Locality domains in syntax: Evidence from sentence processing

Stefan Keine

University of Massachusetts Amherst

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Previous evidence for intermediate gaps in Spec,vP

Experiment: CPs vs. vPs

Introduction

Background

Long-distance movement is formed successively cyclically (Chomsky 1973, 1977)

The traditional view:
Intermediate gap created in Spec,CP

(1) Who did Sue say \([_{CP} t \text{ that Sam thinks } ]_{CP} t \text{ Bill likes } t\)?
Extensions to vP

- More recently (Chomsky 1986, 2000, 2001), vPs have standardly been taken to also require successive-cyclic movement through their specifier

**Phases**

- C and v are phase heads
- Phase Impenetrability Condition requires intermediate landing site in specifier
This talk

**Main point**
Evidence from sentence processing can be used to locate intermediate landing sites and thereby phases

**Main claims**
- Reading time evidence for intermediate gaps created by successive cyclicity
- This evidence suggests that only CPs host intermediate gaps; vPs do not
Roadmap

1. Successive cyclicity in parsing: Previous evidence
2. Experiment: CPs vs. vPs
3. Previous evidence for intermediate gaps in Spec,vP
Roadmap

1. Successive cyclicity in parsing: Previous evidence
2. Experiment: CPs vs. vPs
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Why sentence processing?

Syntactic constraints and sentence processing

Phases are the result of constraints on computational resources

- This directly leads one to expect to observe effects of phases in online processing → successive cyclicity
Why sentence processing?

Syntactic constraints and sentence processing

Phases are the result of constraints on computational resources

- This directly leads one to expect to observe effects of phases in online processing ➔ successive cyclicity

- Gibson & Warren (2004):
Reading time evidence for intermediate gaps in Spec,CP
Gibson & Warren (2004): Background

**The role of filler–gap distance**

The greater the **distance** between the filler and the gap, the greater the **reading time** at the position of the gap (e.g., King & Just 1991, Gibson 1998, 2000, Gordon et al. 2001, Warren & Gibson 2002, Lewis & Vasishth 2005)

- **Rationale:**
  
  Filler has to be syntactically and semantically integrated at gap position → distance increases the difficulty of filler retrieval
Gibson & Warren (2004): The basic idea

- Movement out of CP compared to movement over complex subject DP

(2) **CP condition**
The consultant [who the manager claimed [CP that the new proposal had pleased ___ ]] will hire five workers tomorrow.

(3) **DP condition**
The consultant [who [DP the manager’s claim about the new proposal ] had pleased ___ ] will hire five workers tomorrow.
Structure of relative clause

\[
\text{who} \quad \{ \begin{array}{l}
\text{the manager claimed \([CP \_ \_ \_ \text{that the new proposal} \[DP \text{the manager’s claim about the new proposal}] \)}
\end{array}\} \text{had pleased t}
\]
Structure of relative clause

who

{ the manager claimed \[CP \text{ that the new proposal } \]
\[DP \text{ the manager’s claim about the new proposal}\] } had pleased t

Previous evidence
Experiment: CPs vs. vPs
Previous evidence for intermediate gaps in Spec,vP
Structure of relative clause

\[
\text{who} \quad \left\{ \text{the manager claimed} \ [\_{\text{CP}} \quad \text{that the new proposal} \ [\_{\text{DP}} \text{the manager’s claim about the new proposal}] \right\} \text{had pleased t}
\]
**Structure of relative clause**

- **Expectation**
  Distance to closest antecedent is \textit{smaller} in CP structure due to intermediate trace DP condition

- This should manifest itself in the reading times at gap-hosting verb ‘pleased’
Reading time: The crucial comparisons

(4) **CP condition**

a. The manager **who** the consultant claimed that the new proposals had **pleased** t will hire five workers tomorrow.

(5) **DP condition**

a. The manager **who** the consultant’s claim about the new proposal had **pleased** t will hire five workers tomorrow.
Reading time: The crucial comparisons

(4) **CP condition**

a. The manager **who** the consultant claimed that the new proposals had **pleased** t will hire five workers tomorrow.

b. The consultant claimed that the new proposals had **pleased** the manager who will hire five workers tomorrow.  

(BASELINE)

(5) **DP condition**

a. The manager **who** the consultant’s claim about the new proposal had **pleased** t will hire five workers tomorrow.

b. The consultant’s claim about the new proposal had **pleased** the manager who will hire five workers tomorrow.

