LSA 125 – Psycholinguistics and Syntactic Corpora

Today: *Extracting and importing data from syntactic corpora into a database*

LSA Summer Institute 2009, UC Berkeley

Florian Jaeger

TAs: Judith Degen, Alex Fine, and Peter Graff

A forwarded plea for elevatorian consideration

- Andrew Garrett:

  "[please] avoid the north elevator, the one that requires [you] to walk through the Rhetoric or Classics Department corridor[…]; instead, […] **take the elevator that ends up between 370 and 7205.**"

Website, Passwords, Confusion

- Our website:
  - Info: http://wiki.bcs.rochester.edu:2525/HlpLab/Lsa09
  - Readings linked to website: http://www.hlp.rochester.edu/internal/classes/lsa09/readings/
    - Login: *psycho*
    - Password: *linguistics*
  - ***nothing*** on bSpace
- Our corpus server: (see website for most up-to-date info)
  - 174.129.5.193 (faster CPU)
  - 174.129.205.212 (maybe less traffic)
    - Login: *lsaXX,* e.g. *lsa18*
    - Password: only you know

The C-Team (again)

- Judith Degen
- Alex Fine
- Peter Graff

Q & A

- Do you have questions about the processing accounts described in the previous lecture?
  - Accessibility
    - Availability
    - Alignment
  - Audience Design
    - Ambiguity Avoidance
  - Dependency Minimization (MiD, MaOP)

- We will get back to them **next Tuesday** when I will also discuss
  - **Alternative audience design accounts**
  - **Uniform Information Density** – a computational account of efficient language production
  - **Alternatives to processing accounts**

Today

- Get your feet wet:
  - What is a **syntactically-annotated corpus**?
  - **TGrep2** :: a tool to search syntactically-annotated corpora
  - **TDT*lite*** :: a set of scripts we wrote to combine TGrep2 output into a database that can be handed to Excel or a stats program of your choice (e.g. R).
- Start thinking about your project – **have you found a work group**?

Timeline for Corpus-based Project

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  - avoid over-exclusive (hard)
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that-omission

- Non-subject-extracted relative clauses in English allow optional *that*-omission:

$$\textbf{\textit{How big is the family}} \left\{ \begin{array}{lll} & \textbf{\textit{you}} & \textit{cook for?} \\ \textbf{\textit{that}} & \textbf{\textit{you}} & \textit{cook for?} \end{array} \right\}$$

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TGrep2

- Search tools for syntactic corpora developed by Doug Rohde (2005)
  - Downloadable for free: http://tedlab.mit.edu/~dr/Tgrep2/
  - Online tutorial: http://www.bcs.rochester.edu/people/fjaeger/teaching/tutorials/TGrep2/LabSyntax-Tutorial.html
- Parsed Switchboard in Penn Treebank format
  - 800,000 word syntactically annotated telephone **conversation** corpus (Switchboard, Treebank III)

A common syntactic annotation standard

- Syntactic structure annotation
  - Hierarchical dependencies
  - Linear order
  - Traces
  - Syntactic categories
- Predicate argument structure annotation
  - Grammatical functions (e.g. SUBJ, TOP, ADV, …)
  - Modification types (e.g. NP-TEMP, ADV-LOC, …)
  - Case marking preposition (e.g. PP-DTV)
- Part-of-speech (POS) annotation
- In Switchboard: disfluency (reparandum, repair)
- Genre, speaker, etc. information

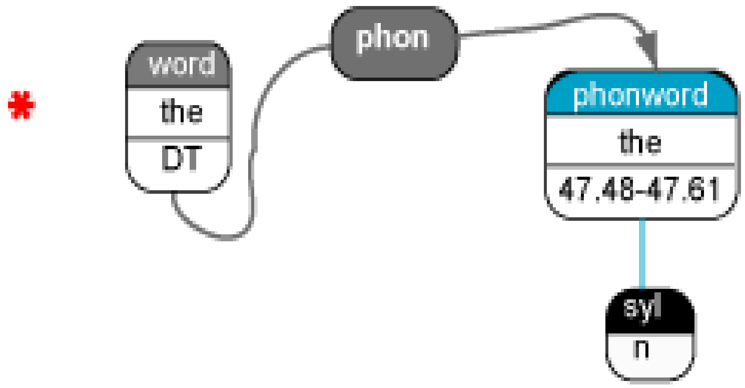
WSJ

```
(TOP (S (NP-SBJ (NP (NNP Pierre)
                    (NNP Vinken))
                (, ,)
                (ADJP (NP (CD 61)
                          (NNS years))
                      (JJ old))
                (, ,))
        (VP (MD will)
            (VP (VB join)
                (NP (DT the)
                    (NN board))
                (PP-CLR (IN as)
                        (NP (DT a)
                            (JJ nonexecutive)
                            (NN director)))
                (NP-TMP (NNP Nov.)
                        (CD 29))))
        (. .)))
(TOP (S (NP-SBJ (NNP Mr.)
                (NNP Vinken))
        (VP (VBZ is)
            (NP-PRD (NP (NN chairman))
                    (PP (IN of)
                        (NP (NP (NNP Elsevier)
                                (NNP N.V.)) …
```

