Locality and anti-locality effects in German.
Insights from relative clauses

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The puzzle

Intervening material makes processing harder.

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Locality effects

(1) a. The reporter [who __ attacked the senator] quit. SRC
b. The reporter [who the senator attacked __ ] quit. ORC

- ORCs are harder to process than SRCs (King & Just, 1991)
- ORCs are later acquired than SRCs (De Villiers et al., 1979)

Longer dependencies are harder to process due to
- Memory load/processing cost (e.g., DLT; Gibson, 2000)
- Intervention (e.g., Relativized Minimality; Rizzi, 1990)
- Specific explanations, here e.g., consistency wrt role/syntactic function (e.g., Sheldon’s (1974) parallel function hypothesis)
Anti-Locality effects

(2) a. Er hat das Buch, das Lisa gestern gekauft hatte, hingelegt.
    he has the book that Lisa yesterday bought had laid down
    ‘He has laid down the book that Lisa had bought yesterday.’

b. Er hat das Buch hingelegt, das Lisa gestern gekauft hatte.
    he has the book laid down that Lisa yesterday bought had
    ‘He has laid down the book that Lisa had bought yesterday.’

- Konieczny (2000) found faster reading times for the main-clause verb when the relative clause intervenes

Intervening material facilitates integration because ...
- it provides time for creating expectations (anticipation)
- it contains constraining information (preactivation)
- it keeps the activation level up (reactivation)
Outline

1 Introduction

2 Subject-extracted vs. object extracted RCs
   - Experiment 1: SRC vs. ORC (short vs. long)
   - Experiment 2: Accessibility of intervening NP

3 Locality in multiply center embedded RCs

4 Experiment 3: Locality and GP-strength

5 Conclusions
English: robust ORC-penalty (various measures)

German: ??

Previous studies on SRCs vs. ORCs in German focused on ambiguity resolution. Studies which included unambiguous sentences found no or only a slight ORC-penalty (e.g., Friederici et al., 1998).

(Friederici et al., 1998 found, however, a penalty on the relative pronoun.)
(3) The captain noticed . . .
   a. a passenger who hid {a refugee | a bottle of scotch} on the ship.
   b. {a refugee | a bottle of scotch} who a passenger hid on the ship.

(4) Der Kapitän bemerkte . . .
   a. einen Passagier, der {einen Flüchtling | eine Flasche Whisky} auf dem Schiff versteckte.
   b. {einen Flüchtling | eine Flasche Whisky}, den|die ein Passagier auf dem Schiff versteckte.

- part of a larger study run in parallel in English and German
- offline ratings (7pt scale)
Locality: SRC vs. ORC

(5) The captain noticed . . .
   a. a passenger who hid {a refugee | a bottle of scotch} on the ship.
   b. {a refugee | a bottle of scotch} who a passenger hid on the ship.

80 participants
20 items
joint analyses:
   3-way interaction *

English:
   Order *
   Animacy *
   interaction *

German:
   no significant effects

(taken from Häussler et al., submitted)
Experiments 1-3: General characteristics

Structure of experimental sentences:

(6) Main clause [COMP subject $[_{RC} \text{ who NP2 \ldots \ldots Verb }]$ object $V$].

- RC modifies subject of an embedded clause
- RC verb in clause-final position
- RC is followed by the object and the verb of the superordinate clause

Procedure:

- Self-paced reading
  - word-by-word
  - non-cumulative
  - pre-presentation of each word in form of understrokes
Ich weiß, dass der Reporter, der Manager (Adv) einen Tipp gegeben hat, den Trainer ansprechen wird.

‘I know that the reporter {who gave the manager a hint| who the manager gave a hint} will ask the coach.’

