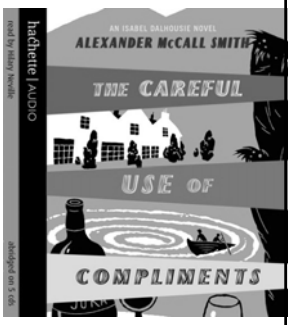
Acquisition of Complements



What is complementation?

- A special case of a complex sentence -
  - A complex sentence has two verbs expressing two propositions
  - Complementation -
    - One proposition is nested within another
    - One proposition is an *argument* of another proposition
- Sentential Complements
  - I THINK I can put him in a house
- Wh-complements (with null argument)
  - LOOK AT what the little bear's eating

Propositions (Kintsch)

Proposition = a "meaning unit", "idea unit"

Every sentence can be represented by 1 or more propositions

The stupid man bought the wrong car.

Proposition 1: ***BOUGHT*** (***MAN***, ***CAR***)
Proposition 2: ***STUPID*** (***MAN***)
Proposition 3: ***WRONG*** (***CAR***)

BOUGHT, STUPID, WRONG = **Predicates**
- Action, state, relationship, ...

MAN, ***CAR*** = **Arguments**
- Entities participating in the action, ...

The same propositions are found in other ways of saying (roughly) the same thing

The guy was so dumb he bought the wrong car.

Why is complementation important?

- Evidence for recursion in language!
  - S --> NP VP
  - VP --> V S
  - "I know Jim said Bill thought Fred said Sara knew…"
  - I know [Jim said [Bill thought [Fred said [Sara knew…]]]]
- Complement-taking verbs refer to abstract mental states

Both reasons indicative of increasing complexity in linguistic and conceptual development

Methods

Table 15.2 Age and mean length of utterance for two developmental times

	Times*	Number of sessions	Age		MLU	
			Range	Mean	Range	Mean
Eric	1	3	2;1.1–2;5.3	2;3.1	2.63–3.45	2.97
	2	2	2;9.0–3;0.0	2;10.2	3.49–4.21	3.85
Gia	1	3	2;1.2–2;4.2	2;3.2	2.30–3.07	2.71
	2	2	2;6.0–2;10.2	2;8.1	3.64–3.71	3.68
Kathryn	1	3	2;0.2–2;5.1	2;2.3	2.83–3.35	3.16
	2	2	2;8.1–2;11.1	2;9.3	3.70–4.23	3.97
Peter	1	3	2;3.0–2;6.0	2;4.2	2.63–2.90	2.75
	2	4	2;7.2–3;2.0	2;10.2	3.05–3.58	3.37

* Times 1 and 2 are the result of grouping data, with Time 1 = MLU < 3.5, and Time 2 = MLU > 3.5.

- Four children studied longitudinally
- Observed in their homes during routine activities and playing
- Sessions lasted ~8 hours, at 6-week intervals
- Data grouped into 2 time points based on MLU

Frequency of Complementation

- Perception Verbs
  - See (14%); look (10%)
  - Eric: Doggie is looking up
  - Kathryn: And nobody can see him
  - Gia: Look what my mommy got me
  - Kathryn: I'll see where it is
- Epistemic (i.e., cognitive) Verbs
  - know (44%); think (83%)
  - Eric: I don't know that part
  - Kathryn: I think up on this bed
  - Peter: Know what the other ones do?
  - Gia: I think the children go to bed

Table 15.3 Frequencies of complement and non-complement sentences

		Perception		Epistemic	
		see	look	know	think
		Eric			
Time 1	+COMP	15	13	6	12
	–COMP	349	161	4	2
Time 2	+COMP	53	8	27	42
	–COMP	96	119	68	5
		Gia			
Time 1	+COMP	1	9	1	7
	–COMP	115	27	4	3
Time 2	+COMP	23	10	11	5
	–COMP	77	58	14	1
		Kathryn			
Time 1	+COMP	23	7	7	30
	–COMP	174	40	1	4
Time 2	+COMP	45	4	9	44
	–COMP	223	37	4	41
		Peter			
Time 1	+COMP	17	3	20	3
	–COMP	165	63	6	5
Time 2	+COMP	30	8	49	35
	–COMP	87	89	16	4
Totals	+COMP	207	62	130	178
	–COMP	1286	594	117	65

