By way of introduction

- Before the scientist submitted his paper, the journal changed its policy
- After the scientist submitted his paper, the journal changed its policy

Brain response to after and before

After and Before

Temporal relationship of events

- The parser “looks back” examining the relationship between the clauses or constituents

Relating two clauses

Münte, Schiltz & Kutas (1998): when sentences present events out of chronological order, additional discourse-level computation is required
Questions

Are there other structures that show the same look-back effect?
Does parametric variation make looking back more pervasive in some languages?
If so, how do those languages cope with the extra difficulty?

Questions

Are there other structures that cause the same look back problem?

While ___ reading the paper Mary felt depressed
As she shut the door Susan realized that…

Looking back and forth in Japanese or Korean

<table>
<thead>
<tr>
<th>Forward dependency</th>
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Forward and backward dependencies are syntactically similar

Binding principles in English:

Mary claimed that she was innocent
That she was innocent was claimed by Mary
She claimed that Mary was innocent

Binding principles in Korean

누구나 자기가 옳다고 생각한다
nwukwuna [caki]-ka olh-ta-ko sayngkakha-n-ta
everyone self-NOM be_right-Comp think-PRS-DEC
‘Everyone thinks s/he is right.’

자기 가 옳다고 누구나 생각한다.
[caki]-ka olh-ta]-ko nwukwuna sayngkakha-n-ta
‘Everyone thinks s/he is right.’
Questions

Assuming that structural principles are generally the same,
• do head-final languages use special strategies for processing backward-looking dependencies?
• do “backward-looking” languages treat silent elements the same as “forward-looking” languages?

Answers:
• Processing of backward dependencies shows both similarities and differences compared to forward dependencies
• Head-final languages restrict the amount of “looking back”

Questions

• Assuming that structural principles are generally the same, do “backward-looking” languages have the same inventory of items with impoverished or null lexical content as “forward-looking” languages?
• Answer (tentative): – The use of silent elements may be different from what is deployed in “forward-looking” languages

Outline

• Looking back: Processing costs
• Avoiding the need to look back: Structural workarounds
• Looking back made easier?
  Inventory of silent elements
• Conclusions

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• Avoiding the need to look back: Structural workarounds
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Binding principles in Korean

* 자기가 누구나가 옳다고 생각한다
* cakii-ka [nwukwu(na)-ka, olh-ta]-ko sayngkakha-n-ta
  self-NOM everyone-NOM be_right-C think-PRS-DEC

* 누구나가 옳다고 자기가 생각한다
* [nwukwu(na)-ka, olh-ta]-ko cakii-ka sayngkakha-n-ta
  everyone-NOM be_right-C self-NOM think-PRS-DEC

(“Self thinks everyone is right.”)
Looking back: Processing costs
(Kwon 2008; Kwon et al. 2008; Kwon et al. in preparation-b)

Placement of Electrodes

Event-Related Brain Potentials (ERP)

ERPs at work

Brain response to known and unknown words as measured by electroencephalography (EEG)

20 m.o. infants (Conroy & Mills 2006)

What ERP can do for you

• When? ERPs provide good indication of temporal resolution
• Powerful source of data in establishing the timeline for processing long-distance dependencies

What ERP can do for you

• When? Good indicator of temporal resolution
• Where? Not good at spatial resolution
Relative vs. adjunct clauses: syntactic vs. anaphoric dependency

Relative clause (syntactic dependency)
The reporter, [RC who attacked the senator] admitted the error.

- Syntactic dependency:
  1. coindexation between filler and gap is syntactically licensed and obligatory
  2. presence of a filler entails the presence of a gap

Adjunct clause (anaphoric dependency)
Because he was fed up, the girl cleaned the house.

- Anaphoric dependency:
  1. coindexation between antecedent and gap is semantically/pragmatically licensed and is not obligatory
  2. presence of a pronoun does NOT entail the presence of an intra-sentential antecedent

Looking back is like looking forward

Immediate gap-antecedent association:
- LAN (left Anterior Negativity)
  - to relative clauses in comparison to adjunct clauses
  - to adjunct clause in comparison to control clauses

Looking back is different:
Incremental but CAUTIOUS parsing

- Relative clause
- Adjunct clause

Continuous evaluation:
- of the semantic fit between gap and filler
- of inter-sentential relationships

Korean stimuli

Relative clause: 'The actor, who the singer openly criticized held a press conference.'
Adjunct clause: 'Because the singer openly criticized (him), the actor, held a press conference.'
Control sentence: 'The reporters rushed to the management company of the actor who the singer criticized.'
Looking forward

• The parser assumes the gap
• The parser immediately associates the gap with an antecedent (active search mechanism)
• Active search strategy:
  as soon as the antecedent (filler) is encountered, the parser starts building a dependency

Looking back: Incremental CAUTIOUS parsing

• The parser assumes the gap at some point
• The parser starts looking for an association of the gap with a filler
• The parser continuously evaluates
  – semantic fit of gap and filler
  – inter-sentential relationships

By way of comparison

• No continuous evaluation effects in forward looking dependencies

When is the gap posited?