Adv: am Samstag vor dem Spiel (‘on Saturday before the game’)}
Experiment 1: Results

Anti-locality

SO, w/o Adverbial
OS, w/o Adverbial
SO, with Adverbial
OS, with Adverbial

Residual Reading Times

SO, w/o Adverbial
OS, w/o Adverbial
SO, with Adverbial
OS, with Adverbial

rc−wh

np2

adv

np3

rc−v

matrixo

matrixv

RC-Type

Adverbial

Interaction

n.s.

n.s.

n.s.

n.s.

n.s.

n.s.

n.s.

n.s.

n.s.

n.s.
Experiment 2

(8) Ich weiß, dass der Reporter, (‘I know that the reporter’)  
\[ \begin{align*} 
\text{a) } & \text{ der } \{\text{den Manager|mich}\} \text{ am Montag angerufen hat,} \\
& \text{ who.NOM the manager me on Monday called has} \\
\text{b) } & \text{ den } \{\text{der Manager|ich}\} \text{ am Montag angerufen hat|habe,} \\
& \text{ who.ACC the manager I on Monday called has have} \\
\end{align*} \]

den Trainer ansprechen wird. (‘will ask the coach’)

- transitive verbs in RC (accusative object)
- Factor **Structure**: SRC vs. ORC
- New factor **NP-type**: type/pronominality of intervening NP
Experiment 2: Results

Localization

- SO, Full DP
- OS, Full DP
- SO, Pronoun
- OS, Pronoun

Residual Reading Times

**/*** n.s. n.s. n.s. n.s.

RC-Type: der|den who
NP-Type: the manager
Adv: am Montag on Monday
RC-V: angerufen hat called has
matrixO: den Trainer the coach
matrixV: kritisiert hat criticized has

RC-wh
NP2
Adv
RC-V
matrixO
matrixV

RC-Type: n.s.
NP-Type: n.s.
interaction: n.s.
Interim Summary

Locality versus Antilocality

- Anti-locality effect:
  Adverbial facilitates integration of subsequent items

- Locality effect:
  Prolonged reading times when intervening NP is lexical rather than pronominal

SRC versus ORC

- No SRC-ORC asymmetry in German

- This follows only if locality concerns verb–argument dependencies (e.g., DLT), not filler-gap dependencies (e.g., Rizzi et al., 2009)
**Length of filler gap dependency**

**English:** shorter in SRC $\rightarrow$ penalty in ORC ✓

(9) a. The reporter **who** \( t_i \) **attacked** the senator gave up.

b. The reporter **who** the senator **attacked** \( t_i \) gave up.

**German:** shorter in SRC $\rightarrow$ penalty in ORC !

(10) a. Der Reporter, **der** \( t_i \) **den** Senator **attackierte**, gab auf.

b. Der Reporter, **den** der Senator **attackierte**, gab auf.


Length of verb-argument dependencies

**English**: shorter in SRC $\rightarrow$ penalty in ORC ✓

(11) a. The reporter *who* $t_i$ attacked the senator gave up.

       a. The reporter *who* the senator attacked $t_i$ gave up.

**German**: same distance $\rightarrow$ no SCR-ORC contrast ✓


       a. Der Reporter, *den* der Senator $t_i$ *attackierte*, gab auf.
Excursus: Multiply center-embedded clauses

Additional intervening material sometimes leads to locality effects (for English, see Grodner & Gibson, 2005):

(13) Ich glaube, I believe
dass man den Vater, that they the father
der den Lehrer, who the teacher
der das Buch ausgewählt hat, who selected the book
angerufen hat, called has
kritisiert hat,.... criticized has

Reading times for V of the superordinate clause (criticized has)

<table>
<thead>
<tr>
<th>Without RCs</th>
<th>With higher RC only</th>
<th>With higher and lower RC</th>
</tr>
</thead>
<tbody>
<tr>
<td>77ms</td>
<td>118ms</td>
<td>284ms</td>
</tr>
</tbody>
</table>

Diff crit. = 144ms
Experiment 3: unambiguous and locally ambiguous ORCs

(14) Ich weiß, dass der Reporter, (‘I know that the reporter’)

\[
\text{den die Manager (am Montag) angerufen haben, who.ACC the managers on Monday called have}
\]

heute noch den Trainer ansprechen wird. (‘will ask the coach this very day’)