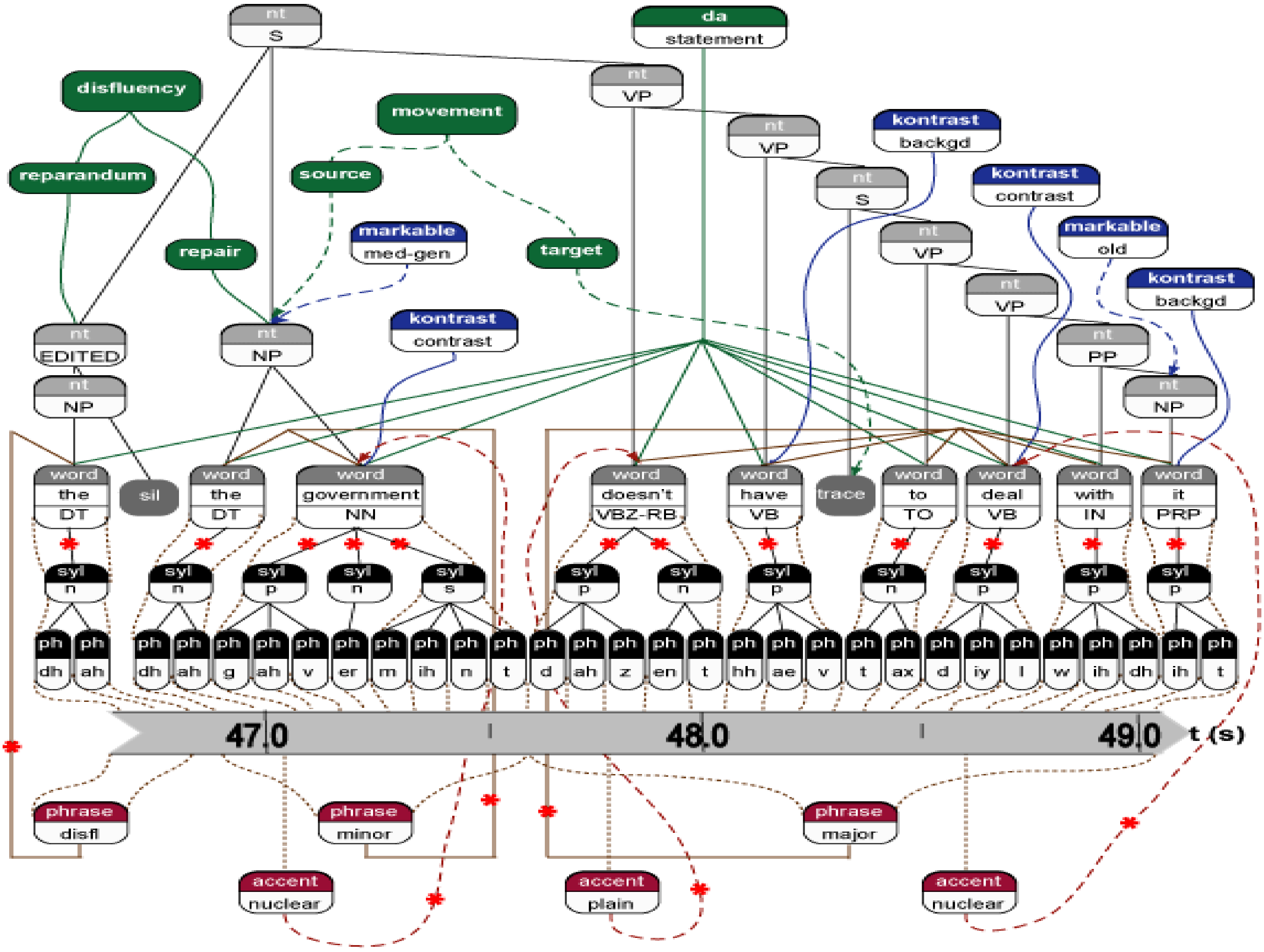
SWBD

```
(TOP (CODE (SYM SpeakerA1)
           (. .)))
(TOP (INTJ (UH Okay)
           (. .)
           (-DFL- E_S)))
(TOP (S (INTJ (UH Uh))
        (, ,)
        (ADVP-TMP (RB first))
        (, ,)
        (INTJ (UH um))
        (, ,)
        (NP-SBJ-1 (PRP I))
        (VP (VBP need)
            (S (NP-SBJ (-NONE- *-1))
               (VP (TO to)
                   (VP (VB know)
                       (, ,)
                       (INTJ (UH uh))
                       (, ,)
                       (SBARQ (WHADVP-2 (WRB how))
                              (SQ (VBP do)
                                  (NP-SBJ (PRP you))
                                  (VP (VB feel)
                                      (ADVP (-NONE- *T*-2))
                                      (EDITED (RM (-DFL- \[))
                                              (PP-UNF (IN about))
```

