Minimalist Parsing of Heavy NP Shift

Lei Liu lei.liu.1@stonybrook.edu

Department of Linguistics
Stony Brook University

1. Heavy NP Shift: structure and processing

- HNPS: when **"heavy"**, move!

(1) Max put [$_{PP}$ in his car] [$_{NP}$ **all the boxes of home furnishings**].

(2) Cf. Max put [$_{NP}$ **all the boxes of home furnishings**] [$_{PP}$ in his car].

- Processing preference
  - when NP is "heavy", — **shift > canonical** (Stallings and MacDonald 2011)
  - when NP and PP are "heavy", — canonical > shift Ibid
  - when PP is "heavy", — canonical > shift (Ross 1986)
  - when NP and PP are not "heavy", — canonical > shift Ibid
- Syntactic Analyses

(3) *Rightward movement* (Ross 1986)

Max put *t* in his car <put> all ... furnishings.

(4) *PP movement* (Kayne 1994)

Max put _ all ... furnishings <put> in his car

(5) *Remnant movement* (Rochemont and Culicover 1997)

Max put _ [all ... furnishings] <put> in his car

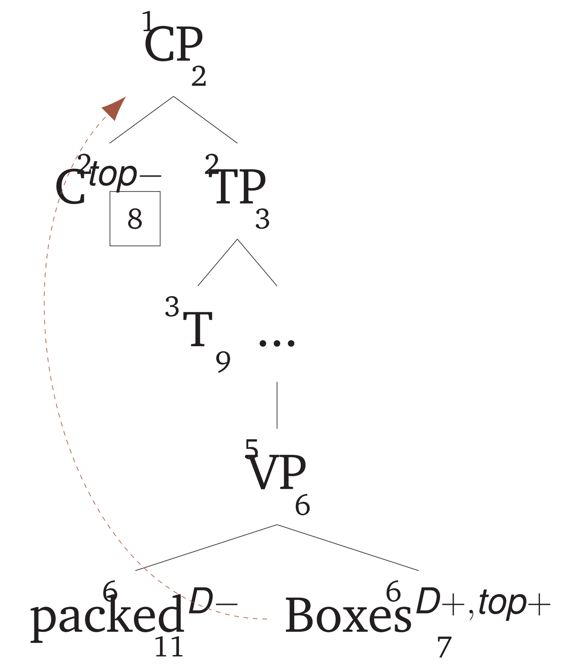
- Questions: Can a parsing model...
  - **replicate human processing preferences?**
  - **offer insights into syntactic theories?**
- Method
  - Parsing model: Minimalist Grammar parsing
  - Preference: memory usage

2. Minimalist Parsing

- Minimalist Grammar

  merge: combines lexical items and/or phrases
  move: displaces lexical items and/or phrases

(6) Boxes, Max packed *t*.



- MG parser: recursive descent parser

  Input: sentence represented as string of words
  Output: tree encoding of sentence structure

