

Asymmetries in grammar



Day 3: Early asymmetries in child language

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Early asymmetries in child language

- OT and Universal Grammar
- Language acquisition in OT
- Non-adult constraint ranking gives rise to asymmetries
- Illustrations: Early words, subject-object word order
- Evidence from adult sentence processing

OT and Universal Grammar

- Constraints in OT are universal.
- Only their ranking is language-specific.
- Re-ranking of constraints plays role in:
 - Language variation → Typology by reranking
 - Language change (Mattausch, H. de Swart)
 - Language acquisition

Language acquisition in OT

- Set of constraints is innate.
- What children have to acquire is the adult constraint ranking.
- Common assumption: Grammar gives rise to same results in production and comprehension.
- (but see OT account of DPBE)

Smolensky (1996)

Smolensky (1996):

- In Optimality Theory, production and comprehension may yield different results.

OT is output-oriented

- Optimality Theory is output-oriented:
 - Markedness constraints penalize outputs
 - Faithfulness constraints penalize input-output mappings
- If direction of optimization is reversed:
 - Effect of markedness constraints changes
 - Effect of faithfulness constraints stays the same

Markedness vs. faithfulness

Markedness constraints, e.g.:

- NoCoda: A syllable has no coda.
- *Dors: No dorsal segments.

Faithfulness constraints, e.g.:

- Parse: Every element in the input must be expressed in the output (= No deletion)
- Fill: Every element in the output must be present in the input (= No insertion)

(Smolensky, 1996)

Common expectation

- Different constraint ranking:
 - Different grammars, so possibly different results
 - Adults' grammar
 - Children's grammar
- Same constraint ranking:
 - Same grammar, so identical results
 - Children's grammar in production
 - Children's grammar in comprehension

Different constraint rankings, ...

Input:	FAITH	MARK
/kæt/	Parse, Fill	NoCoda, *Dors
[kæt]		*
[ta]	*!	

Tableau 1:
Adults' grammar:
FAITH >> MARK

Input:	MARK	FAITH
/kæt/	NoCoda, *Dors	Parse, Fill
[kæt]	*!	
[ta]		*

Tableau 2:
Children's grammar:
MARK >> FAITH

..., so different results

- If for children MARK >> FAITH, whereas for adults FAITH >> MARK:
 - Adults will produce [kæt], whereas children will produce the more economical form [ta].
 - Children must acquire adult constraint ranking.
 - They are able to do so based on observed mismatch between optimal output ([ta]) and heard form ([kæt]).
- error-driven learning

Implicit negative evidence

- Proposed algorithms:
 - Tesar & Smolensky's (1998, 2000) Error-Driven Constraint Demotion Algorithm
 - Boersma & Hayes' (2001) Gradual Learning Algorithm
- Heard form (winner) is compared with form generated by grammar (losers).
- Each winner-loser pair thus provides the child with implicit negative evidence.

Constraint re-ranking

Input:	MARK	FAITH
/kæt/	NoCoda, *Dors	Parse, Fill
winner [kæt]	*!	
loser [ta]		*

Tableau 2:
Children's grammar:
MARK >> FAITH

- Tesar & Smolensky: The constraints violated by the winner must be demoted below at least one constraint violated by the loser.
- Constraint ranking is adjusted iteratively.
- Boersma & Hayes: Also constraint promotion.

Same constraint rankings, ...

Input:	MARK	FAITH		Input:	MARK	FAITH
/kæɪt/	NoCoda, *Dors	Parse, Fill		[kæɪt]	NoCoda, *Dors	Parse, Fill
[kæɪt]	*!		☞	/kæɪt/		
☞ [tæ]		*		/tæ/		*!

Tableau 2:
Children's grammar:
Production

Tableau 3:
Children's grammar:
Comprehension

..., but different results!

- Same constraint ranking can give rise to different results in comprehension and production:
- Incorrect production but correct comprehension.
- This corresponds to observation that comprehension of first words precedes their production.



OT is direction-sensitive

- Production: Meaning → Form
 - Faithfulness constraints
 - Markedness constraints on form
- Comprehension: Form → Meaning
 - Faithfulness constraints
 - Markedness constraints on meaning
- Different constraints apply in production and comprehension

Delays in production

- Delays in production are predicted if markedness constraints on **form** are ranked too high.
- Of course, such delays can also be explained from sensory-motor difficulties.
- However, OT gives these effects for free; no additional assumptions are needed.

