

Predicting (mis)matches in sluicing

Evidence from cloze, rating and reading time data

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Is sluicing subject to syntactic identity constraints?

Argument structure mismatches between antecedent and target (1) are degraded.

- (1) *Hans hat mit jemandem telefoniert, aber ich weiß nicht, wer (mit Hans telefoniert hat)
Hans has with somebody phoned but I know not who with Hans phoned has
'Hans was on the phone with somebody, but I don't know who'

Syntactic identity constraints

- ▶ **Chung (2006): Numeration Condition**
Omitted words must be contained in the numeration of the antecedent
- ▶ **Chung (2013): Argument Structure Condition (ASC)**
Argument sluices require parallel argument structure in antecedent and target

Can the data be explained by independently motivated processing constraints?

- ▶ Unlikely expressions are harder to process (Hale, 2001; Levy, 2008)
- ▶ High processing effort results in reduced acceptability
- ▶ Argument structure mismatches are infrequent
- ▶ Mismatches are unacceptable because they are hard to process

Outline of the talk

- 1 Syntactic identity or processing?
- 2 Experimental methods and materials
- 3 Acceptability rating study
- 4 Production study
- 5 Self-paced reading study
- 6 Conclusion

Syntactic identity

The Argument Structure Condition (ASC) (Chung, 2013)

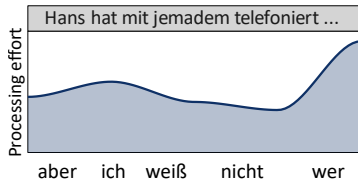
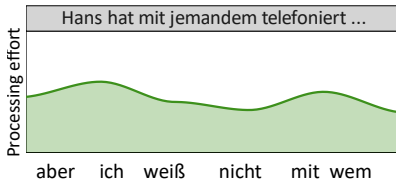
- ▶ Argument (2,3) sluices require a parallel argument structure
- ▶ Adjunct (4) sluices allow for argument structure mismatches

- (2) Hans hat mit jemandem telefoniert, aber ich weiß nicht, mit wem
Hans has with somebody phoned but I know not with who
'Somebody was on the phone with somebody, but I don't know with whom'
- (3) *Jemand hat mit Hans telefoniert, aber ich weiß nicht, mit wem
Somebody has with Hans phoned but I know not who
'Somebody was on the phone with Hans, but I don't know with who'
- (4) Jemand hat mit Hans programmiert, aber ich weiß nicht, mit wem
Somebody has with Hans coded but I know not with who
'Somebody was coding with Hans, but I don't know with whom'

Towards a processing account of sluicing mismatches

Key assumptions

- ▶ Predictability is proportional to processing effort (Hale, 2001; Levy, 2008)
- ▶ High processing effort results in degraded acceptability (Hofmeister et al., 2013)
- ▶ Speakers perform **audience design** (Pate and Goldwater, 2015)



Application to sluicing (mismatches)

- ▶ Mismatches are unlikely \Rightarrow harder to process
- ▶ Recovering the TP in case of sluicing requires additional effort on the *wh*-phrase
- ▶ Mismatches under ellipsis are specifically difficult \Rightarrow degraded

Two sources of predictability

Explicit v. implicit antecedent (sprouting)

- ▶ Explicit antecedents (5a) increase the likelihood of a related continuation

- (5)
- Hans hat **mit jemandem** telefoniert, aber ich weiß nicht ...
 - Hans hat telefoniert, aber ich weiß nicht ...

Likelihood of a partner

- ▶ Some verbs increase the likelihood a partner **beyond** argument structure

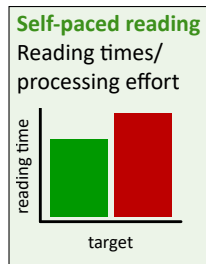
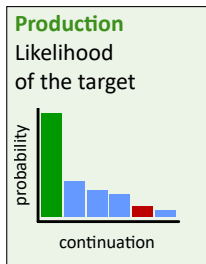
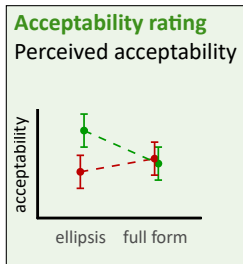
- (6)
- Hans hat telefoniert, aber ich weiß nicht ... (conversation partner required)
 - Hans hat programmiert, aber ich weiß nicht ... (coding partner unlikely)
 - Hans hat getanzt, aber ich weiß nicht ... (dancing partner likely)