• Forward dependency (filler-gap ordering)
  – gap is postulated when the parser encounters a filler (Active Filler Strategy, Frazier & Clifton 1989)
• Backward dependency (gap-filler ordering)
  – Gap could be postulated when the parser is cued by local information e.g., verbal agreement, case marker, argument structure of the relational expression (e.g., predicate)
Gap positing in a backward dependency

- Gap positing in languages with rich agreement (e.g., Spanish and Italian)
  - Gap is posited immediately at the agreeing predicate (Fernandez-Salgueiro et al. 2007; de Vincenzi 1991)
- Gap posting in languages with case markers
  - Gap is posited immediately at the accusative marked sentence-initial NP
  - Gap is posited at the verb which provides the argument-structure information

When is the gap posited?

- SR: senator-ACC attack-ADN
  - 1. missing subject
  - 2. transitive structure
  - Intransitive structure?
  - Gap postulation
  - Gap postulation

- OR: senator-NOM attack-ADN
  - 1. missing object
  - 2. transitive structure

Interim summary

- Gap-filler association in backward dependencies elicits a LAN effect (Korean ORs vs. SRs), just as in forward dependencies (e.g., English ORs vs. SRs)

- Backward dependencies show a subject/object processing asymmetry, similar to the pattern found in forward dependencies (Kwon, Polinsky & Kluender 2006)

Locality in forward dependency

- Forward looking dependencies show locality effects in filler-gap dependencies: closer gap preferred
- This is due to:
  - storage costs of maintaining filler in working memory; semantic (and phonological) information to store

"The reporter that the senator..."

Locality in backward dependencies

- Head-final languages (Korean and Japanese) show lack of locality effects in gap-filler dependencies: gap proximity does not matter
- This is due to:
  - lack of storage costs in gap-filler dependencies (no phonological or semantic information to store)

"senator-NOM __ attacked-REL..."
Interim summary

• The gap is posited only when sufficient evidence is present that it is needed (at the argument-assigning expression)
• Once the gap in a backward dependency is posited, the parser immediately associates it with its potential antecedent (similar to forward dependencies)
• However, the parser continues to evaluate the semantic fit of the inter-clausal (and thus the antecedent-anaphor) relationship through sentence end, despite immediate gap-antecedent association.

Looking back is like looking forward

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Immediate potential</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>gap-filler association</td>
<td></td>
<td></td>
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<tr>
<td>Sensitivity to structural</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>distance</td>
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Looking back is different

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<td>Gap postulation</td>
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<td></td>
<td>filler position</td>
<td>available local</td>
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<td>information (e.g.,</td>
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<td>verbal agreement</td>
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<tr>
<td>Locality effect</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Re-evaluation</td>
<td>✗</td>
<td>✓</td>
</tr>
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Outline

• Looking back: Processing costs
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• Conclusions

Don’t look back…

Structural workarounds

Looking back less

• Intransitive Bias: minimizing the argument-head domain
• Eliminating the need for backward dependencies whatsoever
Child language data

Korean children produce more transitive verbs than Japanese children
Japanese children produce more adjectives than Korean children
\textbf{No difference} between the two groups on intransitive verbs
Both J and K children produce higher proportions of intransitive verbs than their caregivers do

Child language and caregiver speech

The higher proportion of intransitive verbs in Japanese children’s speech may be due to frequent use of particular predicates in caregiver speech
The higher proportion of intransitive verbs in Korean children’s speech is unlikely to be due to frequent use of particular predicates in caregiver speech
The higher proportion of intransitive verbs in Korean children’s speech is due to their developing grammar
Intransitive bias elsewhere

Descriptive generalization (Nichols et al. 2004):
- Some languages are predominantly intransitive, and morphologically derive transitive verbs from intransitive forms.
- Other languages are predominantly transitive, deriving one-place predicates via detransitivization.
- Head-final languages are predominantly intransitive.