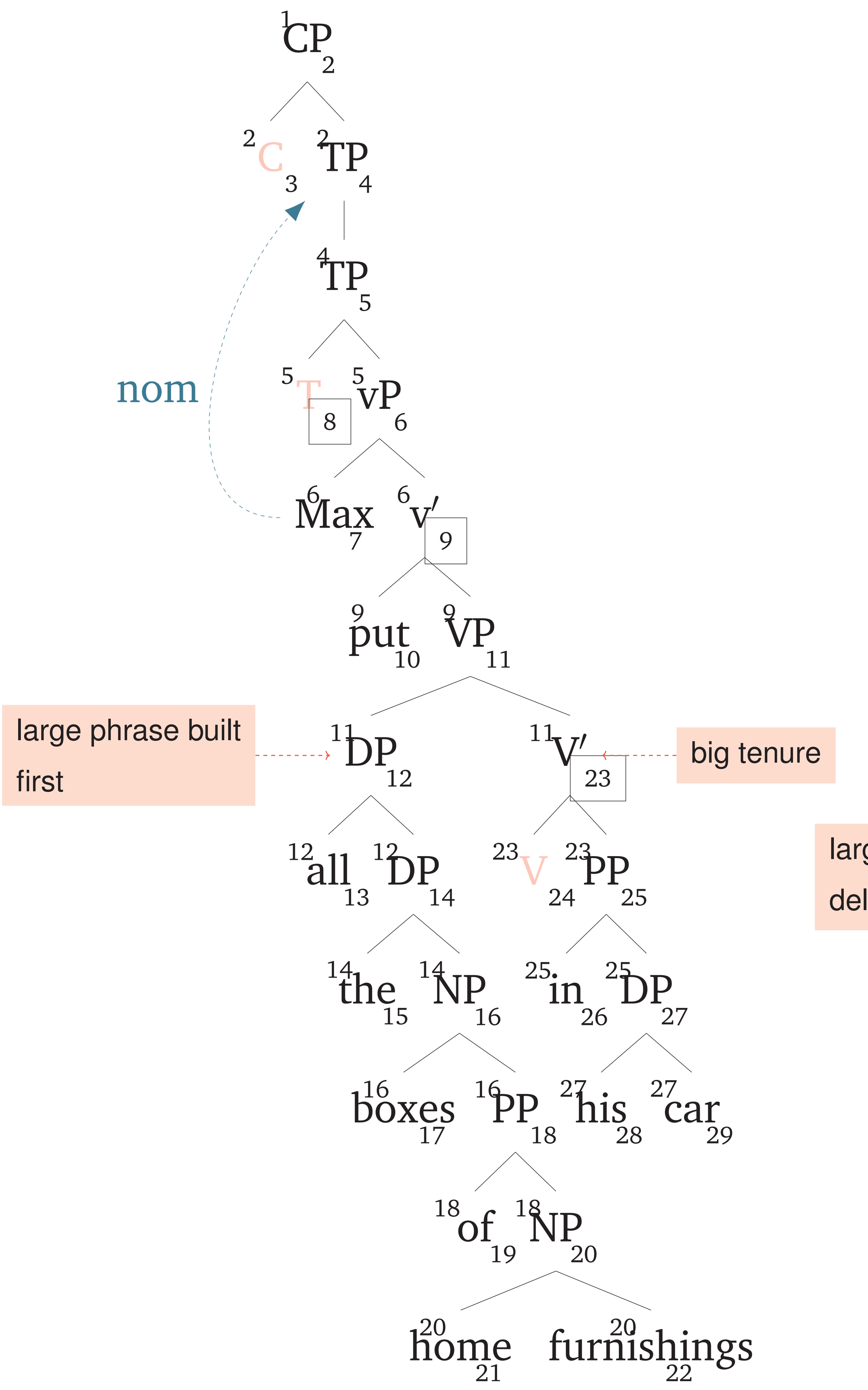
  - Procedure (Kobele et al. 2013, Graf et al. 2017)
    i Hypothesize top of structure and add nodes downward & left-to-right.
    ii Move prediction triggers search for mover
       ⇒ build the shortest path towards predicted mover
    iii When the mover is confirmed, continue from where it was conjectured.
- Complexity metrics
  - Memory Usage: if a node is conjectured at step *i* but cannot be confirmed until step *j*, it is kept in memory for $j - i$ steps.

    Tenure how long a node is kept in memory
    Payload how many nodes are kept in memory
    Size how long movement dependencies stretch
  - Example metrics: a structure *p* is harder to parse than *q* iff:

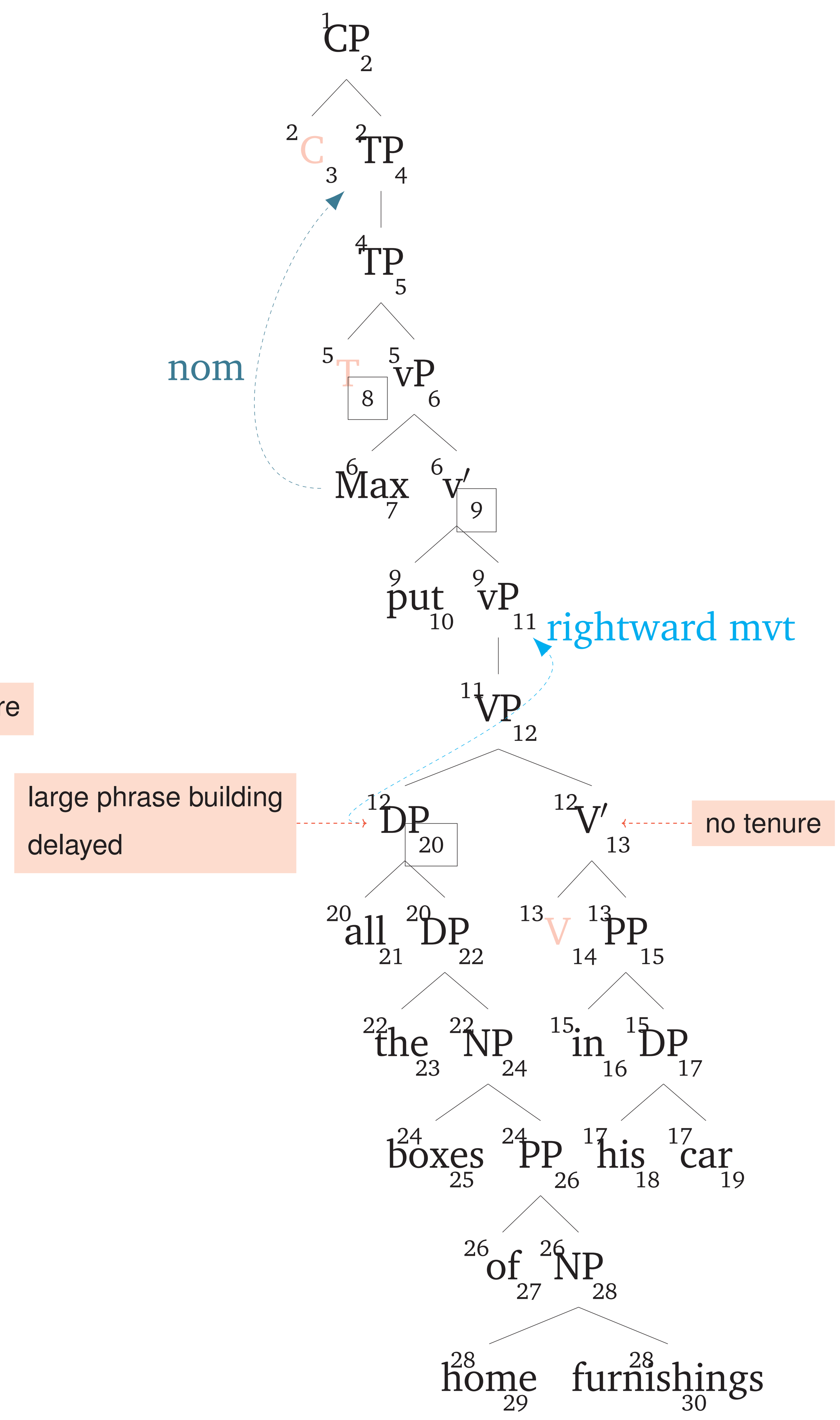
    MaxT Maximum tenure in *p* is greater than that in *q*
    SumS sum of movement lengths in *p* is greater than that in *q*
    MaxS^R farthest movement in *p* is greater than that in *q*

3. Derivation Trees

(7) Canonical order



(8) Rightward movement



4. Results and discussion

- Can MG parsing replicate human processing preferences? - **Yes**
  - **8 out of 10** tenure based metrics were able to predict processing biases for **rightward movement** analysis.
  - **7 out of 10** and **8 out of 10** tenure-based filtered metrics predict processing biases for the **PP movement** and **remnant movement** analyses respectively, when unpronounced nodes are ignored.
  - Ranked complexity metrics that are successful in predicting processing biases for other syntactic structures, < **MaxT, SumS** > and < **MaxT, MaxS^R** >, also make correct predictions for HNPS when a **rightward movement** structure is assumed.
- Can MG parsing offer insights into syntactic theories? - **Yes**
  - Complexity metrics favor **rightward movement** analysis over the rest.
- Next step
  - why **rightward movement**?
    - information structure
    - syntactic architecture
  - Japanese **long-before-short** bias

(9) [$_{obj.}$ se-ga takakute gassiri-sita hannin-o] [$_{subj.}$ Keezi-ga] oikaketa
[$_{obj.}$ height-nom tall-and big-boned suspect-acc] [$_{subj.}$ detective-nom] chased
"The detective chased the suspect who is tall and big-boned." (Yamashita and Chang 2001)

References

• Graf, Thomas, James Monette, and Chong Zhang. 2017. Relative clauses as a benchmark for Minimalist parsing. *Journal of Language Modelling 5:57–106.* • Kayne, Richard S. 1994. *The antisymmetry of syntax*.25. MIT Press. • Kobele, Gregory M, Sabrina Gerth, and John Hale. 2013. Memory resource allocation in top-down minimalist parsing. In *Formal Grammar*,32–51. Springer. • Rochemont, Michael, and Peter W Culicover. 1997. Deriving dependent right adjuncts in english. *Rightward movement* 279–300. • Ross, John Robert. 1986. *Infinite syntax.* Ablex Publishing Corporation. • Stallings, Lynne M, and Maryellen C MacDonald. 2011. It's not just the "heavy np": relative phrase length modulates the production of heavy-np shift. *Journal of psycholinguistic research* 40:177–187. • Yamashita, Hiroko, and Franklin Chang. 2001. long before short preference in the production of a head-final language. *Cognition* 81:B45–B55.