Outline

- timing coordination – turn taking
- meaning coordination – dialogue acts
- meaning coordination – grounding
- style coordination - alignment and adaptation
- language *acquisition* in interaction
Outline

• Main theories of first language acquisition.
  ▶ Nativist
  ▶ Empiricist
  ▶ Interactive

• Interaction view. Two examples of recent work:
  ▶ convergence in child-adult interaction
  ▶ corrective feedback
The nativist view

Knowledge of grammar is innate, in the form of a Universal Grammar that is the initial state of the language faculty.

“Language learning is not really something that the child does; it is something that happens to the child placed in an appropriate environment, much as the child’s body grows and matures in a predetermined way when provided with appropriate nutrition and environmental stimulation”

(Chomsky 1993, p. 519)

Main motivation:

• Acquisition is fast and easy,
• in spite of inadequate input (poverty of stimulus),
• and happens without direct instruction (no negative evidence).

None of these claims is well supported empirically.
The nativist view: counter evidence

• Fast?
  Children are exposed to language around 10 hours per day (millions of words/sentence in the first 5 years).

• Easy?
  Children go through learning stages and make errors over several years (meaning extension, morphological regularisation, word order).

• Poor input?
  Child-directed speech is simpler, clearer, and more well formed than adult-adult speech.

• No negative evidence?
  Typically no explicit correction, but plenty of implicit feedback (more later).
The empiricist vs. interaction views

input vs. interaction
sensitivity to statistical regularities in the input ignoring interaction
sensitivity to when & how the input is offered in interaction

Adult: Help me put your toys away, darling.
Child: I’m going to Colin’s and I need some toys.
Adult: You don’t need a lot of toys.
Child: Only a little bit toys.
Adult: You only need a few.
Child: Yes, a few toys.

child → adult  language learning
child ← adult  child-directed speech
The interactive view

“Relevant input” — *joint attention, engagement, topic continuity, contingent replies* . . . — has been shown to be a positive predictor of language development (Tamis-LeMonda et al. 2001; Hoff & Naigles, 2002; Rollins, 2003; Mazur et al. 2005; Hoff, 2006; a.o.)

McGillion et al. (2013): what sort of responsiveness matters?

- *semantic responsiveness*: related to the child’s focus of attentions
- *temporal responsiveness*: temporally contingent with an act produced by the child.

⇝ *combined measure only significant predictor of vocabulary growth*

**Longer-term:** use computational modelling to investigate how these aspects relate to the learning mechanisms employed by the child – and what this can tell us about theories of dialogue.

**Today:** recent work on methodologies for studying *interaction* and *contingent responsiveness* in corpus data.
Two examples of concrete work

Ways of investigating how speakers pick up on each other’s language (coordinate) at different degrees of locality.


Empirical study on impact of one particular interactive phenomenon on learning:

Turn-based Cross-Recurrence Plots

Two-party dialogue transcript

A1: which one do you want first
B1: that one
A2: you like this one
B2: yeah, give me
...
An: ...

Recurrence (coordination) score for each (i, j)

Cross-recurrence plot: each cell corresponds to a pair of turns (i, j)

• **global recurrence**: average coordination over all turn pairs
• **local recurrence**: recurrence in (semi-)adjacent turns, separated by at most distance \( d < n \) (diagonal line of incidence)
• **upper recurrence**: child’s turn comes after adult’s adult ← child
• **lower recurrence**: adult’s turn comes after child’s child ← adult

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NASSLLI 2016
Turn-based Cross-Recurrence Plots

CRP of a dialogue with Abe (2.5 years old):

Same *global* recurrence but very different *local* recurrence

~~ global: chance recurrence regardless of temporal development of interaction
**Linguistic Measures of Recurrence**

*Syntactic recurrence*: number of shared part-of-speech bigrams factoring out lexical identity, normalised by length of longest turn.

*Lexical recurrence*: shared lexeme unigrams / biagrams factoring out lexical identity, normalised by length of longest turn.

**Conceptual recurrence**: semantic similarity, e.g., $\langle N|\text{dog} \rangle \approx \langle V|\text{bark} \rangle$

- distributional semantic model: 2-billion-word WaCuk corpus and the DISSECT toolkit (Dinu, Pham & Baroni, 2013)
- one vector per turn by adding up the lexical vectors
- cosine of a turn pair $(i, j)$ as the convergence score
379 *child-adult dialogues* from 3 children over a period of \( \sim 3 \) years.

<table>
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<th>corpus</th>
<th>age range</th>
<th># dialogues</th>
<th>av. # turns/dialogue</th>
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<td>Sarah</td>
<td>2;6 – 5;1</td>
<td>107</td>
<td>340 ( \text{sd}=84 )</td>
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<tr>
<td>Naomi</td>
<td>1;11 – 4;9</td>
<td>62</td>
<td>152 ( \text{sd}=100 )</td>
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We generate a *CRP* for each dialogue, computing convergence values for all turn pairs \((i, j)\) for each of the linguistic convergence measures: *lexical*, *syntactic*, *conceptual*. 
Results: child-adult dialogue

- **local vs. global**: significantly more local coordination.
- **directionality**: both coordinate more at local levels, but the adult recurs with the child significantly more.
Results: adult-adult dialogue

For comparison: \( \sim 1000 \) adult-adult dialogues from Switchboard. We ignore backchannels ("uh huh") since they are not considered proper turns (19% of all utterances).