Possible motivation

Domain minimization:
“Minimize the connected sequences of linguistic forms … in which relations of combination and/or dependency are processed” (Hawkins 2004: 103)

Interim summary

- Regular minimization of domains where arguments are assigned relieves the stress of looking back.
- Intransitive Bias reflects one of the principled ways of minimizing the structural distance to the head.

Looking forward or avoiding dependencies whatsoever

- Internally headed relative clauses (IHRC): Nominalization instead of a dependency.

IHRC

ルームメイトが
Ruuumumeito-ga
Roommate-NOM
[恵子が りんごを 買ってきたの]-を
[Keiko-ga ringo-o kattekita-no]-o
K-NOM apple-ACC bought-NML]-ACC
勝手に 食べた
katteni tabeta
w/out permission ate
‘Keiko’s roommate ate the apples that she had bought without her permission.’

Looking forward or avoiding dependencies whatsoever

Internally headed relative clauses (IHRC):
Analysis 1:
\[
[\text{DP} \quad [\text{CP} \quad [\text{IP} \quad \text{HEAD} \quad \text{D}]]]
\]
no dependency whatsoever
Analysis 2:
\[
[\text{DP} \quad [\text{CP} \quad [\text{IP} \quad \text{HEAD}_i \quad \text{pro}_i \text{D}]]]
\]
forward referential dependency
Looking forward or avoiding dependencies whatsoever

- with frequency higher than chance, IHRCs are found in head final languages (Cole 1987, Basilico 1996);
- possible exceptions: Moore (Tellier 1988), Dogon, Bambara (Culy 1990); SVO on surface; however, they all show OV as base order

---

**Interim summary**

Structural means of avoiding looking back:
- Internally headed relative clauses provide an alternative for avoiding a backward dependency (while maintaining the same semantics)
- Tentative correlation between internally headed relative clauses and headedness

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**Outline**

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**Inventory of silent elements**

Relative clauses and control clauses
Relative clauses

Wanted:

\[ [\text{Op}_i, \ldots, t_i, \text{V-ADN}] \text{Head NP}_i \]

Problems:

- Ambiguity and/or limitations of island effects
- No evidence of parasitic gaps

Problems:

- Ambiguity and/or limitations of island effects

\[[\ldots, \text{tolakasi-konase}] \text{on kyelyey-ka}
passed.away-after all people-NOM
sulpeheh-a] \text{senayngnim},
got.sad-ADN \text{teacher}
‘the teacher, who after he died, all people got sad’

also Han & Kim (2004) for double NOM relativization

Weak crossover?

- Three candidates:
  - reflexive (\text{zibun, caki})
  - overt pronoun
  - silent gap
- Word order effects: scrambling ameliorates WCO (Frank et al. 1996, Chung 1995)

Quantitative study of Korean WCO

Kwon 2008, Kwon & Polinsky in progress:

- Rating, 1-5 scale
- Root clauses: 30 sentences for each condition (\text{caki, ku, pro} x Su/Obj position), 10 subjects
- Relative clauses: 30 sentences for each condition (\text{caki, ku, pro} x Su/Obj position), 10 subjects

Root clauses, direct order

\text{NP with a quantifier in subject position}

kakkakuy sonyen-i \text{[ku][pro]][caki]-uy emeni-lul
each boy-NOM he/pro/self-GEN mother-ACC
towassta
helped ‘Each boy helped his/self’s mother’

\text{NP with a quantifier in object position}

[ku][pro][caki]-uy emeni-ka kakkakuy sonyen-ul
he/pro/self-GEN mother-NOM each boy-ACC
towassta
helped ‘His/(His)/Self’s mother helped each boy,’

WCO?

\text{ku, caki, and pro} in root clauses

Ratings, 1-5 scale
Relative clauses

**subject relative clauses**

[ ___ ku/pro/caki-uy emeni-lul tow-un] kak
he/pro/self-GEN mother-ACC helped-ADN each
haksayng.
student
‘each student who helped his mother’

**object relative clauses**

[ku/pro/caki-uy emeni-ka __ tow-un] kak
he/pro/self-GEN mother-NOM helped-ADN each
haksayng
student
‘each student who his mother helped’

*zibun* and *caki*

- *caki* also shows properties of a bound variable, supported by the ratings (cf. Han & Storoshenko 2008, Storoshenko 2007 for a similar analysis of *caki*)

*kare* and *ku* resist binding

  Japanese 3 person pronouns are noun-like or DP-like
- Hong 1985:
  Korean *ku* and its derivatives are DP-like and can only refer

*caki* in relative clauses

Relative clause with *caki* in the subject position shows WCO

\( \text*{caki} \sim \text{bound variable} \)

