Long Distance Dependencies
Overview

- Some examples of the phenomenon
- What is new and different about it
- Brief sketch of the TG approach
- Broad outlines of our approach
- Details of our approach
- Subject extraction
- Coordinate Structure Constraint
Examples

• wh-questions:
  What did you find?
  Tell me who you talked to

• relative clauses:
  the item that I found
  the guy who(m) I talked to

• topicalization:
  The manual, I can’t find
  Chris, you should talk to.

• easy-adjectives:
  My house is easy to find.
  Pat is hard to talk to.
What these have in common

• There is a ‘gap’: nothing following *find* and *to*, even though both normally require objects.
• Something that fills the role of the element missing from the gap occurs at the beginning of the clause.
• We use topicalization and *easy*-adjectives to illustrate:

  *The manual, I can’t find_____*  
  *Chris is easy to talk to _____*
Gaps and their fillers can be far apart:

- *The solution to this problem, Pat said that someone claimed you thought I would never find* ____.

- *Chris is easy to consider it impossible for anyone but a genius to try to talk to* ____.

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Fillers often have syntactic properties associated with their gaps

*He, I haven’t met___.

*The scissors, Pat told us ____ was missing.

*To Pat, you can rely___.
LDDs in TG

• These were long thought to constitute the strongest evidence for transformations.

• They were handled in TG by moving the filler from the gap position.

• Case, agreement, preposition selection could apply before movement.
A big debate about LDDs in TG

• Does long-distance movement take place in one fell swoop or in lots of little steps?
Looping is now generally accepted in TG

• Various languages show morphological marking on the verbs or complementizers of clauses between the filler and the gap.

• Psycholinguistic evidence indicates increased processing load in the region between filler and gap.

• This opens the door to non-transformational analyses, in which the filler-gap dependency is mediated by local information passing.
Very Rough Sketch of Our Approach

• A feature GAP records information about a missing constituent.
• The GAP value is passed up the tree by a new principle.
• A new grammar rule expands S as a filler followed by another S whose GAP value matches the filler.
• Caveat: Making the details of this general idea work involves several complications.
The Feature GAP

• Like valence features and ARG-ST, GAP’s value is a list of feature structures (often empty).

• Subject gaps are introduced by a lexical rule.

• Non-subject gaps are introduced by revising the Argument Realization Principle.
# The Revised ARP

- **word:** 

- **\( \ominus \)** is a kind of list subtraction, but:
  - it’s not always defined, and
  - when defined, it’s not always unique

- The ARP now says the non-SPR arguments are distributed between COMPS and GAP.
A Word with a Non-Empty GAP Value
How We Want GAP to Propagate
What We Want the GAP Propagation Mechanism to Do

• Pass any GAP values from daughters up to their mothers,

• except when the filler is found.

• For topicalization, we can write the exception into the grammar rule, but

• For *easy*-adjectives, the NP that corresponds to the gap is the subject, which is introduced by the Head-Specifier Rule.

• Since specifiers are not generally gap fillers, we can’t write the gap-filling into the HSR.
Our Solution to this Problem

• For *easy*-adjectives, we treat the adjective formally as the filler, marking its SPR value as coindexed with its GAP value.

• We use a feature STOP-GAP to trigger the emptying of the GAP list.
  • STOP-GAP stops gap propagation
  • *easy*-adjectives mark STOP-GAP lexically
  • a new grammar rule, the Head-Filler Rule mentions STOP-GAP
The GAP Principle

A local subtree $\Phi$ satisfies the GAP Principle with respect to a headed rule $\rho$ if and only if $\Phi$ satisfies:

\[
\begin{align*}
\text{GAP (} & \text{A}_1 \oplus \ldots \oplus \text{A}_n \text{)} \ominus \text{A}_0 \\
\end{align*}
\]
How does STOP-GAP work?

- STOP-GAP is empty almost everywhere.
- When a gap is filled, STOP-GAP is nonempty, and its value is the same as the gap being filled.
- This blocks propagation of that GAP value, so gaps are only filled once.
- The nonempty STOP-GAP values come from two sources:
  - a stipulation in the Head-Filler Rule
  - lexical entries for *easy*-adjectives
- No principle propagates STOP-GAP
The Head-Filler Rule

\[
[\text{phrase}] \to \begin{bmatrix} 1 \ \text{GAP} \langle \rangle \end{bmatrix}
\]

- This only covers gap filling in finite Ss
- The filler has to be identical to the GAP value
- The STOP-GAP value is also identical
- The GAP Principle ensures that the mother’s GAP value is the empty list
Gap Filling with *easy*-Adjectives

- Because STOP-GAP and GAP have the same value, that value will be subtracted from the mother’s GAP value.

- The first argument is coindexed with the GAP value, accounting for the interpretation of the subject as the filler.
A Tree for *easy to talk to ___*

```
[VAL [SPR ⟨ [2]NP\textsubscript{i} ⟩ ]
GAP ⟨ ⟩ ]
```

```
A
```

```
COMPS ⟨ [3] ⟩ ]
GAP ⟨ ⟩
STOP-GAP ⟨ [1] ⟩
```

```
[VAL [SPR ⟨ [NP] ⟩ ]
GAP ⟨ [1]NP\textsubscript{i} ⟩ ]
```

```
3 VP
```

```
easy
to talk to ___
```
STOP-GAP Housekeeping

• Lexical entries with nonempty STOP-GAP values (like *easy*) are rare, so STOP-GAP is by default empty in the lexicon.

• Head-Specifier and Head-Modifier rules need to say \([\text{STOP-GAP} < >]\)

• Lexical rules preserve STOP-GAP values.
GAP Housekeeping

• The initial symbol must say [GAP < >]. Why?
  • To block *Pat found and *Chris talked to as stand-alone sentences.