Annotations in SWBD: NITE XML



- Combination of annotations from different projects in one big data structure
- Nodes can
  - have children (hierarchical relationship)
  - point at other nodes (arbitrary relationship)
- Some nodes have timing information from original sound files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disfluency
movement
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VP
kontrast
backgd
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kontrast
contrast
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med-gen
repair
target
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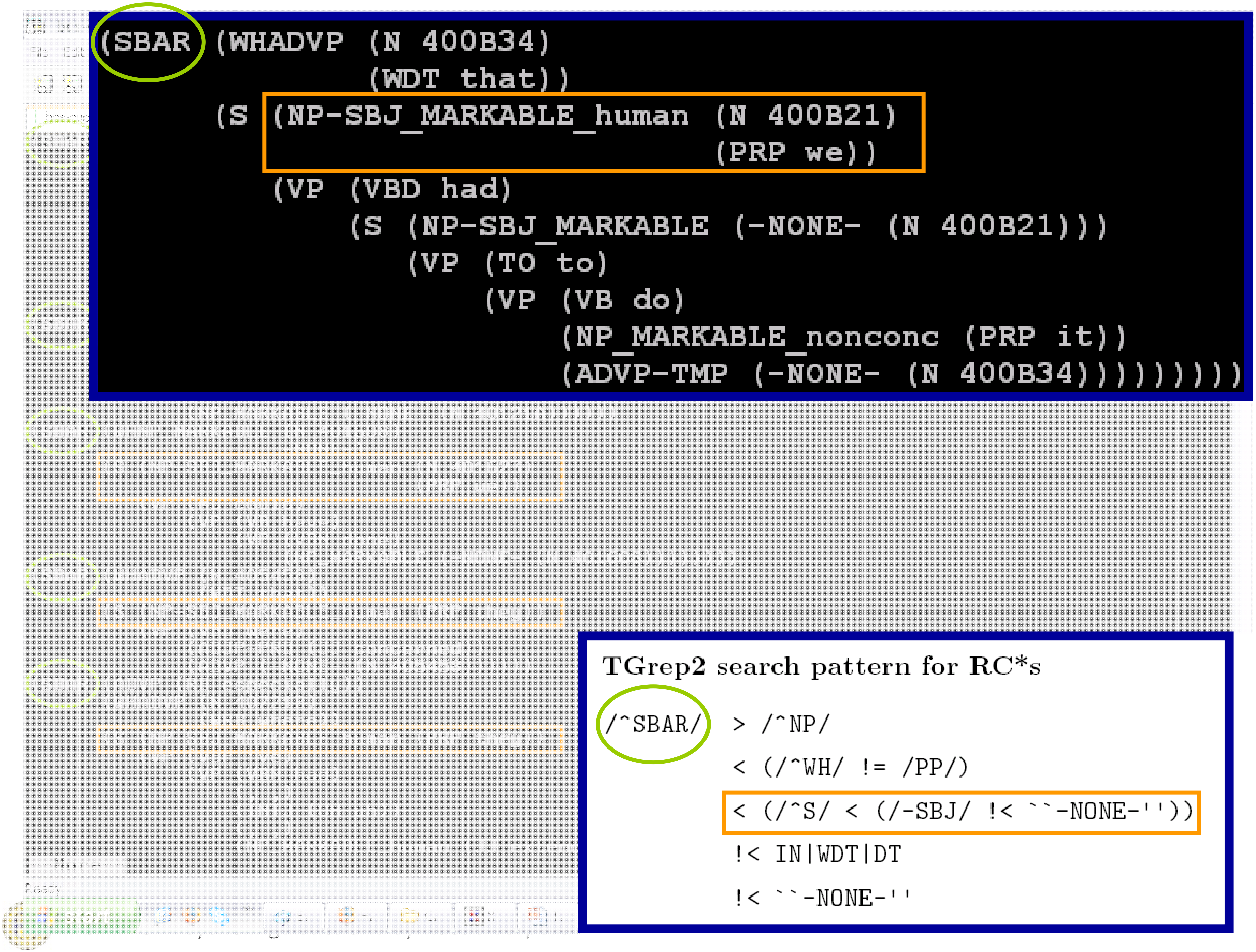

```
(SBAR (WHADVP (N 400B34)
              (WDT that))
      (S (NP-SBJ_MARKABLE_human (N 400B21)
                                (PRP we))
         (VP (VBD had)
             (S (NP-SBJ_MARKABLE (-NONE- (N 400B21)))
                (VP (TO to)
                    (VP (VB do)
                        (NP_MARKABLE_noncon (PRP it))
                        (ADVP-TMP (-NONE- (N 400B34)))))))))
```

```
                 (NP_MARKABLE (-NONE- (N 40121A))))))
(SBAR (WHNP_MARKABLE (N 401608)
                     -NONE-)
      (S (NP-SBJ_MARKABLE_human (N 401623)
                                (PRP we))
         (VP (MD could)
             (VP (VB have)
                 (VP (VBN done)
                     (NP_MARKABLE (-NONE- (N 401608))))))))
(SBAR (WHADVP (N 405458)
              (WDT that))
      (S (NP-SBJ_MARKABLE_human (PRP they))
         (VP (VBD were)
             (ADJP-PRD (JJ concerned))
             (ADVP (-NONE- (N 405458))))))
(SBAR (ADVP (RB especially))
      (WHADVP (N 40721B)
              (WRB where))
      (S (NP-SBJ_MARKABLE_human (PRP they))
         (VP (VBP 've)
             (VP (VBN had)
                 (, ,)
                 (INTJ (UH uh))
                 (, ,)
                 (NP_MARKABLE_human (JJ extend
```

