Asymmetries in the Acquisition of Contrastive Stress

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Workshop on Contrast, Information Structure and Intonation,
Stockholm University, October 28-29, 2005

Baby Born Talking – Describes Heaven

- Title of Chapter 9 of Steven Pinker's book "The Language Instinct".
- Of course, children are not born talking.
- But sometimes their productive skills may be well ahead of their comprehensive skills.

Overview of the Talk

- Contrastive stress
- Acquisition of productive and comprehensive skills does not proceed at the same pace.
- Production sometimes precedes comprehension.
- Proposed explanation in terms of bidirectional Optimality Theory.
- Distinction between speaker's perspective and hearer's perspective.
- Can we use these asymmetries in acquisition as a test for bidirectional optimization?

General Pattern in First Language Acquisition

- Usually, correct comprehension of a given form precedes correct production of this form.

   Cf. Bates, Dale and Thal (1995); Benedict (1979); Clark (1993); Fraser, Bellugi and Brown (1963); Goldin-Meadow, Seligman and Gelman (1976); Layton and Stick (1979).

- However, there are exceptional cases where correct production precedes correct comprehension by several years.

Production/Comprehension Asymmetries

- Subject-object order in English (Chapman & Miller, 1975).
- Pronouns (the "Pronoun Interpretation Problem": de Villiers, Cahillane & Altreuter, 2005; Spenader, Smits & Hendriks, in prep.).
- Indefinite subjects and objects in Dutch (de Hoop & Krämer, to appear).
- Contrastive stress (Cutler & Swinney, 1987).
- Scalar implicatures (e.g., Papafragou & Musolino, 2003).
- Perhaps other phenomena?

General pattern: Children show correct production by the age of 3 or 4, but fail to show correct comprehension until the age of 6 or 7.

Types of Explanation for Observed Asymmetries

- Children appear to have the relevant knowledge in production, but in fact they don't (Cutler & Swinney, 1987; McClellan, Yewchuk & Holdgrafer, 1986).
- Children appear to lack the relevant knowledge in comprehension, but this is caused by:
  - processing difficulties (Avrutin, 1999; Reinhart, e.g. 2004),
  - lack of pragmatic knowledge (Chien & Wexler, 1990),
  - interference of task requirements or world knowledge (Bloom et al., 1994; Grimshaw & Rosen, 1990; McClellan et al., 1986).
- These asymmetries are real and require a linguistic explanation (this talk).

Do Children Have Knowledge in Production?

- Cutler & Swinney (1987: p. 145): "The previous literature on the development of prosodic competence shows an apparent anomaly in that young children's productive skills appear to outstrip their receptive skills".
- "In general, children's semantic/pragmatic abilities follow the general rule of linguistic performance: production is at best as good as comprehension, it never outstrips it. Only prosodic performance seems to be an exception" (p. 162).
- Their explanation: Accenting is a primitive physiological reaction associated with speaker excitation (cf. Bolinger, 1983). No linguistic intention or underlying meaning representation need be involved in children's correct production of contrastive accent.

Focus Particle *Only*

- The focus particle *only* associates with the focus of the utterance:
  - Only John swims.
- Focus evokes a set of alternatives (contrast set):
  - {John, Sue, Mary, ...}
- *Only* asserts that the focused phrase has some property that the other members of the contrast set lack (exhaustivity):
  - Sue, Mary, ..., don't have the property of swimming.
- A different placement of stress can result in a different choice of the focus, which can give rise to a change in truth conditions.

Bound Focus and Stress

1) Tigger only threw a chair to PIGLET.
   - Default stress.
   - Ambiguous: Focus on indirect object or entire VP.
   - False if Tigger also threw a chair *to Winnie* OR if Tigger also *did something else*.

2) Tigger only threw a CHAIR to Piglet.
   - Marked stress.
   - Not ambiguous: Focus on direct object.
   - False if Tigger also threw *a table* to Piglet.

Children's Use of Contrastive Stress

- Children's **production** of default stress and marked stress seems adult-like from the age of 3 or 4.
  - (e.g. Baltaxe, 1984; Hornby & Hass, 1970; Nederstigt, 2001)

- Children's **comprehension** of **default** stress is adult-like from the age of 4.
  However, their comprehension of **marked** stress is around chance until at least 5 or 6: They allow for VP focus as well.
  - (e.g., Gennari, Gualmini, Meroni, Maciukaite & Crain, 2001; Gualmini, Maciukaite & Crain, 2002; Halbert, Crain, Schankweiler & Woodams, 1995, for English, and Szendrői, 2004, for Dutch)

Optimality Theory (OT)

- Introduced into linguistics by Prince & Smolensky (1993).
- Optimization over possible outputs.
- Possible outputs are evaluated through the parallel (and possibly cross-modular) application of constraints.
- Constraints are output-oriented:
  - Markedness constraints
  - Faithfulness constraints.
- Constraints are potentially conflicting and differ in strength.
- Speaker's perspective: input is meaning, output is form.
- Hearer's perspective: input is form, output is meaning.