Initial ranking

- Tesar & Smolensky (1998: p. 253): For all grammars to be learnable, $M \gg F$ in the initial state.
- Motivation: If there are no grammatical alternations in a language with respect to M, but M is ranked below F initially, M will never end up above F.
- $M \gg F$: Only if a marked form is observed, M will be demoted.

Prediction

- Under the OT account, delays are conceivable in comprehension, too.
- Delays in comprehension are predicted if markedness constraints on **meaning** are ranked too high.



Can production precede comprehension?

- Eve Clark (1993: p. 246):
 - “Logically, comprehension must precede production. How else can speakers know which words to use to convey a particular meaning? They must already have mapped the relevant meanings onto specific forms, and have these units represented in memory, to be accessed on subsequent occasions whenever they hear the relevant forms from others.”

Chapman & Miller (1975)

- Investigated mastery of SVO word order by 15 English children (1;8 - 2;8 years old).
- Using act out task with following materials:
 - The boy is hitting the girl. (+animate, +animate)
 - The girl is hitting the car. (+animate, -animate)
 - The car is hitting the boy. (-animate, +animate)
 - The car is hitting the boat. (-animate, -animate)
- Tested similar sentences in production and comprehension.

Chapman & Miller’s results

	Production (% correct)	Comprehension (% correct)
1. The boy is hitting the girl. (+animate, +animate)	83.7	66.5
2. The girl is hitting the car. (+animate, -animate)	86.3	93.8
3. The car is hitting the boy. (-animate, +animate)	89.3	50.1
4. The car is hitting the boat. (-animate, -animate)	81.8	65.2

Global results of asymmetry have been confirmed by McClellan, Yewchuk & Holdgrafer (1986)

Chapman and Miller’s explanation

- “There remains the puzzle, then, of why the child appears unable to take the product of such a procedure, a sentence, and reverse his rule by inferring the relations among referent objects from the word order information” (p. 369)
- Their proposal: Preschoolers are often unable to reverse processes (cf. Piaget, 1950).

An OT explanation

Faithfulness constraint:

- Precedence: The subject precedes the object.

Markedness constraint on meaning:

- Prominence: The subject outranks the object in prominence (e.g., animacy).

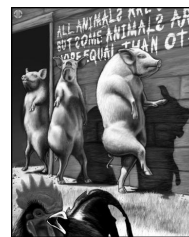
(Hendriks, de Hoop & Lamers, 2005)

Animacy

The animacy hierarchy:

- Humans >> animates >> inanimates

All animals are equal,
but...



Language variation

In some languages, Prominence (animacy) >> Precedence, e.g. Fore (de Hoop, 2005):

- Yagaa wá aegúye
pig man hit
'The man hit (killed) the pig'

English adults

- For English adults, Prec >> Prom
- Always subject-object order in production.
- Always subject-object interpretation in comprehension.
- ➔ English adults always base their forms and interpretations on word order.

Children

- If young English children entertain the wrong constraint ranking Prom >> Prec, OT predicts:
- Always subject-object order in production
- In certain cases, object-subject interpretation in comprehension (namely, when animacy information conflicts with word order)

Children's comprehension

Input form:	Output meaning:	MARK	FAITH
NP1, NP2	Arg1, Arg2 interpretation	Prom.	Prec.
☞ +anim, +anim	SO (66.5%)	*	
	OS	*	*!
☞ +anim, -anim	SO (93.8%)		
	OS	*!	*
☞ -anim, +anim	SO		
	OS (50.1%)	*!	*
☞ -anim, -anim	SO (65.2%)	*	
	OS	*	*!

Tableau 4: Children's comprehension of word order

Children's production

Input meaning:	Output form:	MARK	FAITH
Arg1, Arg2	NP1, NP2 word order	Prom.	Prec.
☞ +anim, +anim	SO (83.7%)		
	OS		*!
☞ +anim, -anim	SO (86.3%)		
	OS		*!
☞ -anim, +anim	SO (89.3%)		
	OS		*!
☞ -anim, -anim	SO (81.8%)		
	OS		*!

Tableau 5: Children's production of word order

Delays in early child language

- Early delays in production arise if markedness constraints on form are ranked too high (e.g., NoCoda).
- Early delays in comprehension arise if markedness constraints on meaning are ranked too high (e.g., Prominence).