• The Imperative Rule must propagate GAP values. Why?
  • It’s not a headed rule, so the effect of the GAP Principle must be replicated
  • Imperatives can have gaps: *This book, put on the top shelf!*
Sentences with Multiple Gaps

• Famous examples:

  *This violin, sonatas are easy to play___ on___.
  *Sonatas, this violin is easy to play___ on___.

• Our analysis gets this:
  • The subject of easy is coindexed with the first element of the GAP list.
  • The Head-Filler rule only allows one GAP remaining.
  • There are languages that allow multiple gaps more generally.
Where We Are

• filler-gap structures:

  The solution to this problem, nobody understood

  That problem is easy to understand

• The feature GAP encodes information about missing constituents

• Modified ARP allows arguments that should be on the COMPS list to show up in the GAP list

• GAP values are passed up the tree by the GAP Principle
Where We Are (continued)

- The feature STOP-GAP signals where GAP passing should stop.
- The Head-Filler Rule matches a filler to a GAP and (via STOP-GAP) empties GAP.
- Lexical entries for *easy*-adjectives require a gap in the complement, coindex the subject with the gap, and (via STOP-GAP) empty GAP on the mother.
On to New Material....

- Sentences with subject gaps
- Gaps in coordinate constructions
Subject Gaps

- The ARP revision only allowed missing complements.
- But gaps occur in subject position, too: 
  *This problem, everyone thought ___ was too easy.*
- We handle these via a lexical rule that, in effect, moves the contents of the SPR list into the GAP list.
The Subject Extraction Lexical Rule

\[ \text{\textit{pi-rule}} \]

**INPUT** \[ \langle X , \text{SYN} \text{, ARG-ST} \{ A \} \rangle \]

**OUTPUT** \[ \langle Y , \text{SYN} \text{, ARG-ST} \{ A \{ 1 \} , \ldots \} \rangle \]

- **NB:** This says nothing about the phonology, because the default for \textit{pi-rules} is to leave the phonology unchanged.
A Lexical Sequence This Licenses

\[ \begin{align*}
\text{word} & \begin{cases}
\text{HEAD} & \text{verb [FORM fin]} \\
\text{VAL} & \text{SPR [⟩]} \\
\text{GAP} & \text{COMPS [2]} \\
\text{STOP-GAP} & \langle ⟩ \\
\text{ARG-ST} & \langle 1, 2\text{NP[acc]} \rangle
\end{cases}
\end{align*} \]

- Note that the ARP is satisfied
A Tree with a Subject Gap

```
S
| GAP ⟨ ⟩ |
NP
| GAP ⟨ ⟩ |
| Kim |
NP
| GAP ⟨ ⟩ |
| we |
V
| GAP ⟨ ⟩ |
| know |
V
| GAP ⟨NP⟩ |
| likes |
NP
| Dana |
```
Island Constraints

• There are configurations that block filler-gap dependencies, sometimes called “islands”
• Trying to explain them has been a central topic of syntactic research since the mid 1960s
• We’ll look at just one, Ross’s so-called “Coordinate Structure Constraint”
• Loose statement of the constraint: a constituent outside a coordinate structure cannot be the filler for a gap inside the coordinate structure.
Coordinate Structure Constraint Examples

*This problem, nobody finished the extra credit and____
*This problem, nobody finished____ and the extra credit.
*This problem, nobody finished ___ and started the extra credit.
*This problem, nobody started the extra credit and finished____

• But notice:

This problem, everybody started____ and nobody finished ____
The Coordinate Structure Constraint

• In a coordinate structure,
  • no conjunct can be a gap (conjunct constraint), and
  • no gap can be contained in a conjunct if its filler is outside of that conjunct (element constraint)

• …..unless each conjunct has a gap that is paired with the same filler (across-the-board exception)
These observations cry out for explanation

- In our analysis, the conjunct constraint is an immediate consequence: individual conjuncts are not on the ARG-ST list of any word, so they can’t be put on the GAP list.

- The element constraint and ATB exception suggest that GAP is one of those features (along with VAL and FORM) that must agree across conjuncts.

- Note: There is no ATB exception to the conjunct constraint.

*This problem, you can compare only____ and____.
Our Coordination Rule, so far

\[
\begin{align*}
\begin{bmatrix}
\text{FORM} & 1 \\
\text{VAL} & 0 \\
\text{IND} & s_0
\end{bmatrix} & \rightarrow \\
\begin{bmatrix}
\text{FORM} & 1 \\
\text{VAL} & 0 \\
\text{IND} & s_1
\end{bmatrix} & \rightarrow \\
\begin{bmatrix}
\text{HEAD} & \text{conj} \\
\text{IND} & s_0 \\
\text{RESTR} & \langle \text{ARGS} \langle s_1 \ldots s_n \rangle \rangle
\end{bmatrix} & \rightarrow \\
\begin{bmatrix}
\text{FORM} & 1 \\
\text{VAL} & 0 \\
\text{IND} & s_n
\end{bmatrix}
\end{align*}
\]

- Recall that we have tinkered with what must agree across conjuncts at various times.
- Now we’ll add GAP to the things that conjuncts must share.
Our Final Coordination Rule

- We’ve just added GAP to all the conjuncts and the mother.
- This makes the conjuncts all have the same gap (if any)
- Why do we need it on the mother?
Closing Remarks on LDDs

• This is a huge topic; we’ve only scratched the surface
  • There are many more kinds of LDDs, which would require additional grammar rules
  • There are also more island constraints, which also need to be explained
• Our account of the coordinate structure constraint (based on ideas of Gazdar) is a step in the right direction, but it would be nice to explain why certain features must agree across conjuncts.
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