Hypothesis

Children's pattern can be modeled by OT:
- Speaker's perspective ➔ Optimization from meaning to form:
  - Production of VP focus
  - Production of Indirect Object focus
  - Production of Direct Object focus
- Hearer's perspective ➔ Optimization from form to meaning:
  - Interpretation of stress on Indirect Object
  - Interpretation of stress on Direct Object

Because the constraints (the grammar) are asymmetrical, the results can be different for production and comprehension.

Violable Constraints on Focus and Stress

- **Association With Focus** (Markedness constraint on meanings):
  - The c-command domain of the focus particle *only* must contain the focus.
- **Stress Marks Focus** (Faithfulness constraint):
  - The focus must contain the word carrying main stress.
- **Nuclear Stress Rule** (Markedness constraint on forms):
  - The main stress must fall on the most deeply embedded constituent in the sentence.
    - (cf. Chomsky & Halle, 1968; Cinque, 1993; Reinhart, to appear; see Aloni, Butler & Hindsill, to appear, for use of the NSR as an OT constraint on free focus)

OT Production of VP Focus

Input: VP focus	Association With Focus	Stress Marks Focus	Nuclear Stress
Stress on DP_S		*!	*
Stress on V			*!
Stress on DP_{DO}			*!
☞ Stress on DP_{IO}			

OT Production of Indirect Object Focus

Input: IO focus	Association With Focus	Stress Marks Focus	Nuclear Stress
Stress on DP_S		*!	*
Stress on V		*!	*
Stress on DP_{DO}		*!	*
☞ Stress on DP_{IO}			

OT Production of Direct Object Focus

Input: DO focus	Association With Focus	Stress Marks Focus	Nuclear Stress
Stress on DP_S		*!	*
Stress on V		*!	*
☞ Stress on DP_{DO}			*
Stress on DP_{IO}		*!	

OT Interpretation of Stress on Indirect Object

Input: stress on IO	Association With Focus	Stress Marks Focus	Nuclear Stress
Focus = DP_S	*!	*	
Focus = DP_{DO}		*!	
☞ Focus = DP_{IO}			
☞ Focus = VP			
Focus = IP	*!		

OT Interpretation of Stress on Direct Object

Input: stress on DO	Association With Focus	Stress Marks Focus	Nuclear Stress
Focus = DP_S	*!	*	
☞ Focus = DP_{DO}			
Focus = DP_{IO}		*!	
☞ Focus = VP			
Focus = IP	*!		

Predictions of OT

Input:		Optimal output:
• VP focus or IO focus	→	Stress on IO
• DO focus	→	Stress on DO
• Stress on IO	→	VP focus or IO focus
• Stress on DO	→	VP focus or DO focus

Children: All four predictions are borne out by children's pattern.

Adults: All predictions *except prediction 4* correspond to the adult pattern as well.

Speaker's Alternatives

Question: But if OT explains the correct pattern of production and comprehension of stress, then why are sentences with marked stress (e.g., stress on Direct Object) not ambiguous for adults?:

• Tigger only threw a CHAIR to Piglet.

Answer: Because adult hearers also take into account the speaker's alternatives (= bidirectional OT, cf. Blutner, 2000):

Bidirectional Optimization

Optimization over form-meaning pairs (Blutner, 2000; Jäger, 2002):

A form-meaning pair <f,m> is **bidirectionally optimal** iff:
a) there is no **bidirectionally optimal** pair <f',m> such that <f',m> is more harmonic than <f,m>.
b) there is no **bidirectionally optimal** pair <f,m'> such that <f,m'> is more harmonic than <f,m>.

First Round of Optimization

		Association With Focus	Stress Marks Focus	Nuclear Stress
	<Stress on DP_{DO}, Focus=DP_S>	*	*	*
	<Stress on DP_{DO}, Focus=DP_{DO}>			*
	<Stress on DP_{DO}, Focus=DP_{IO}>		*	*
	<Stress on DP_{DO}, Focus=VP>			*
	<Stress on DP_{DO}, Focus= IP>	*		*
	<Stress on DP_{IO}, Focus= DP_S>	*	*	
	<Stress on DP_{IO}, Focus=DP_{DO}>		*	
☞	<Stress on DP_{IO}, Focus=DP_{IO}>			
☞	<Stress on DP_{IO}, Focus=VP>			
	<Stress on DP_{IO}, Focus=IP>	*		