Problem

- OT correctly predicts that children perform best on (+anim,-anim) sentences, and experience most difficulty with (-anim,+anim) sentences.
- However, why don't children interpret (+anim,+anim) and (-anim,-anim) sentences 100% correct?
- Perhaps other prominence factors besides animacy (saliency, visual cues) may have influenced results.

Prominence

- Is Prominence a grammatical constraint or a non-linguistic strategy?
- German: Case >> Prec >> Prom
- Den Zaun hat Bernhard zerbrochen.
the fence_{ACC} has Bernhard broken
'Bernard broke the fence'
- Evidence for Prominence as a grammatical constraint in German:

Adults' sentence processing (1)

Frisch & Schlesewsky (2001): ↓ N400

- * ... welcher Bischof ... der Priest ...
... which bishop_{NOM} ... the priest_{NOM} ...

↓ no N400

- * ... welcher Bischof ... der Zweig ...
... which bishop_{NOM} ... the twig_{NOM} ...

➔ People seem to have more problems interpreting (+anim, +anim) sentence.

OT and sentence processing

- OT is able to assign an optimal interpretation to ungrammatical sentences (robustness).
- OT can assign an optimal interpretation to sentences in an incremental fashion
(cf. Lamers & de Hoop, 2004; de Hoop & Lamers, 2006)
- ➔ OT may not only be seen as a theory of grammar, but also as a theory of sentence processing.

Incremental interpretation (1)

↓ N400

Input form:	Output meaning:	FAITH	FAITH	MARK
...welcher Bischof _{NOM} ... der Priest _{NOM}	Arg1, Arg2	Case	Prec.	Prom.
+anim, +anim	SO interpretation OS	*	*!	*

↓ no N400

Input form:	Output meaning:	FAITH	FAITH	MARK
...welcher Bischof _{NOM} ... der Zweig _{NOM}	Arg1, Arg2	Case	Prec.	Prom.
+anim, -anim	SO interpretation OS	*	*!	**

Tableau 6: Adults' comprehension of word order

Adults' sentence processing (2)

Schlesewsky & Bornkessel (2004):

↓ no N400

- ... welchen Bischof der Priest begleitete
... which bishop_{ACC} the priest_{NOM} accompanied

↓ N400

- ... welchen Bischof der Zweig streifte
... which bishop_{ACC} the twig_{NOM} brushed

➔ Effects of violations of Prominence?

Incremental interpretation (2)

↓ no N400

Input form:	Output meaning:	FAITH	FAITH	MARK
...welchen Bischof _{ACC}	Arg1, Arg2	Case	Prec.	Prom.
... der Priest _{NOM}	SO interpretation	*!		*
+anim, +anim	OS		*	*

↓ N400

Input form:	Output meaning:	FAITH	FAITH	MARK
...welchen Bischof _{ACC}	Arg1, Arg2	Case	Prec.	Prom.
... der Zweig _{NOM}	SO interpretation	*!		*
+anim, -anim	OS		*	**

Tableau 7: Adults' comprehension of word order

Asymmetries in language acquisition

	Early delay	Late delay
Delay in production	Early words	Anaphoric subjects
Delay in comprehension	Subject-object word order	DPBE, Object scrambling

Implications for theories of grammar

- If all four types of acquisition delays are observed, then language must be largely asymmetric.
- Adult symmetric pattern requires:
 - particular ranking of direction-sensitive constraints
 - bidirectional optimization

Developing your own OT analysis

1. Not only look at the adult pattern of forms and meanings, but also at children's patterns.
- Children's patterns may reveal differences between production and comprehension.
- These suggest the presence of one or more markedness constraints.

Developing your own OT analysis

2. Distinguish between aspects of form and aspects of meaning.
 - NB: May be different from traditional distinction between syntactic and semantic entities.
 - Aspects of form: word form, word order
 - Aspects of meaning: grammatical function, reference, scope

Developing your own OT analysis

3. Formulate OT constraints capturing the observed relations between forms and meanings.
 - NB: Exceptions are no problem. Constraint interaction should deal with these.
 - Constraints should be formulated as general as possible.
 - Some (though not all) constraints may be functionally grounded.

Today's conclusions

- Young children's delay in their production of first words are explained by an OT grammar.
- OT also predicts delays in young children's comprehension of subject-object word order.
- So OT is able to explain why production and comprehension can yield different results.