Modeling Syntactic Encoding with Tree Adjoining Grammar:

How grammar constrains production and production constrains grammar

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1. Commitments in Sentence Planning

- Grammar is a bottleneck through which meaning is encoded.

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Destroy(e)
Agent(e,Daniel)
Patient(e,x)
Tower(x)
Tall(x)
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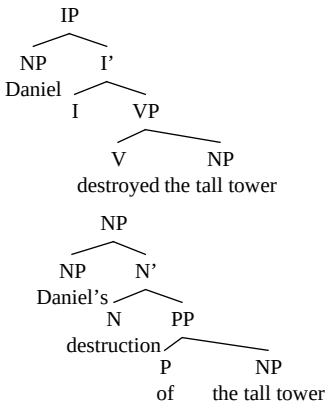
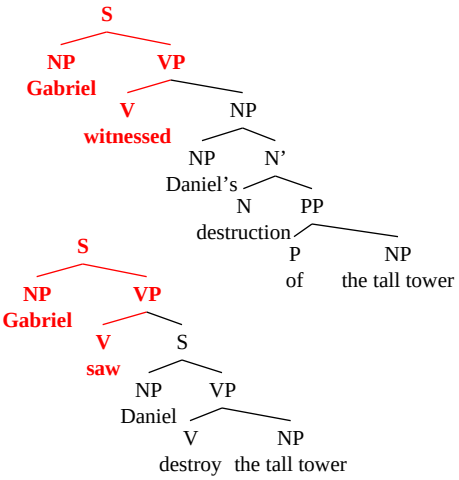


Encoding proceeds incrementally

- Early decisions have downstream effects.

VisPerceive(e')
Agent(e',Gabriel)
Agent(e,Daniel)
Destroy(e,x)
Tower(x)
Tall(x)



If Sen. Howard Baker had been a psycholinguist....

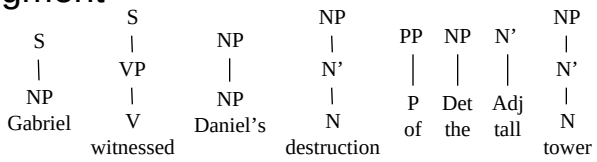
What structural commitments does the sentence planner make and when does it make them?

Talk Outline

- Grammatical models in incremental sentence planning
- Basics of Tree Adjoining Grammar (TAG)
- Incremental sentence planning with TAG
- Processing complexity in comprehension and production
- Grammatical lessons from production:
  The case of heavy NP shift

2. Grammatical Models in Incremental Sentence Planning

- Segment grammar (deSmedt & Kempen)
  - Words are associated with a syntactic "segment"



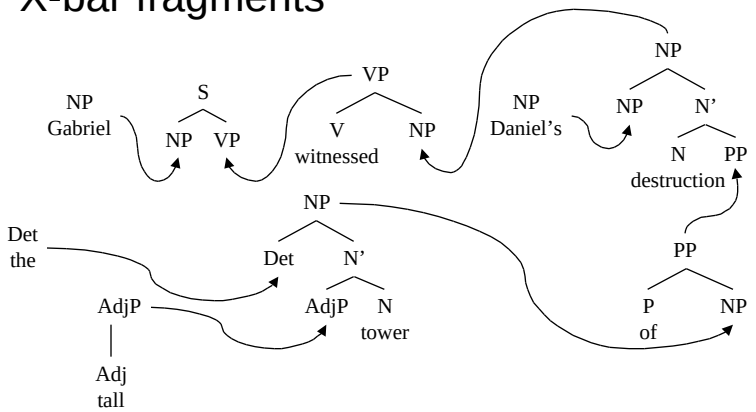
  - Planning involves the incremental selection and combination of segments

Segments minimize commitment

- Planning is word by word
  - Limited syntactic structure in a segment implies no downstream syntactic commitments:
- But, there is evidence for early commitment
  - For example, planning of verb at beginning of clause (Lindsley 1975, Kempen and Huijbers 1983, Ferreira 1994)

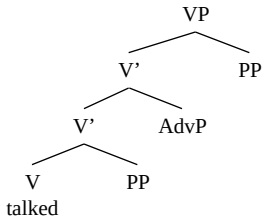
Lapointe & Dell (1989)

- Build structure by selecting and combining X-bar fragments



Lapointe & Dell (cont'd)

- Entails commitment to modifying adjuncts must be at the head
  - I talked to John [yesterday] [for an hour]