Sentential complements

Sentential (S) Complements

- Kathryn: I see Mommy washing her hands
- Gia: I think that he wanna eat this

- Add a simple sentence frame after a verb
- What about the complementizer: *that*?
  - Usually optional in adult speech
    - I know that you're doing well
    - I know you're doing well
  - Very rare in the speech of these children
    - For think, 3 of 179 S-complements used that (1.7%)

- Why?

- Maybe they don't know the word?
  - The children used 'that':
    - Kathryn: I thought that was a snacktime (demonstrative)
    - Peter: That's how get them out (deictic)
    - Kathryn: I think that girl is going to dust that that paper away (determiner)
    - They clearly know the word
- Use of 'that' with other functions inhibits its acquisition as a complementizer
  - An item with several different functions may be more difficult to acquire
  - Prior acquisition of other functions of 'that' may inhibit its acquisition as a complementizer
- Input frequency?
  - Maybe they never heard 'that'-complements?
  - 'that'-less complements are frequent with think, know, see (in adult language)

Wh- complements

Wh- complements

- Kathryn: Let's go see where Mommy is.
- Gia: You know what's in this bag?

- A question is embedded after the matrix verb
  - Wh- complements were not used with *think*
  - Wh- words may not be terribly salient because they occur in the middle of the sentence
  - Acquisition may depend on prior learning of wh-words as questions – where they are sentence initial

Wh-Movement: Filler-Gap Dependencies

a. Did Calvin bring pizza?

b. Calvin brought what?

c. What did Calvin bring __ ?
FILLER GAP

⇨ thematic (agent, patient) and functional (subject object) ambiguity

d. *What did Calvin bring pizza?
FILLER

e. *Did Calvin bring __ ?
GAP

* : ungrammatical

Wh-Movement: Filler-Gap Dependencies

Bi-Clausal Sentences

a. Without filler-gap dependency:
Did Hobbes say [that Calvin brought pizza]?

b. With filler-gap dependency:
Did Hobbes say [what Calvin brought __]?
FILLER GAP

c. With filler-gap dependency:
What did Hobbes say [that Calvin brought __]?
FILLER GAP

Emergence of wh- words

- Questions
  - what, where, who emerge first
  - how, why later
- Complementizer
  - Emerge after questions
  - Use of word as complementizer is later than use of that same word as a question
  - Except for how (and maybe why)

Table 15.4 Average age of emergence for *Wh*-question words and *Wh*-complement words

Wh-Q[a] words	Average age	Number of children[b]	*Wh*-COMP words	Average age	Number of children[c]
what	2; 2	7	–	–	–
where	2; 2	7	–	–	–
who	2; 4	7	–	–	–
–	–	–	what	2; 6	4
–	–	–	where	2; 7.2	3
how	2; 9	7	how	2; 9.2	3
–	–	–	(if)	2; 10	4
why	2; 11	7	who	2; 11	3

[a] The results for *Wh*-question words are from Bloom et al. (1982).
[b] $n = 7$.
[c] $n = 4$.

- Use of different connectives was verb specific
  - see: what, if, how, where
  - know: what, where, how
  - look (at): what

Other aspects of Complementation

Frequency of Complement Types

- S-complements are simpler than wh-complements
  - Should they emerge earlier?
  - Do they?
- *think* has no wh-complements
- *know* has (almost) no S-complements

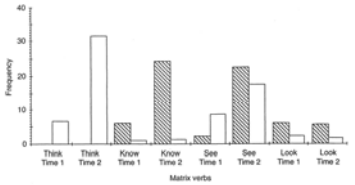


Figure 15.2 Mean frequency of complement types. ■, *Wh*-comp; □, *S*-comp.