(BASELINE)
Reading time: The crucial comparisons

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b. The consultant claimed that the new proposals had pleased the manager who will hire five workers tomorrow. (BASELINE)

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Reading time: The crucial comparisons

(4) **CP condition**

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   *(BASELINE)*

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Reading time: The crucial comparisons

(4) **CP condition**

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a. The manager who the consultant’s claim about the new proposal had pleased t will hire five workers tomorrow.

b. The consultant’s claim about the new proposal had pleased the manager who will hire five workers tomorrow. (BASELINE)
Gibson & Warren (2004): Results

**Finding**

Reading time increase between movement structure and baseline was **smaller** in CP condition than in DP condition.

- Intermediate gap in Spec,CP facilitates processing at gap site
- No such facilitation in DP condition due to lack of intermediate gap
CP and vP?

- **What we know:**
  Gibson & Warren (2004)’s results show successive-cyclic movement through Spec,CP

- **Question:**
  Is there successive-cyclic movement through Spec,vP as well?

- **‘CP only’ hypothesis**
  Intermediate trace only in Spec,CP

- **‘CP+vP’ hypothesis**
  Intermediate trace in both Spec,CP and Spec,vP
Intermediate gaps on the CP+\(vP\) hypothesis

The limits of Gibson & Warren (2004)’s results

Gibson & Warren (2004)’s results are compatible with both ‘CP only’ and ‘CP+\(vP\)’ hypothesis
Intermediate gaps on the CP+vP hypothesis

The limits of Gibson & Warren (2004)’s results

Gibson & Warren (2004)’s results are compatible with both ‘CP only’ and ‘CP+vP’ hypothesis

**CP structure:**

who the manager \[vP\] t claimed \[CP\] t that the new proposal had \[vP\] t pleased t

**DP structure:**

who \[DP\] the manager’s claim about the new proposal] had \[vP\] t pleased t

- 3 intermediate gaps CP structure; only 1 in DP structure
- Relative easiness of CP structure follows if no only distance to closest gap matters but also number of intermediate reactivations (e.g., Vasishth & Lewis 2006)
Roadmap

1. Successive cyclicity in parsing: Previous evidence
2. Experiment: CPs vs. vPs
3. Previous evidence for intermediate gaps in Spec,vP
Expectations

<table>
<thead>
<tr>
<th>‘CP only’ hypothesis</th>
<th>‘CP+νP’ hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPs have facilitatory effect on ultimate gap, νPs do not</td>
<td>Both CPs and νPs have facilitatory effect</td>
</tr>
</tbody>
</table>

Different predictions for structures that contain an additional νP layer but no CP layer
Design

- Extension of Gibson & Warren’s experiment with additional TP structure, all compared to no-movement control

(6) CP structure
The witness who the prosecutor proved [CP that the bloody footprint had conclusively incriminated t ] admitted the truth.

(7) DP structure
The witness who [DP the prosecutor’s proof about the bloody footprint] had conclusively incriminated t admitted the truth.

(8) TP structure
The witness who the prosecutor proved [TP the bloody footprint to have conclusively incriminated t ] admitted the truth.
Movement in the three structures

**CP structure:**

who the prosecutor \( [vP \_] \) proved \( [CP \_] \) that the bloody footprint had \( [vP \_] \) conclusively incriminated t

**DP structure:**

who \( [DP \_] \) the prosecutor’s proof about the bloody footprint \( [vP \_] \) had \( [vP \_] \) conclusively incriminated t

**TP structure:**

who the prosecutor \( [vP \_] \) proved \( [TP \_] \) the bloody footprint to have \( [vP \_] \) conclusively incriminated t
Movement in the three structures

**CP structure:**

\[ \text{who } \text{the prosecutor } [_{vP} \_\_ \text{proved } [_{CP} \_\_ \text{that the bloody footprint had }] \_\_ \text{conclusively incriminated } t \]

**Intermediate Gaps:**  
\textbf{CP only: 1}

**DP structure:**

\[ \text{who } [_{DP} \_\_ \text{the prosecutor’s proof about the bloody footprint] had }] \_\_ \text{conclusively incriminated } t \]

**Intermediate Gaps:**  
\textbf{CP only: 0}

**TP structure:**

\[ \text{who } \text{the prosecutor } [_{vP} \_\_ \text{proved } [_{TP} \_\_ \text{the bloody footprint to have }] \_\_ \text{conclusively incriminated } t \]

**Intermediate Gaps:**  
\textbf{CP only: 0}
Movement in the three structures

**CP structure:**

who the prosecutor [\(v_P\) ___ proved [\(CP\) ___ that the bloody footprint had \([v_P\) ___ conclusively incriminated \(t\)]

**DP structure:**

who [\(DP\) the prosecutor’s proof about the bloody footprint] had \([v_P\) ___ conclusively incriminated \(t\)]