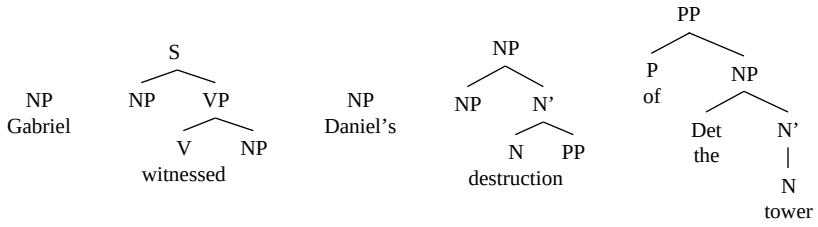


2. Basics of TAG

- Syntactic description factors grammatical dependencies from recursive processes of structure building (Joshi 1985)
  - Basic units of grammar are ***elementary trees:*** the syntactic realization of a word's lexical requirements (e.g.,thematic role assignment)

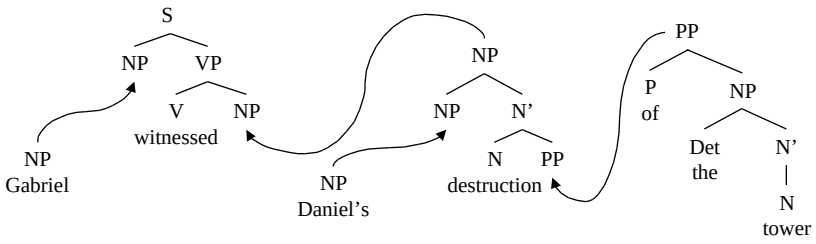
TAG basics (continued)

- Elementary trees are extended projections of a single lexical head (Frank 1992)



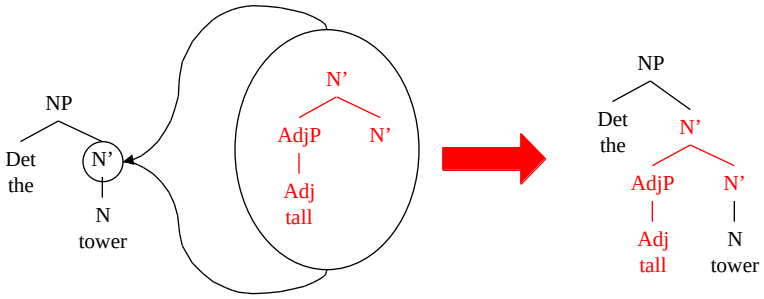
TAG basics (continued)

- Combination of elementary trees via substitution:



TAG basics (continued)

- Combination of elementary trees via adjoining:



3. Incremental Sentence Planning with TAG (iTAG*)

- Incremental sentence planning involves:
  1. Selection of an elementary tree
  2. Combination of selected elementary tree with previously built structure using substitution or adjoining.

(see Ferreira 2000)

* © John Hale

Selecting Elementary Trees I

- Each elementary tree is associated with some piece of meaning.
  - Encodes maximal subpart of intended message (Stone & Doran 1997)
  - Encodes the most salient/prominent subpart of meaning that remains unexpressed
  - Choose the most highly activated elementary tree: syntactic priming (Ferreira 2000)
  - Choose elementary tree to satisfy outstanding structural commitments

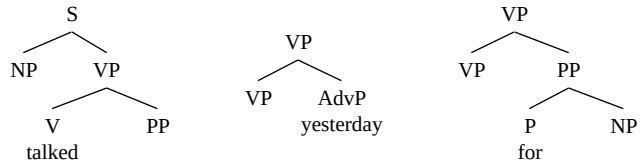
Selecting Elementary Trees II

- Processing implications of lexical nature of elementary trees:
  - Planning of a lexical head brings along with it a grammatically natural class of structural commitments: those present in the head's elementary tree.
  - Lemma selection = elementary tree selection
    - Linkage between structure building and choice of lexical items
    - Verbal exchanges preserve subcategorization (Badecker and Frank 1999)

Freedom from commitment

- Unlike Lapointe and Dell's model, modifiers can be planned late in iTAG (Joshi 1987)

  I talked to John [yesterday] [for an hour]



Every elementary tree in its place

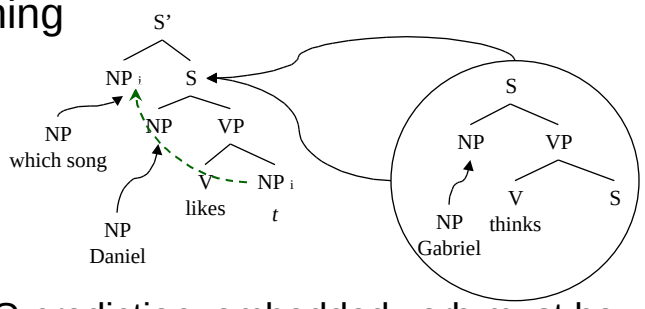
- **Connectedness constraint**:

  To complete the planning of an elementary tree, it must have somewhere to go.