(15) Ich weiß, dass die Reporterin, (‘I know that the reporter’)

\[
\text{die die Manager (am Montag) angerufen haben, who.NOM|ACC the managers on Monday called have}
\]

heute noch den Trainer ansprechen wird. (‘will ask the coach’)

- further factor: Adverbial (+/− present)
Experiment 3: Garden-path strength

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**Residual Reading Times**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Mean (in ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambiguous, w/o Adverbial</td>
<td></td>
</tr>
<tr>
<td>Ambiguous, with Adverbial</td>
<td></td>
</tr>
<tr>
<td>Unambiguous, w/o Adverbial</td>
<td></td>
</tr>
<tr>
<td>Unambiguous, with Adverbial</td>
<td></td>
</tr>
</tbody>
</table>

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**Ambiguity**

- ** den | die who **/*
- ** die Manger who */+
- ** am Montag on Monday */+

**Adverbial**

- n.s.
- n.s.
- n.s.

**Interaction**

- n.s.
- n.s.
- n.s.
- n.s.
- */n.s.

---

**Sentence Examples**

- den | die Manger who
- die Manger who am Montag on Monday
- angerufen called
- haben have
- den Trainer who
- kritisiert hat criticized has

---

**Notes**

- **/**
- */+
- **/**
- *//+
Experiment 3: Garden-path strength

<table>
<thead>
<tr>
<th></th>
<th>Residual Reading Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>ambiguous, w/o Adverbial</td>
<td>62 19</td>
</tr>
<tr>
<td>ambiguous, with Adverbial</td>
<td>56 44</td>
</tr>
<tr>
<td>unambiguous, w/o Adverbial</td>
<td>43 -11</td>
</tr>
<tr>
<td>unambiguous, with Adverbial</td>
<td>-17 -100</td>
</tr>
</tbody>
</table>

RTs for the RC-verb (diffcrit = 25.5 ms)

<table>
<thead>
<tr>
<th></th>
<th>Residual Reading Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>ambiguous, w/o Adverbial</td>
<td>109 96</td>
</tr>
<tr>
<td>ambiguous, with Adverbial</td>
<td>156 50</td>
</tr>
<tr>
<td>unambiguous, w/o Adverbial</td>
<td></td>
</tr>
<tr>
<td>unambiguous, with Adverbial</td>
<td></td>
</tr>
</tbody>
</table>

RTs for the matrix verb (diffcrit = 44.5 ms)

<table>
<thead>
<tr>
<th></th>
<th>Residual Reading Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>ambiguous, w/o Adverbial</td>
<td>109 96</td>
</tr>
<tr>
<td>ambiguous, with Adverbial</td>
<td>156 50</td>
</tr>
<tr>
<td>unambiguous, w/o Adverbial</td>
<td></td>
</tr>
<tr>
<td>unambiguous, with Adverbial</td>
<td></td>
</tr>
</tbody>
</table>
Experiment 3: Discussion

Summary of results:

- In unambiguous sentences, the presence of an adverbial leads to faster comprehension times.
- In ambiguous sentences, reading times between sentences with and without adverbial do not differ.

Conclusion:

- The adverbial caused the usual antilocality effect.
- In ambiguous sentences, this antilocality effect was offset by a locality effect: An intervening adverbial makes garden-path recovery more difficult (see the Semantic Cost Principle of Frazier & Clifton, 1998).
Summary and Conclusion

Unambiguous sentences

- no SRC-ORC contrast
- the presence of an adverbial decreases reading times
- pronominal intervenor decreases reading times

Ambiguous sentences

- no reading time difference between sentences with and without adverbial

Conclusion:

- Locality effects and anti-locality effects co-occur.
- The burdens of distance may cancel the benefits of additional material
- Garden-Path recovery becomes more difficult when additional material lengthens the ambiguous part
Thank you