**TP structure:**

who the prosecutor [\(v_P\) ___ proved [\(TP\) the bloody footprint to have \([v_P\) ___ conclusively incriminated \(t\)]

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Movement in the three structures

**CP structure:**

who the prosecutor [vP ___ proved [CP ___ that the bloody footprint had [vP ___ conclusively incriminated t

INTERMEDIATE GAPS: CP only: 1; CP+vP: 3

**DP structure:**

who [DP the prosecutor’s proof about the bloody footprint] had [vP ___ conclusively incriminated t

INTERMEDIATE GAPS: CP only: 0; CP+vP: 1

**TP structure:**

who the prosecutor [vP ___ proved [TP the bloody footprint to have [vP ___ conclusively incriminated t

CP only: 0; CP+vP: 2
Predictions

<table>
<thead>
<tr>
<th></th>
<th>CP only</th>
<th>CP+vP</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP structure</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>DP structure</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>TP structure</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

**Prediction:**

Reading time increase: \{DP, TP\} > CP  \> DP > TP > CP
Method

- 2 x 3 design (crossing MOVEMENT and STRUCTURE)
- 162 participants recruited on MTurk
- 30 plausibility-controlled items
- Latin Square
- 60 filler sentences
Results

Gap region
- increase in TP condition greater than in CP and DP condition ($\hat{\beta} = -0.05, t = -2.2$)
- no difference between CP and DP condition ($\hat{\beta} = -0.00, t = -0.04$)

Spillover region
- increase in DP and TP structures greater than in CP structure ($\hat{\beta} = 0.06, t = 2.1$)
- no difference between DP and TP condition ($\hat{\beta} = -0.02, t = -0.7$)
Results vs. predictions

**Predictions:** Reading time increase

- **CP only:** \(\{DP, TP\} > CP\)
- **CP+vP:** \(DP > TP > CP\)

**Results:**

- Gap region: \(\{CP, DP\} > TP\)
- Spillover region: \(CP > \{DP, TP\}\)

\[TP > DP > CP\]
Results vs. predictions

**Predictions:** Reading time increase
- **CP only:** \{DP, TP\} > CP
- **CP+vP:** DP > TP > CP

**Results:**
- Gap region: \{CP, DP\} > TP
- Spillover region: CP > \{DP, TP\} \quad \{ TP > DP > CP \}

**Conclusion**
- Filler easiest to retrieve in CP structure
  - successive cyclicity through Spec,CP
Results vs. predictions

Predictions: Reading time increase

- CP only: \{DP, TP\} > CP
- CP+vP: DP > TP > CP

Results:

- Gap region: \{CP, DP\} > TP
- Spillover region: CP > \{DP, TP\}

\begin{align*}
&\text{TP} > \text{DP} > \text{CP}
\end{align*}

Conclusion

- Filler easiest to retrieve in CP structure
  \(\rightarrow\) successive cyclicity through Spec,CP
- No facilitation in TP structure
  \(\rightarrow\) no successive cyclicity through Spec,vP
- Evidence for ‘CP only’ and against CP+vP hypothesis
The role of structural distance

A remaining question:
Why is retrieval of the filler hardest in the TP structure?

Answer:
This is plausibly due the **structural** distance between the filler and the trace.
The role of structural distance

- **TP structure:**
  Movement is **cross-clausal** → particularly hard

- **CP structure:**
  Movement is **intra-clausal**, thanks to successive cyclicity

- **DP structure:**
  Movement is **intra-clausal**
The role of structural distance

- **TP structure:**
  Movement is **cross-clausal** → particularly hard

- **CP structure:**
  Movement is **intra-clausal**, thanks to successive cyclicity

- **DP structure:**
  Movement is **intra-clausal**

**Upshot**

- Movement in TP structure is cross-clausal only if there is **no** intermediate gap in Spec,vP

  → Additional evidence for ‘CP only’ hypothesis
Summary

- Reading time increase: TP > DP > CP
- Accounted for under ‘CP only’ hypothesis plus structural distance
  - Intermediate gap in Spec,CP $\Rightarrow$ facilitation in CP structure
  - No intermediate gap in Spec,vP $\Rightarrow$ no facilitation in TP structure
- Pattern is not accounted for under CP+vP hypothesis

Conclusion
Successive cyclicity through Spec,CP but not through Spec,vP
Roadmap

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‘Wh’-expletives

- In, e.g., Hindi, wh-expletives occur before every verb between a wh-phrase and its scope position:

  (9) Sita-ne kyaa socaa ki Ravi-ne kis-ko dekhaa?
  Sita-ERG EXPL think that Ravi-ERG who-ACC saw
  ‘Who did Sita think that Ravi saw?’