Overt pronoun in Korean relative clause: Avoiding coreference

Coreference between *ku* and head of the relative clause rated low, regardless of structural position of the gap

\[ ___ ku_{-},uy emeni-lul tow-un \text{ (kak) haksayng,} \]

**pro?**

No WCO effect with the silent gap in the relative clause

\[ ___ pro_{-},uy emeni-lul tow-un \text{ (kak) haksayng,} \]
**ku, caki, and pro in relatives**

- **R-expression-like**
- **bound variable-like**
- **not a trace**

**Ratings, 1-5 scale**

**Back to ERPs**

- Operator-trace dependency:
  - qualitative difference between wh- and adjunct clauses
  - positivity (P600) in brain response
  (for German, see Felser et al. 2003, Fiebach et al. 2002)
- Relative clause in Korean:
  - Adjunct and relative clauses are not different qualitatively
  - LAN, no positivity

**Reading time results**

- Main effect of gap type
  - subject gaps are easier than object gaps regardless of construction type
- No main effect of clause type (RC vs. adjunct clause)

**Experimental evidence**

- No qualitative difference in ERPs to relative clauses vs. adjunct clauses
- Both types of clauses show subject preference (Kwon, Polinsky & Kluender 2006)
- Both types of clauses show look-back effects

**Back to ERPs**

- Relative clause in Korean: Adjunct and relative clauses are not different qualitatively
- LAN, no positivity

**RC without a trace**

Wanted: $[Op_i \ldots t_i V-ADN] \text{Head } NP_i$

Received: $[Op_i \ldots pro_i V-ADN] \text{Head } NP_i$

Base-generated structure with backward referential dependency
What about WCO?

- No trace, no movement, no WCO
- Whence the bound variable problem with caki?

**Proposal:** an operator binds the silent pronominal in the subject position (cf. Reinhart 1998; Adger & Ramchand 2005); this operator blocks the binding from the external head, which leads to the appearance of WCO

Proposal:

- the adnominal marker –(nu)n takes a TP complement
- -nu/n marks an operator that binds the null pronominal in the subject position inside TP
- this binding blocks the binding from the external head
- result: appearance of WCO
  cf. a similar proposal for Old Chinese zhe (Aldridge 2008)

does Korean need traces?


```
DP          ⇔ D-pronoun
  D
    N                  ⇔ N-pronoun
```

Outstanding theoretical questions

- Precise nature of the silent element:
  - Special lexical item (pro)?
  - Silent resumptive pronoun?
  - Regular pronoun that fails to be spelled out at PF? (Perlmutter 1972; Holmberg 2005)
- Could these distinctions be too subtle?
- If binding is semantic, and the resulting dependency is referential, what is the source of strict identity conditions in RCs?

Outstanding processing questions

- What is the processing signature of semantic binding?
- Are referential dependencies easier to process than syntactic dependencies, and if yes, why?

Control clauses

1. Chelswu-ka Yenghi-lul [ ______ ACC1
   Chelswu-NOM Yenghi-ACC
   hakkyo-lul ttena-tolok] seltukhayssta
   school-ACC quit-COMPL persuaded

2. Chelswu-ka [ ___ hakkyo-lul ACC2
   Chelswu-NOM GAP school-ACC
   ttena-tolok] Yenghi-lul seltukhayssta
   quit-COMPL Yenghi-ACC persuaded

3. Chelswu-ka [Yenghi-ka hakkyo-lul NOM
   Chelswu-NOM Yenghi-NOM school-ACC
   ttena-tolok] ] seltukhayssta
   quit-COMPL GAP persuaded

   ‘Chelswu persuaded Yenghi to quit school.’
No trace, no PRO

- Although co-indexation between the filler and gap is preferred, it is not obligatory
- All three constructions permit the interpretation of the silent element as different from the antecedent (Choe 2006, Polinsky et al. 2007—contra Kwon & Polinsky 2005)
- The gap in control clauses is a silent pronominal (pro)

Demonstratives, reflexives, pronouns in Korean

- Demonstratives = R-expressions
- Reflexives ~ bound variables
- Silent elements = true pronouns
  - either special lexical items or deletion at PF
  - D-silence and N-silence
- More restricted distribution of traces than in languages like English

Conclusions

- Looking back is not free
  - Use of referential dependencies where more familiar languages may rely on a syntactic dependency
- Consequence: silent pronominal in lieu of expected traces in a number of dependencies
Thank you

감사합니다.

ありがとうございます。

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