Syntactic bootstrapping with minimal verbal morphology
Learning Mandarin Chinese attitude verb meanings

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Learning the meanings of attitude verbs via syntactic bootstrapping

- Belief and desire verbs describe mental states that lack stable physical correlates.
- Their meanings are difficult to learn from the situational context alone.
- How do children learn that these verbs have different semantics?

Syntactic bootstrapping: learners relate observed morphosyntactic cues to meanings, using principled links, e.g. Gleitman '90; Gleitman et al. '05, also Lasnik '83/'89.

Hypothesis: the learner

(i) Observes that in morphosyntactic terms, there are two classes of attitude verbs, and

(ii) Infers that this corresponds to a difference in verb semantics.

What kinds of morphosyntactic cues might children be sensitive to?

Cross-linguistically, the complements of belief and desire verbs differ morphosyntactically in a principled fashion.

"Declarative main clause syntax" hypothesis: complements of belief verbs have the syntactic features found in declarative main clauses, e.g. Dayal & Grimshaw '09; Hacquard '14; White et al. '16.

- Feasible in Romance, English, German, e.g. Bolinger '68, Scheffler '09.

Verbs	*Syntactic property of complement*		
	Romance	*English*	*German*
Belief	**Indicative**	**Finite**	**V2 possible**
Desire	**Subjunctive**	**Non-finite**	**No V2**
Declarative main clauses	Indicative	Finite	V2

Selected references: Gillette, J. et al. 1999. Human simulations on vocabulary learning. Gleitman, L. R. 1990. The structural sources of verb meanings. Huang, C.-T. J. 1982. Logical relations in Chinese and the theory of grammar. Hu, J., H. Pan, and L. Xu. 2001. Is there a finite vs. nonfinite distinction in Chinese? McCawley, J. 1994. Remarks on the Syntax of Mandarin yes-no Questions. Tardif, T. 1993. Adult-to-child speech and language acquisition in Mandarin Chinese. Hacquard, V. 2014. Bootstrapping attitudes. White, A. S., V. Hacquard, and J. Lidz. 2016. Main clause syntax and the labeling problem in syntactic bootstrapping.
Questions and comments welcome! Please email znhuang@umd.edu

Case study: Mandarin Chinese

Can syntactic bootstrapping help one learn attitude verb meanings in languages with minimal (verbal) morphology?

Mandarin Chinese:
- No mood / tense / case morphology
- No finiteness distinction (Hu et al. '01)
- Allows null subjects

i. *Lisi {renwei / xiangxin} chi-su.*   Belief verbs
   L   think / believe   eat-vegetarian
   'Lisi thinks/believes [she/he/they/you/I/we] is vegetarian.'
   (in an appropriate context)

ii. *Lisi {xiang / yao} chi-su.*   Desire verbs
    L   want   eat-vegetarian
    'Lisi wants to be vegetarian.'

Certain syntactic properties distinguish belief verb complements from desire verb complements

While exceptions exist, overt subjects and auxiliaries are possible in belief verb complements and in declarative main clauses.

- Consistent with the declarative main clause syntax hypothesis.
- Some of these properties have been discussed in the syntax literature, on whether Chinese makes a finiteness distinction.

Overt subject possible in complement (Huang '89)

1a. *Lisi {renwei / xiangxin} John chi-su.*
    L   think / believe   J   eat-vegetarian
    'Lisi thinks/believes John is vegetarian.'

b. *Lisi {yao John/ xiang (*John)} chi-su.*
   L   want J   want J   eat-vegetarian
   Intended: 'Lisi wants John to be vegetarian.'

Modal auxiliary (e.g. future, epistemic modal) (pace Hu et al. '01)

2a. *Lisi renwei John {hui / yiding} chi-su.*
    L   think J   will necessary eat-vegetarian
    'Lisi thinks that he {will / must} be vegetarian.'

b. *Lisi {yao / xiang} (*hui / *yiding) chi-su.*
   L   want   will necessary eat-vegetarian
   Intended: 'Lisi wants to be vegetarian (in the future) /
   In all of Lisi's desire worlds, it is necessary that he is vegetarian.'

A-not-A yes/no question morphology (Huang '82, McCawley '94)

3a. *Lisi renwei John chi-bu-chi-su?*
    L   think J   eat-NEG-eat-vegetarian
    'Does Lisi think John is vegetarian, or does Lisi think John is not?'

b. * *Lisi {yao / xiang} chi-bu-chi-su?*
   L   want   eat-NEG-eat-vegetarian
   Intended: 'Does Lisi want to be vegetarian, or does Lisi want to not be vegetarian?'

Syntactic properties distributed differently across attitude verbs in input

Initial results from ongoing CHILDES corpus study.

Attitude predicates	% tokens with clause-like complements containing …		
	Overt subjects	Auxiliaries	A-not-A question morphology
Belief verbs			
shuo "say"	55.7%	8.9%	4.0%
zhidao "know"	55.0%	6.3%	3.1%
jiang "say"	21.4%	5.7%	0.0%
juede "feel"	54.5%	9.1%	9.1%
Desire verbs			
yao "want, need, FUT"	4.6%	0.5%	0.0%
xiang "miss, want, think"	2.7%	2.3%	0.8%
xihuan "like"	0.9%	0.0%	0.0%
ai "love"	0.0%	0.0%	0.0%

- Data for ambient speech in 'Beijing,' 'Context,' and 'Zhou2' corpora
- Tokens with relevant attitude verbs: ~7,200 (~7% of all utterances)
- Tokens with clause-like complements: ~3,400
- Attitude verbs shown here are the 8 most frequent (~97% of relevant tokens).

Syntactic cues in the input in Mandarin are distributed differently for belief and desire verbs. Next step: apply a learning algorithm to the data. Is the distribution of syntactic cues sufficiently different for a child to infer meaning differences?