- Semantic lexical/conceptual measures, same trend: above-chance convergence in close-by turns.

- Syntactic measure: very different coordination patterns, with adults showing syntactic divergence at adjacent turns: \( \sim \) less recurrence than expected by chance.
Contrast with previous evidence of syntactic alignment in adult-adult dialogue (e.g., Pickering & Ferreira 2008), but not surprising: advancing a conversation requires different dialogue acts with distinct syntactic patterns.

Why is there syntactic recurrence in child-adult dialogue?

- feedback mechanism to ratify linguistic constructions?
- possibly related to reformulations / recasts / corrective feedback

Child: you’re good to sharing.
Mother: I’m good at sharing?
Reformulations


- Adults check up on the meaning intended by the child.
- 3 English and 2 French children (longitudinal data)
- Around 2/3 of erroneous utterances are reformulated by the adult.
- All types of errors (phonology, morphology, lexicon, syntax).
- Children attend to and respond to the reformulations

% of Abe’s conventional utterances replayed and erroneous utterances reformulated.
Corrective feedback


An utterance by the child followed by an utterance by an adult constitutes an instance of corrective feedback if all the following constraints are met:

(C1) The child’s utterance contains a grammatical anomaly.
(C2) There is some degree of overlap between the adult and child utterances: the adult’s response is anchored to the child utterance through at least one exactly matching word.
(C3) The adult utterance is not a mere repetition of the child’s, i.e., there is some contrast.
(C4) This contrast offers a correct counterpart of the child’s erroneous form.
Data and annotation

- Manual annotation: 4-6 files from four different children
- Extraction of candidate CF utterance pairs (partial repetition)
Results of corpus study

Examples:

**synt: subject, omission**
CHI: don’t want to.
MOT: you don’t want to?

**v. morph: irregular past, substitution**
CHI: he falled out and bumped his head.
MOT: he fell out and bumped his head.

**u. morph: auxiliary, addition**
CHI: I’m read it.
DAD: you read it to mummy.

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<th>Sub</th>
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- Focus on subject omission errors (SOE).
- Use of machine learning techniques to extract SEOs and CF on SOEs in the entire corpus.
Preprocessed and annotated data

CHI: I climb up daddy.

- POS & morph  %mor: pro.sub|I v|climb prep|up n|daddy
- dependency  %gra: 1|2|SUBJ 2|0|ROOT 3|2|JCT 4|3|POBJ

DAD: you did climb over daddy.

- POS & morph  %mor: pro|you v|do.PAST v|climb prep|over n|daddy
- dependency  %gra: 1|2|SUBJ 2|0|ROOT 3|2|OBJ 4|3|JCT 5|4|POBJ
- overlap     %adu: $EXA:climb $EXA:daddy $ADD:you did $ADD:over
               $DEL:i $DEL:up $REP = 0.40

manual annotation  %cof: $CF $ERR = umorph:prep; $TYP = subst

Automatic detection results:

- Detection of SOE: rule-based classifier, 83% precision.
- Detection of CF on SOE: SVM, 89%.
Corrective feedback and learning

Does CF on SOE contribute to error reduction?

We compute the amount of SOEs at two different time periods, $t_0$ and a later time $t_1$. We then calculate the *relative error reduction* ($rer$) as the proportion of SOEs at $t_0$ that has been overcome at $t_1$:

$$rer(t_0,t_1) = \frac{SOE_{t_0} - SOE_{t_1}}{SOE_{t_0}}$$

Control variables:

- child age in months ($age$);
- mean length of utterance of child speech and of child directed speech ($chi.mlu/cds.mlu$);
- vocabulary size of child speech and of child directed speech ($chi.vocab/cds.vocab$);
- proportion of child SOEs ($chi.soe$);
- proportion of child directed utterances with subject omissions ($cds.so$);
- proportion of words uttered by the child over all words uttered in the child-adult interactions ($chi.speech$).
Corrective feedback and learning

- Linear regression model with all possible pairs \((t_0, t_1)\) for the 25 children in the corpus (N= 2613): CF explains a significant proportion of the variance in relative error reduction of SOEs independently from all other factors.
- CF has a significant effect after a time lapse of 7 to 12 months,
- for any starting age \(t_0\) for which there is available data.
• Local interaction can function as corrective feedback and contribute to language learning.
• Data-driven approach, but caution regarding errors introduced by automatic detectors.

• What does this tell us about acquisition and learning?
  ▶ language learning in use is not totally unsupervised.
  ▶ the learner is active in eliciting feedback

• How can we model this interactive learning process computationally?
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- **Meaning** coordination – dialogue acts
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- Language **acquisition** in interaction

**thank you**