- Thus, before finishing the planning of a subject NP, we must select a verbally headed elementary tree into which the NP can substitute.
  - Properties of subject can depend on lexical idiosyncrasies of the verb (e.g., quirky case)
  - Evidence for early verb planning

Every elementary tree in its place

- TAG derivation of wh-movement via adjoining



  - ➡iTAG prediction: embedded verb must be planned in order to provide a slot for inserting fronted wh-phrase

4. Processing Complexity in Production and Comprehension

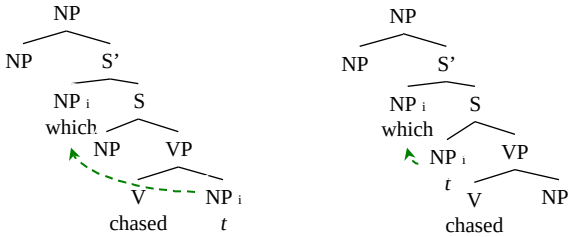
- Sentences that are hard to understand also tend to be hard to produce.

  The rat that the cat that the dog chased bit died.

- This is a puzzle!
  - Explanations of the difficulty of such cases focus on the problems in recovering structure from surface string.

Where is production complexity?

ob-rel (1) The cat ***which*** the dog ***chased***
sub-rel (2) The cat ***which chased*** the dog



Idea: production complexity arises from need to hold on to lexicalized syntactic structure (present in already selected elementary tree) prior to spell-out.

Center-embedding revisited

- Each additional relative clause in a center embedding context adds an additional verb that must be retained.

  The rat ***that*** the cat ***that*** the dog ***chased bit*** died.

A more complex case

- S-Complement vs. Relative clauses (Cowper 1976, Gibson 1998)

(1) The fact that the employees who the manager hired stole office supplies worried the executive. (Comp-Rel)

(2) # The executive who the fact that the employees stole office supplies worried hired the manager. (Rel-Comp)

A production explanation

- Contrast derives from difference in composition of S-complements and relative modifiers:
  - Planning of NP's S-complement precedes planning of matrix verb.
  - Planning of NP relative modifiers will follow planning of matrix verb. This entails that we must hold onto the matrix verb during the planning of the adjunct.

5. Grammatical lessons from production

- Heavy NP shift

  I brought to a close [a long discussion about adverbs]

  Why should heavy things shift?

  ➡Wasow (1997): speaker exploits range of syntactic options to reduce processing load. By shifting, speaker has more time to plan the NP and fewer interfering demands during planning.

More on HNPS

- Wasow (1997) observes contrasts in rate of HNPS with different verb classes
  - Obligatorily transitive vs. Optionally transitive

  (1) Memo ***sent*** to Noam a long letter about adverbs

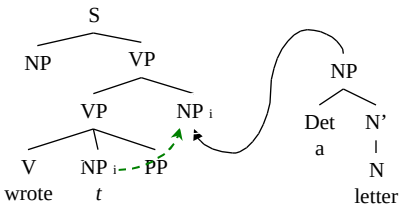
  (2) Memo ***wrote*** to Noam (a long letter about adverbs)

  - HNPS in (2) is twice as frequent as in (1)
- Wasow's proposal:

  Speakers exploit optionality to avoid early structural commitment.

A TAG Analysis of HNPS

- If we analyze HNPS as analogous to wh-movement:

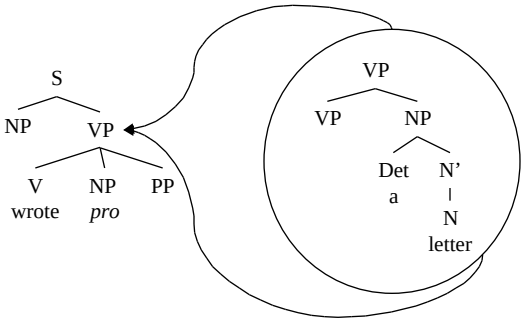


We get no added benefit for optional transitivity:

At verb we must commit to presence or absence of shifted NP. Thus, we lose an account of Wasow's asymmetry.

HNPS in TAG

- To avoid making commitment to shifted object, HNPS need not be established within an elementary tree,but via adjoining.



Grammatical Implications

- Generalization to other cases of rightward movement
  - Abeillé (1994) on PP extraposition
- Since leftward and rightward “movements” are generated via distinct mechanisms:
  - Locality differences: Right roof constraint
  - Interpretive differences: operator-variable vs. pronominal binding dependencies (Cinque 1990)

6. Conclusions

- How grammar constrains production?
  - Elementary tree as basic unit of syntactic planning
    - Grammatical grounding for class of planning commitments: arguments vs. modifiers
    - Early verb planning – wh-questions
  - Extended domain of elementary trees (extended projections) allows a simple characterization of production complexity

Conclusions

- How production constrains grammar?
  - Rightward dependencies, if they are to be useful functionally in allowing delay of commitment, must be of a different sort than leftward dependencies.