ri k'ɪ ri



(9) See how well the model did w.r.t. the measure of success

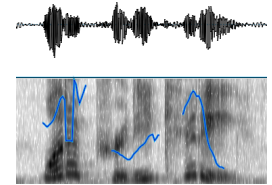
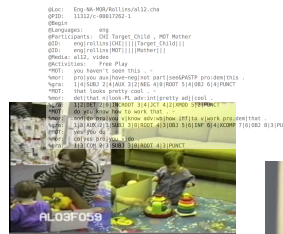
Recognizing useful units (such as words) in a fluent speech stream, as indicated by **looking time behavior**

???



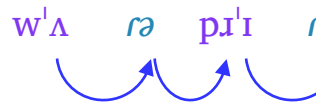
speech segmentation

Research methods



= w'ʌ rə pɪ'ɪ ri k'ɪ ri

???



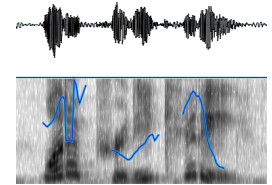
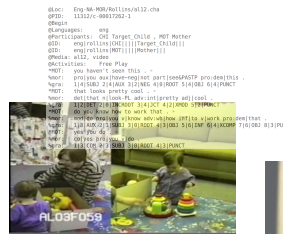
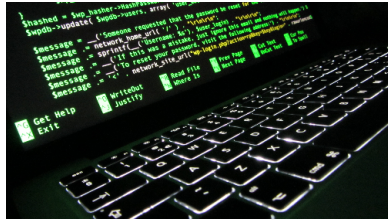
(9) See how well the model did w.r.t. the measure of success

From this, we can determine how well the model did — and more importantly, how well the strategy implemented concretely in the model did.



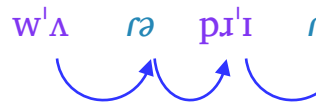
speech segmentation

Research methods

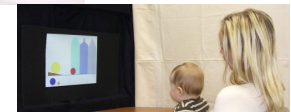


= w'ʌ rə pɪ'ɪ ri k'ɪ ri

???



(10) Interpret the results for other people who aren't you so they know why they should care

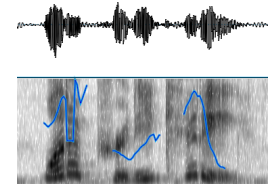
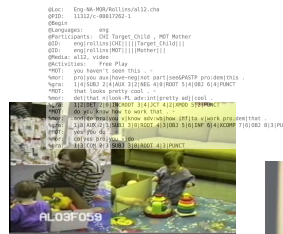
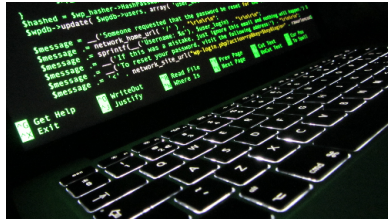


w'ʌr	what
ə	a
pɪ'ɪri	pretty
k'ɪri	kitty

“The modeled child has the same developing knowledge as we think 8-month-olds do. This strategy can be what they’re using!”

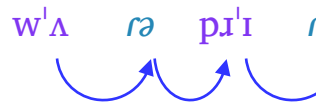
speech segmentation

Research methods



= w'ʌ rə pɪ'ɪ ri k'ɪ ri

???



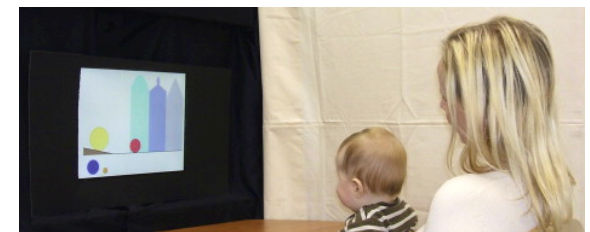
what a pretty kitty!

w'ʌrə
pɪ'ɪri
k'ɪri
w'ʌ
rə
pɪ'ɪrik'ɪri
w'ʌ
rə
pɪ'ɪrik'ɪri
w'ʌ
rə
pɪ'ɪri
pretty
k'ɪri
kitty

(10) Interpret the results for other people who aren't you so they know why they should care



“The modeled child can reproduce the behavior we see in 8-month-olds. This strategy could be what they're using to generate that behavior!”



Recap

Even though children rarely get explicit correction, they can get some help on what the correct forms are by listening to recasts in the input.

Children's input often consists of caretaker speech, which has many properties that may aid language acquisition.

There are different methods for investigating questions in language acquisition, most of which involve using child-directed input and child-produced output. One research method gaining prominence in the field is computational modeling, which tends to look at specific implementations of how the process of language acquisition could work.

Questions?



You should be able to do up through 18 on the introductory review questions and up through 2 on HW1.