- Manetta (2010): Connector between phase-internal wh-phrase and scope position
‘Wh’-expletives

- In, e.g., Hindi, wh-expletives occur before every verb between a wh-phrase and its scope position:

(9) Sita-ne **kyaa socaa ki** Ravi-ne **kis-ko** dekhaa?  
Sita-**erg** **expl** think that Ravi-**erg** **who-acc** saw  
‘Who did Sita think that Ravi saw?’

- Manetta (2010): Connector between phase-internal wh-phrase and scope position

- **Alternative account:** Indirect dependency approach (Dayal 2010)

(10) What does Sita think? Who did Ravi see?
Reconstruction

• Fox (1999): Wh-movement in (11) must proceed through via vP to bind the pronoun and obviate Principle C

(11) [Which of the books that he$_1$ asked Ms. Brown$_2$ for] did every student$_1$ [vP ✓ get from her$_2$ *?]
Reconstruction

- Fox (1999): Wh-movement in (11) must proceed through via vP to bind the pronoun and obviate Principle C

  (11) [Which of the books that he\textsubscript{1} asked Ms. Brown\textsubscript{2} for] did every student\textsubscript{1} [vP ✓ get from her\textsubscript{2} *?]

- Den Dikken (2006): only pair list reading

- If every student raises above the wh-moved element (Kiss 1993), no reconstruction whatsoever is necessary

  (12) [every student]\textsubscript{1} [which of the books that he\textsubscript{1} asked Ms. Brown\textsubscript{2} for]\textsubscript{3} did t\textsubscript{1} get from her\textsubscript{2} t\textsubscript{3}
Copy spellout

- A wh-element is realized in several spots: Spellout of lower copy

\[(13) \textbf{Wen} \text{ hat er gesagt } \textbf{wen} \text{ Maria mag?} \]
\[\text{who has he said who Maria likes} \]
\[\text{‘Who did he say that Maria likes?’} \quad \text{(GERMAN)}\]
Copy spellout

- A wh-element is realized in several spots: Spellout of lower copy

(13) **Wen** hat er gesagt **wen** Maria mag?
    who has he said who Maria likes
    ‘Who did he say that Maria likes?’

- A curious gap:
  A standard CP+vP account predicts a much more striking version of this phenomenon: Copy spellout in CPs and vPs

(14) **Who** do you **who** think **who** that Mary **who** likes?

→ unattested
Conclusion

- Sentence processing constructs movement dependencies successively-cyclically
  - Evidence for successive cyclicity through Spec,CP
  - Evidence against successive cyclicity through Spec,vP

- Consistent with working memory motivation for phases

- Phases are larger than commonly thought
  - C is a phase, v is not

- At least several of the previous arguments for vP phases do not in fact entail vP phases
References I


den Dikken, Marcel (2006). A reappraisal of vP being phasal: A reply to Legate, Ms., CUNY.


Appendix 1: Stimuli

(15) **CP structure**
The witness who the prosecutor proved [CP that the bloody footprint had conclusively incriminated t ] admitted the truth.
control: The prosecutor proved that the bloody footprint had conclusively incriminated the witness who admitted the truth.

(16) **DP structure**
The witness who [DP the prosecutor’s proof about the bloody footprint] had conclusively incriminated t admitted the truth.
control: The prosecutor’s proof about the bloody footprint had conclusively incriminated the witness who admitted the truth.

(17) **TP structure**
The witness who the prosecutor proved [TP the bloody footprint to have conclusively incriminated t ] admitted the truth.
control: The prosecutor proved the bloody footprint to have conclusively incriminated the witness who admitted the truth.
Appendix 2: Complete reading times

The witness who the prosecutor proved/the prosecutor’s proof (that/about) the bloody footprint had/to have conclusively incriminated admitted the truth

Residual reading times (ms)

Clause type [−move] [+move]
Appendix 3: Linear and structural distance

**CP structure:**

who the prosecutor [\textsubscript{VP} proved [\textsubscript{CP} \textbf{that} the bloody footprint had [\textsubscript{VP} conclusively incriminated t

\textbf{LINEAR DISTANCE: small; STRUCTURAL DISTANCE: small $\rightarrow$ fastest}

**DP structure:**

who [\textsubscript{DP} the prosecutor’s proof about the bloody footprint] had [\textsubscript{VP} conclusively incriminated t

\textbf{LINEAR DISTANCE: large; STRUCTURAL DISTANCE: small $\rightarrow$ slower}

**TP structure:**

who the prosecutor [\textsubscript{VP} proved [\textsubscript{TP} the bloody footprint to have [\textsubscript{VP} conclusively incriminated t

\textbf{LINEAR DISTANCE: large; STRUCTURAL DISTANCE: large $\rightarrow$ slowest}