Our processing account, but not syntactic identity predicts predictability effects on acceptability

Experimental methods and materials

Experimental methods

- (7) a. Hans hat mit jemandem getanzt, aber ich weiß nicht, **mit wem Hans getanzt hat.**
b. Hans hat mit jemandem getanzt, aber ich weiß nicht, **wer mit Hans getanzt hat.**



Predictions of the processing account

- ▶ Likely continuations are more often reduced, more acceptable and read faster
- ▶ Predictability is increased by overt antecedents and specific verbs

6 conditions crossing 3 factors

- ▶ CONSTRUCTION: Sluicing/Sprouting
- ▶ TARGET: PP/DP
- ▶ ANTECEDENT: PP/DP (Match/Mismatch)

- (8)
- | | | |
|----|--|------------|
| a. | Hans hat mit jemandem telefoniert, aber ich weiß nicht, mit wem.
Hans has with somebody phoned but I know not with whom | SL, PP, MA |
| b. | Jemand hat mit Hans telefoniert, aber ich weiß nicht, wer.
somebody has with Hans phoned but I know not who | SL, DP, MA |
| c. | Hans hat mit jemandem telefoniert, aber ich weiß nicht, wer. | SL, PP, MM |
| d. | Jemand hat mit Hans telefoniert, aber ich weiß nicht, mit wem. | SL, DP, MM |
| e. | Hans hat telefoniert, aber ich weiß nicht, mit wem. | SP, PP, MA |
| f. | Hans hat telefoniert, aber ich weiß nicht, wer. | SP, DP, MM |

Acceptability rating study

Acceptability rating study

Research questions

- ▶ Are elliptical mismatches degraded?
- ▶ Are sprouting mismatches particularly degraded?
- ▶ Is there an argument-adjunct asymmetry for PP sluices?
- ▶ Are there predictability effects driven by the verb?

Pre-test: How likely is a partner for each verb?

- ▶ Rate the likelihood of a 2nd participant in a statement like *Hans hat getanzt*.
- ▶ 5-point Likert scale, normalization by subject

Procedure

- ▶ All conditions, FORM (Sluicing/Full form) between subjects
- ▶ 96 subjects, recruited on Clickworker, 7-point Likert scale (7 = very natural)
- ▶ 24 items, 60 fillers, individual pseudo-randomized order

Acceptability rating study – Results

Analysis with Cumulative Link Mixed Models, R (Christensen, 2019)

- ✓ Elliptical mismatches are degraded ($\chi^2 = 42.42, p < 0.001$)
- ✓ Sprouting mismatches are particularly degraded ($\chi^2 = 4.55, p < 0.05$)
- ✗ Argument sluices are not degraded ($\chi^2 = 0.04, p > 0.8$)
- ✓ Verb-based predictability effects
 - ▶ Continuations referring to likely partner are better ($\chi^2 = 13.9, p < 0.001$)
 - ▶ ...specifically with implicit antecedents ($\chi^2 = 7.66, p < 0.01$)
 - ▶ ...with matching continuations ($\chi^2 = 9.02, p < 0.01$)
 - ▶ ...and specifically under ellipsis ($\chi^2 = 4.95, p < 0.05$)

Support for processing account

- ▶ All mismatches are degraded, but sprouting mismatches more strongly
- ▶ Predictability effects based on the likelihood of a partner given the verb
- ▶ No evidence for argument-adjunct asymmetry

Production study

Production study

Research questions

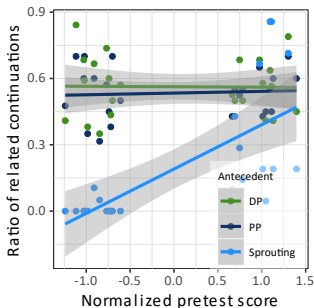
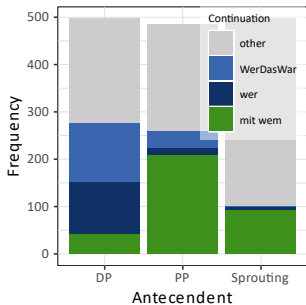
- ▶ Are mismatches less likely than matches?
- ▶ Are related continuations less likely under sprouting?
- ▶ Does the likelihood of a partner determine that of a related continuation?
- ▶ Are predictable continuations more often reduced?

