Is that a question?

Learning to identify interrogatives and questions in early speech to children

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Commit22

Clause types and speech acts

Cross-linguistically, languages tend to have three different clause types, canonically associated with three speech acts:

(1)	That's Bert!	Declarative	~ Assertion
(2)	Is that Bert?	Interrogative	~ Question
(3)	Look at Bert!	Imperative	~ Request/Command

- How do children figure out clause types and speech acts (especially interrogatives and questions), and the mapping between the two?

Sadock & Zwicky 1985; König & Siemund 2007; Krifka 2008; Portner 2018, a.o

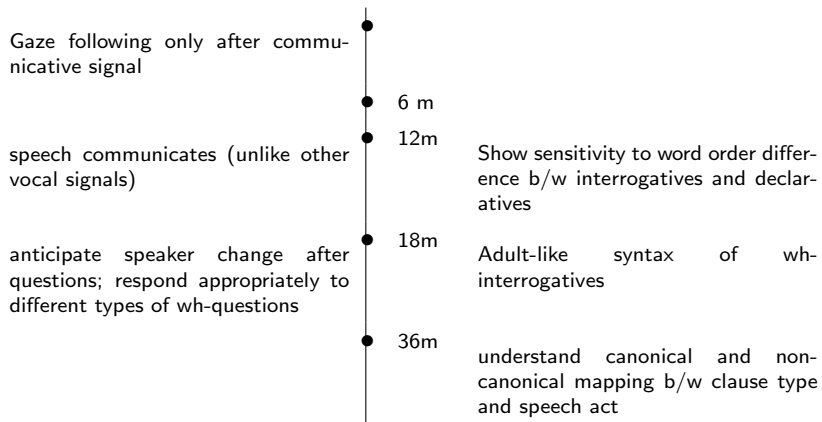# Clause types and speech acts

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Developmental timeline

Infants seem to figure out interrogatives and questions fairly early, around 18 months old:

Gaze following only after communicative signal

6 m

12m

speech communicates (unlike other vocal signals)

Show sensitivity to word order difference b/w interrogatives and declaratives

18m

anticipate speaker change after questions; respond appropriately to different types of wh-questions

Adult-like syntax of wh-interrogatives

36m

understand canonical and non-canonical mapping b/w clause type and speech act

Geffen & Mintz (2015); Tyack & Ingram (1977); Rowland et al. (2003); Casillas & Frank (2017); Perkins (2019);

Ervin-Tripp (1978); Shatz (1978); Berninger & Garvey (1981); Clark & Lindsey (2015); Moradlou et al. (2020),

Senju & Csibra 2008, Goodhue et al. 2020, Woods & Roeper 2021, among many others

Our project:

How do infants as young as 18 months old learn to recognize clause types and speech acts (especially interrogatives and questions), and the mapping between the two?

- ▶ What is the input like?
  → Corpus study of speech to infants (∼ 18mo)
- ▶ Is the input informative enough?
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How do children figure out clause types?

▶ In other words: how do they know which sentence belong to which clause type?

▶ Clustering problem:

▶ Given a new sentence like (4), how do children come to know it's more like (4a) or (4b)?

    (4)   Do you like it?

         a. Is that Bert?

         b. That's Bert!

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Formal features of clause types

We cannot 'build in' certain features into interrogativity, because the surface features of interrogatives differ from language to language:

(5) Xiaxue le.
     Snow   Asp
     "It is snowing."

(6) Xiaxue le   ma.
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▶ Children have to discover the features from their input, and cluster the sentences they hear with these features

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Speech act information might be helpful

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But could also be harmful: indirect speech acts

(10) Questions can be expressed by all kinds of clauses:

   a. Is it snowing? Interrogative

   b. It's snowing? Declarative

   c. Tell me if it's snowing! Imperative

(11) Interrogative can express all kinds of speech acts:

   a. Is it snowing?   Q

   b. Aren't you sweet.   A

   c. Can you pass the salt?   R

▶ Our question: Is speech act information helpful or harmful for the clustering problem?

(12)   Do you like it?

      a. Is that Bert?

      b. That's Bert!

Labeling problem:

▶ Children need learn the 'label' of sentence clusters: one cluster should be interrogative and the speaker uttering the sentence is asking a question

▶ Again, indirect speech acts could be a potential problem

▶ Our question: Is indirect speech act a problem for children?