Blocking Alternative Forms

		Association With Focus	Stress Marks Focus	Nuclear Stress
	<Stress on DP_{DO}, Focus=DP_S>	*	*	*
	<Stress on DP_{DO}, Focus=DP_{DO}>			*
	<Stress on DP_{DO}, Focus=DP_{IO}>		*	*
	<Stress on DP_{DO}, Focus=VP>			*
	<Stress on DP_{DO}, Focus= IP>	*		*
X	<Stress on DP_{IO}, Focus= DP_S>	*	*	
X	<Stress on DP_{IO}, Focus=DP_{DO}>		*	
☞	<Stress on DP_{IO}, Focus=DP_{IO}>			
☞	<Stress on DP_{IO}, Focus=VP>			
X	<Stress on DP_{IO}, Focus=IP>	*		

Blocking Alternative Meanings

		Association With Focus	Stress Marks Focus	Nuclear Stress
	<Stress on DP_{DO}, Focus=DP_S>	*	*	*
	<Stress on DP_{DO}, Focus=DP_{DO}>			*
X	<Stress on DP_{DO}, Focus=DP_{IO}>		*	*
X	<Stress on DP_{DO}, Focus=VP>			*
	<Stress on DP_{DO}, Focus= IP>	*		*
X	<Stress on DP_{IO}, Focus= DP_S>	*	*	
X	<Stress on DP_{IO}, Focus=DP_{DO}>		*	
☞	<Stress on DP_{IO}, Focus=DP_{IO}>			
☞	<Stress on DP_{IO}, Focus=VP>			
X	<Stress on DP_{IO}, Focus=IP>	*		

Second Round of Optimization

	Association With Focus	Stress Marks Focus	Nuclear Stress
<Stress on DP$_{DO}$, Focus=DP$_S$>	*	*	*
☞ <Stress on DP$_{DO}$, Focus=DP$_{DO}$>			*
X <Stress on DP$_{DO}$, Focus=DP$_{IO}$>		*	*
X <Stress on DP$_{DO}$, Focus=VP>			*
<Stress on DP$_{DO}$, Focus= IP>	*		*
X <Stress on DP$_{IO}$, Focus= DP$_S$>	*	*	
X <Stress on DP$_{IO}$, Focus=DP$_{DO}$>		*	
☞ <Stress on DP$_{IO}$, Focus=DP$_{IO}$>			
☞ <Stress on DP$_{IO}$, Focus=VP>			
X <Stress on DP$_{IO}$, Focus=IP>	*		

Modeling Children's Pattern

- Optimality Theory distinguishes between speaker's perspective and hearer's perspective.

- Children's problems in comprehension seem to be the result of adopting a hearer's perspective (unidirectional optimization).
  → Production/comprehension asymmetries.

- Cf. de Hoop & Krämer's (to appear) OT analysis of the interpretation of indefinites; Hendriks & Spenader's (2004) OT analysis of pronoun interpretation.

Modeling the Adult Pattern

- Adult-like production and comprehension seem to be the result of the ability to take into account the conversational partner's alternatives as well (bidirectional optimization).
  → Symmetrical competence grammar.

- Bidirectional optimization appears to be acquired relatively late (from the age of 6-7).

Reinhart's Reference-Set Computation

- Reinhart (2004): Reference-set computations are required by the parser (both for children and adults) only when interpreting marked stress, resulting in extra processing costs.
- **Prediction Reinhart**: For children as well as adults interpreting marked stress is more difficult than interpreting default stress.
- **Prediction OT model**: If bidirectional optimization is automatized, and if ambiguity is assumed to yield processing difficulties, adults are expected to experience more difficulties with default than with marked stress.
- Gennari, Meroni & Crain (in press) show by means of an eye-tracking experiment with 53 adult subjects that marked stress facilitates comprehension. → Cf. OT model.

Counterevidence?

- Children have difficulty comprehending contrastive stress.
- Children have difficulty calculating scalar implicatures.
- However: According to Miller, Schmitt, Chang & Munn (2005), children (4;1-5;5) are correctly able to access the quantity implicature associated with focused *some*.
- Target sentence: Make some faces happy.
- Implicature: *some* → *not all*
- Result: 90% adult-like comprehension when *some* is stressed; only 50% adult-like comprehension when *some* is unstressed.
- Their conclusion: Children as young as 4 are already able to correctly calculate scalar implicatures. Contrastive stress facilitates calculation of the implicature.

Discussion

- Miller et al.'s results are a striking exception to the general pattern that 4 year olds have difficulties with contrastive stress and implicatures.
- What is happening here?
- Possible explanation: Target sentences require no calculation of implicature, but merely the activation of a contrast set. Children are able to do this from a young age on.
- Perhaps we can use production/comprehension asymmetries as a test for bidirectional optimization.
- Contrast set: Does not require reasoning about alternative forms and meanings.
- Contrastive stress, implicatures, etc.: Require reasoning about alternative forms and meanings.

Questions?

31   Workshop on Contrast, Information Structure and Intonation, Stockholm University, October 28-29, 2005