- Complementation was more frequent in time 2 than time 1
- (except for *look*)
- For *see*, S-complements frequent early; wh-complements frequent late

Discourse environment

- Textual Contingency
  - Did an adult use the matrix verb or (part of) the complement within 5 speaker turns
  - Do verbs differ with respect to how they continue a discourse?
  - *look (at)* may introduce a new topic;
  - *think* may continue an old one

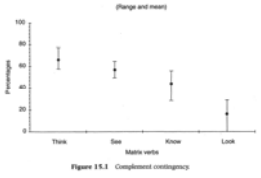


Figure 15.1 Complement contingency

Adult: let's see *how* this one *works*
Kathryn: You know *how* it *works*

Adult: I *think* that lamb is *cold*
Eric: he is very *cold* / I *think* I can put him in a house

Restrictions on Subjects

- Expect main clause subjects to be animate
  - *see*, *look* , *think*, *know*
  - More restricted than expected:
    - *look* – all null second person (imperative)
      - Eric: ***(null)*** Look at that donkey carrying baskets
    - *think* – 3 children only I; 1 child also used you
      - Kathryn: ***I*** think we can put it side of him
      - Peter: ***You*** think it don't belongs to me
    - *know*, *see* – more variety
      - Either first or second person subjects used first
      - Only Eric used 3rd person subjects with these verbs
      - Eric: Oh ***the bunny rabbit*** doesn't know what to do

- Lots of variety in subordinate subjects
  - Pronominal subjects with copula (to be)
    - Kathryn: I think *it's* big enough
    - Eric: Know *what's* in here?
    - Gia: I'm going to see if *there's* any more.
    - *know* (48%); *think* (35%); *see* (31%); *look* (8%)
  - Otherwise lots of variety (1st, 2nd, 3rd person)
    - Eric: Look at ***that donkey*** carrying baskets
    - Kathryn: I think ***we*** can put it side of him

Co-reference

- 2 verbs – 2 subjects
- Do they co-refer?
  - Compare complements like:
    - I want to go home – I want (I) to go home
    - I'm going to go home – I'm going (I) to go home
    - Acquired slightly earlier than S- and wh- complements
- When there was a matrix subject (332)
  - 46 (14%) were co-referential with an expressed subordinate subject
  - Kathryn: ***I*** think ***I'll*** pull the other side
  - Of these, 61% (think); 28% (see); 11% (know); 0% (look)
  - But what about:
  - Eric: Oh ***the bunny rabbit*** doesn't know what ***(BR)*** to do

Morphological Marking

- The subordinate verbs –
  - Were inflected or had modal more than 50% of the time
  - Modals used most often with think
    - 65% of modals used after think
    - Eric: I think we ***should*** put this in a house
    - 29% after see (64% were with can, and used if)
    - Kathryn: See if it ***can*** make some sound
- Syntax of complementation is verb specific

What do these verbs mean?

- Think vs know (activity vs experience)
  - Used to quantify degree of uncertainty
  - Think = uncertain
    - Contingent on prior discourse; children express new information from prior discourse
    - Use of modals to express lack of definiteness in complement
    - "that" indicative of certainty – virtually absent
    - "used parenthetically" = 'perhaps' or 'maybe'
  - Know = certain
    - Less contingent on prior discourse; children had something in mind to introduce to the discourse
    - Occurred with copula in complement – suggesting talk about attributions and generic events (greater certainty for more general claims)

- Look vs see (activity vs experience)
  - Also used to quantify degree of uncertainty
  - See = uncertain
    - Second to *think* in repetitions from prior discourse
    - Second to *think* in use of modals in complement; only verb to itself be used with modals
    - *See* occurred with conditional *if* but never definite *that*
  - Look = certain
    - Used as an imperative
    - Least contingent upon prior discourse
- Two-year olds don't rely on activity vs experience dimension
- Certainty: know (experience); look (activity)
- Uncertainty: think (activity); see (experience)

Conclusions

- Acquisition of syntax of complementation requires child to hold two propositions in mind
  - One is expressed in a simple sentence frame (complement)
  - The other is a mental attitude directed towards that proposition (main clause)
- Acquisition of complementation was verb specific
  - The verb determined if a complementizer was used, and if so, which one
  - This was learned for each verb separately

Theories of Language Development

Cognitive Approaches to Language Learning

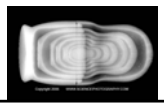
- Piaget –
  - General theory of cognitive development
- Processing approaches –
  - Operating principles approach
  - The Competition Model
- Construction based approaches –
  - Grammar is constructed, not discovered

Piaget

- Acquisition of basic grammatical structures is dependent on child's level of cognitive development
- There is nothing special about learning language
- No innate linguistic knowledge!
- No difference between language, memory, motor control, drawing, etc.