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So far, we are assuming that children know the speech act information independently.

▶ But adult speakers tend to use clause type information to determine whether we are being asked a question

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▶ Providence Corpus, CHILDES

▶ Age Range: 11-18 months

▶ Both transcript and video

▶ Sample: One session per month within the age range, 30min/500 utterances in each session (current size: 12h of video/7208 parent utterances)

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Annotation process

- Transcript: clause type, speech act, formal features of each utterance
- Audio: A subset of utterances were manually aligned using PHON; the rest were forced-aligned using Kaldi
- Video: on a second-by-second basis, parents' attentional behaviors toward the child using ELAN, without consulting the transcript

Hedlund & Rose 2020; Povey et al. 2011; Lausberg & Sloetjes 2009

Learning clause types: Formal features

▶ What are the clauses look like in parental speech?

▶ Annotated morpho-syntactic features that potentially could be identified by infants 18 m.o. or younger

Feature Name	Examples
Subject	(+) I'll take it.
	(−) Take it.
Object	(+) find it!
	(−) What did you find?
Verb	(+) Find Elmo!
	(−) Elmo!
Aux	(+) Can you find it?
	(−) I found it!
Subject-Aux/verb Inversion	(+) Can you find the ladybug?
	(−) I can take it.
Unknown functional item	(see next slide)

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Unknown functional items

- Wh-items are important for clause typing, but infants around 18mo might not know them yet.
- But they might be able to represent them as an unknown functional item.
- Also in this category: quantifiers, connectives (except for *and*), focus particles

Occur sentence-initially	Occur sentence-medially, but before verbs	Occur after verbs
(14) **What** did you find?		(16) I know **what**'s wrong.
	(15) raccoon **only** comes out at night	

- The last two are extremely infrequenty, excluded from analysis

Formal features: results
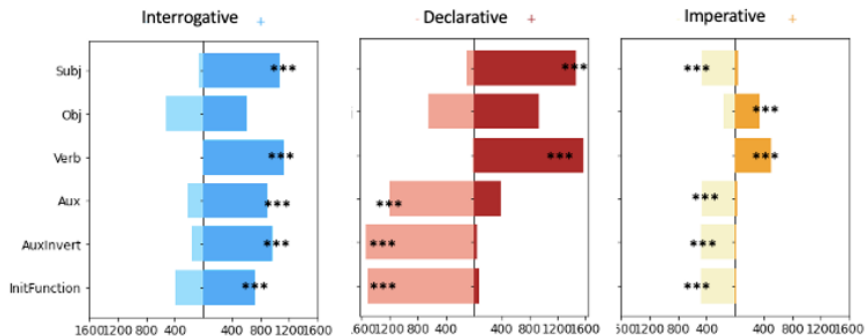
- ▶ Key features associated with each clause type is consistently present
- ▶ But is the input informative enough for infants, who do not know the clause type labels?

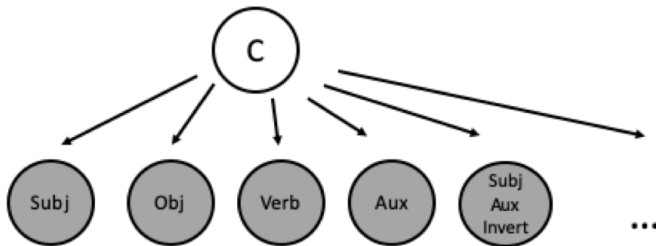# Clustering sentences with formal features

We built an unsupervised learner who has to discover 3 clause types with data from the above formal features:

- ▶ Why 3? Cross-linguistically, we see these three clause types
- ▶ working on a model that needs to discover the number of clause types

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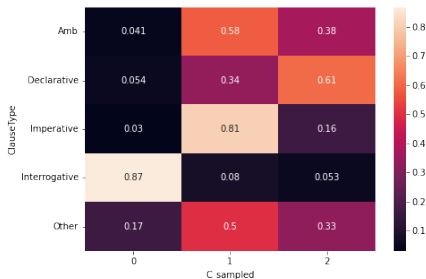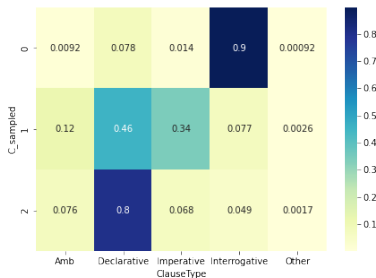
how to read the graph: X-axis, y-axis