- (9) Hans hat mit jemandem telefoniert, aber ich weiß nicht, _____
Hans has with somebody phoned but I know not

Procedure

- ▶ 1×3 design, ANTECEDENT (DP, PP, implicit), 24 items, 120 subjects
- ▶ Web-based production task (provide most natural continuation)
- ▶ Annotation whether the continuation was a **wh-question**, **related** (referring to a partner), **elliptical**, containing a **DP/PP wh**-phrase

How likely are continuations?



Analysis with logistic mixed effects models, R (Bates et al., 2015)

- ✓ Explicit antecedents yield more related continuations ($\chi^2 = 38.35, p < 0.001$)
- ✓ More related continuations when a partner is likely ($\chi^2 = 19.73, p < 0.001$)
- ✓ Specifically strong verb effect for implicit antecedents ($\chi^2 = 27.43, p < 0.001$)
- ✓ More frequent continuations are more often reduced ($F = 50.68, p < 0.001$)

Data support our processing account

Self-paced reading study

Self-paced reading study

Research questions

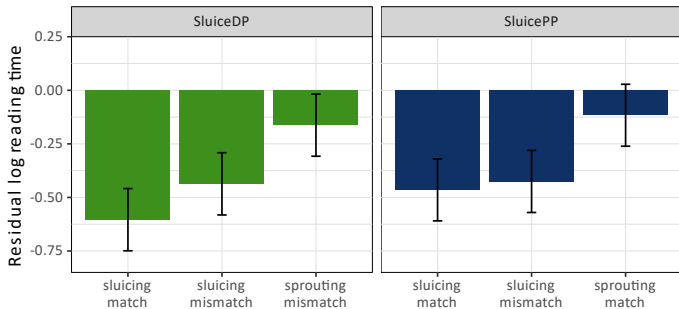
- ▶ Are mismatches, and specifically sprouting mismatches, harder to process?
- ▶ Is sprouting harder to process than sluicing?
- ▶ Are predictability effects of the verb reflected in reading times?

(10) Hans hat mit jemandem telefoniert, aber ich weiß nicht, **mit wem Hans telefoniert** hat.

Procedure

- ▶ 2×3 design (Antecedent \times Sluice), web-based, Ibx
- ▶ 48 subjects recruited on Clickworker, 24 items, 60 fillers
- ▶ Reading times on sluice and redundant TP on full forms (log-transformed, residualized for position, word length, subject (Jaeger, 2008))

Self-paced reading study – Results



Analysis with linear mixed effects models, R (Bates et al., 2015)

- ✓ Mismatches are harder to process ($\chi^2_{DP} = 3.59, p < 0.06, \chi^2_{PP} = 5.39, p < 0.05$)
- ✓ *wh*-phrases referring to implicit antecedents are harder to process ($\chi^2_{DP} = 14.79, p < 0.001, \chi^2_{PP} = 14.6, p < 0.001$)
- ✗ No effects of the likelihood of a partner given the verb

Partial support for processing account

Conclusion

Conclusion

Syntactic identity (Chung, 2013)

- ✓ Argument structure mismatches are degraded
- ✗ Sprouting mismatches are particularly degraded
- ✗ No argument – adjunct asymmetry

Processing account

- ✓ Mismatches are less likely, harder to process and degraded
- ✓ Elliptical mismatches are specifically degraded and only rarely produced
- ✓ Continuations referring to implicit antecedents are less likely and harder to process
- ✓ Verb-based predictability effects in rating and production
- ✗ No verb effect on reading times: Likelihood of existence \neq likelihood of mention?

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