Piaget: Cognitive Stages

- Sensorimotor stage (up to 18 months)
  - Understanding of world based on effect of own actions on world
  - Cannot encode concepts with arbitrary symbols
  - Can't learn mapping between sound and meaning
- Symbolic stage (18 months – 4 or 5 years)
  - Child forms internal representations of world
  - Onset of language (can think about objects no longer present)
- Concrete operational stage (5 - 11 years)
  - Child can reason about tangible objects and relations
- Formal operational stage (12 – 16 years)
  - Child can reason about hypothetical situations and abstract concepts
- Grammar is like Russian dolls
  - Both have nested structure



Problems for Piaget

- How do children segment speech stream into words?
- What about all the data showing sensitivity to lexical/grammatical information prior to 18 months?
  - Children produce first word at 12 months
  - 17 month olds comprehending word order
  - etc.

Processing Approaches

- Operating principles approach (Slobin)
  - What are "operating principles" children use to acquire grammar
  - Based on production data
  - Language specific differences will influence which operating principles are more important in that language
  - Lots of principles have been proposed
  - Are not based on adult grammar!
  - Grammar is built up through childhood – child grammar is very different from adult grammar

More on Operating Principles

- Perceptual and Storage filters
  - Pay attention to the ends of words, stress, beginnings of words
    - Pay attention to salient aspects of speech
  - Track the frequency of every pattern that is stored
    - Helps discover reliability of cues to grammar
- Pattern makers
  - Segment similar sounding portions of utterances
    - The dog walked The dog barked
    - -ed is common to both verbs; yields – walk, bark, -ed

The Competition Model

- Language is probabilistic rather than deterministic
  - Tries to account for individual variation
  - Rich statistical co-occurrences in language input to child
  - Even adult grammar is not fixed – can change to accommodate new utterances
  - Accounts for language specific differences in grammar (Italian vs English word order…)

- Word order in English is fairly rigid (SVO)
- Italian
  - (OSV) La pastaciutta Franco la prende sempre qui (Pasta, Franco it orders always here)
  - (VSO) Allora, mangio anche io la pastachiutta (Well then, am eating I also pasta)
  - (SOV) Allora, io gli spaghetti prendo (In that case, I the spaghetti am having)
- Why is word order more flexible in Italian?
  - Order is a more reliable (and necessary) ***cue*** to meaning in English
- Multiple cues to meaning exist (stress, word order, morphological marking, etc.) – cues interact dynamically and compete
  - Importance of different cues varies cross-linguistically

Construction Based Approaches

- Child language built up over time based on concrete examples
  - Language production reflects knowledge of specific lexical items and grammatical structures
  - Does not reflect abstract categories
- Children do not learn to combine word categories (noun, verb), etc
  - Rather, learn whole syntactic patterns – "constructions"
  - "dog biting bone" is *not* "dog + biting + bone"
  - "dog biting bone" is based on "cat chasing mouse", "daddy washing car" etc.
- Generalization is very limited
  - This is based on analogy! Why doesn't it fail? (or does it?)
  - Analogies are less abstract, more limited…

Announcements

- New experiments have been added, and some have had restrictions relaxed.
- If you are still having trouble finding enough experiments to participate in, contact Laura Kertz (kertz@ling.ucsd.edu)
- Next week we'll start with the brain
  - Tuesday 5/20: neuroanatomy
  - Thursday 5/22: LDER chapters 18,19
  - Tuesday 5/27: pragmatics/autism