► Purity: The learner is able to identify a cluster for declaratives and one for interrogatives

► Accuracy: The majority of interrogatives is put into one cluster by the learner

Formal features of each learned category

The learner is able to identify the correct set of formal features relevant for clause typing:

Cluster	Features
1 (90% Interrogative)	+subj, +verb, +aux, +subj-aux inversion, +S-initial unknown function word
2 (Declarative/Imperative)	-aux, -inversion, -unknown function words
3 (80% Declarative)	+subj, +obj, +verb; -aux, -inversion, -unknown functional words

Interim conclusion

The input to infants around 18 months old are informative enough
for them to find three groups of sentences

► In particular, the learner is able to identify a group highly
correlated with interrogativity

► The learner is able to recognize the key features associated
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Where we are. . .

How do children learn to identify different clause types and speech acts, and the mapping between the two?

- ▶ Clause types
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- ▶ Mapping
  - ▶ Is speech act information helpful or harmful? Is indirect speech act a problem?
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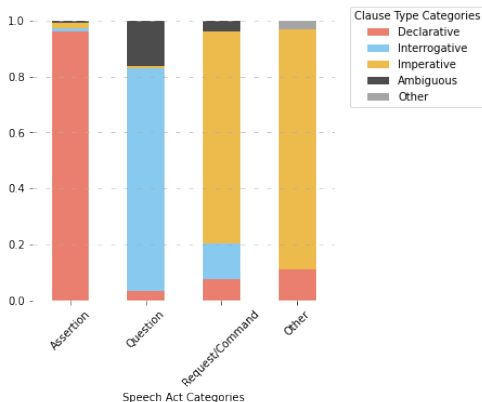 - ▶ Are there any non-clause type (socio-pragmatic) cues?

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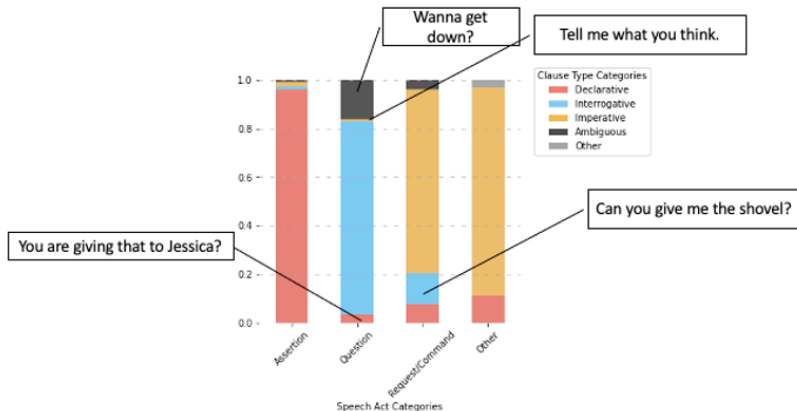 - ▶ Are there any non-clause type (socio-pragmatic) cues?

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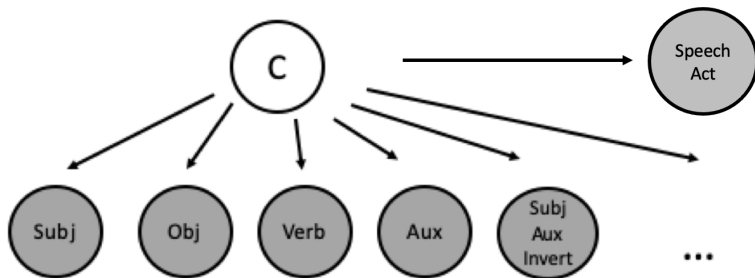
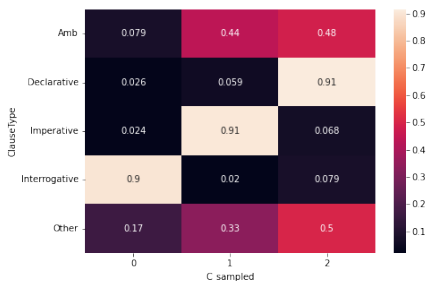▶ The mapping between the two is straightforward:
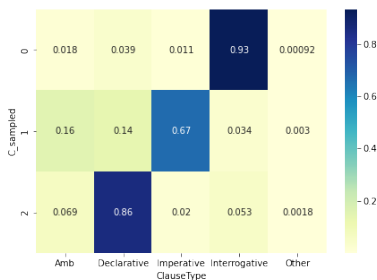
Examples of mismatches:

Unsupervised Learner

Again assuming that this learner has to discover 3 clause types
with data from the formal features, and the speech act information:

how to interpret the graphs

▶ Better purity and accuracy than the previous learner

How do children learn to identify different clause types and speech acts, and the mapping between the two?

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Socio-pragmatic features of questions

- Questions are generally modeled as devices to:
    - Establish topics
    - Seek commitments
    - Elicit responses
- But when parents talk to pre-linguistic infants who might not be able to respond, would they behave differently after questions?
    - Eye gaze
    - Speech gap

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▶ In social interactions, question $\rightarrow$ someone takes up the next turn

▶ Eye gaze $\rightarrow$ speaker wants that person to take up the turn

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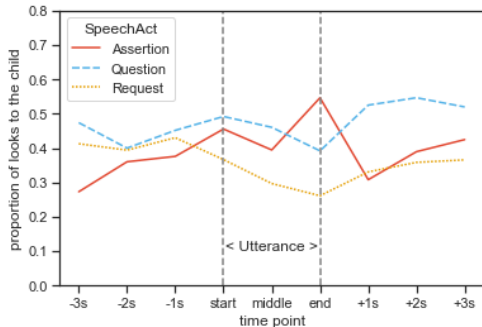Argyle 1972; Kendon 1967; Duncan et al. 1979; Rossano et al. 2009

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Eye gaze: results

► Parents behave as if the child can talk: they look at the child
longer after questions to appoint the child as the next speaker
in turn

Speech gap

▶ Questions → elicit responses

▶ Pauses after an utterance → the speaker wants someone to take up the turn

▶ But would parents still pause if the other speaker is pre-linguistic, and hence might not be able to respond?

Consecutive turn sequences:

(17)   Alex's mother: Who's that? [pause] Is that the postman?

Levinson 1983; Reimchen & Soderstrom 2017 a.o. see recent collection edited by Holler, Kendrick, Casillas, Levinson

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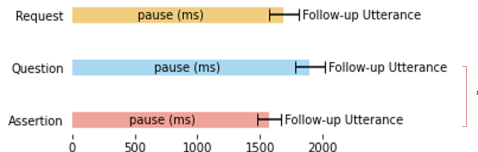
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▶ Parents behave as if the children can talk: they pause longer after questions to solicit answers

Conclusion

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On-going work

- ▶ Prosody
- ▶ We assumed that the unsupervised learner already know there are 3 clause type categories; what if they have to learn the number of categories?
- ▶ Other socio-pragmatic cues (suggestions welcome!)
- ▶ Beyond English: Mandarin

Thanks!

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- ▶ You!

Questions?

- ▶ Slides are posted online at:
  `yu-an.github.io/projects`
- ▶ You can also email me:
  yang.yu.an.06@gmail.com

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The Pragmatic Syntactic Bootstrapping Hypothesis

Children learn to identify speech act (question) and clause type (interrogative) in tandem and mutually informative ways:

- ▶ track formal, prosodic, and non-linguistic features in parents' speech
- ▶ learn to identify interrogatives by tracking formal regularities in conjunction with their growing knowledge of questionhood and its associated non-linguistic cues;
- ▶ learn to identify questions by tracking non-linguistic cues in conjunction with their growing understanding of interrogative syntax.

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Graphical Model
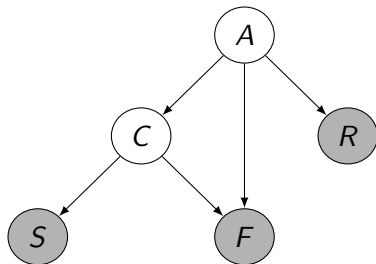
- ▶ A: Speech Acts
- ▶ C: Clause Types
- ▶ S: Syntactic features (feature bundle)
- ▶ R: Pragmatic features (feature bundle)
- ▶ F: prosodic features

▶ We want to jointly infer A and C given S, R, and F through Gibbs sampling.