TGrep2 search pattern for RC*s

```
/^SBAR/  > /^NP/
         < (/^WH/ != /PP/)
         < (/^S/ < (/-SBJ/ !< ``-NONE-''))
         !< IN|WDT|DT
         !< ``-NONE-''
```

Data

- Over 3,700 RC*s (RCs with obligatory *that* were excluded) from approximately 350 different speakers

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- Extracting all RC*s with a pronoun subject:

```
tgrep2 –af –m “%xm\n” “/^SBAR/ > /^NP/ < (/^WH/ != /PP/) <
   (/^S/ < (/-SBJ/ < /^PRP/)) !< IN|WDT|DT !< `-NONE-’”
```

outputs:

```
5:73
21:68
31:28
41:25
236:62
331:168
589:30
651:9
…
```

Variables in the model

- Use a set of scripts (**TGrep2 Database Tools**; **cf. class webpage as of today**) to combine the output of many TGrep2 searches into a database of cases.

- **Probabilities:**
  - **RC Predictability; Predictability of RC onset**
  - Frequency of words immediately preceding and following RC onset

Variables in the model

- Continuous syntactic variables, e.g.
  - Lengths of each of 3 regions (pre-NP, between head noun and RC, & RC)
- Categorical structural variables, e.g.
  - Embedding within the RC
  - Properties of RC subject (NP type, animacy)
  - Properties of matrix clause (negation, verb)
- Structural priming, e.g.
  - Within speakers
  - Across speakers
  - Distance-based; Lemma-based; etc …

Variables in the RC* model

- Phonological variables, e.g.
  - segmental properties of preceding segment
  - stress structure of preceding segment
- Speech variables, e.g.
  - Speech rate, Pauses
  - Rate of disfluency in different regions
  - (Prosodic phrases & accents)
- Social variables, e.g.
  - Age
  - Speaker gender
  - Education

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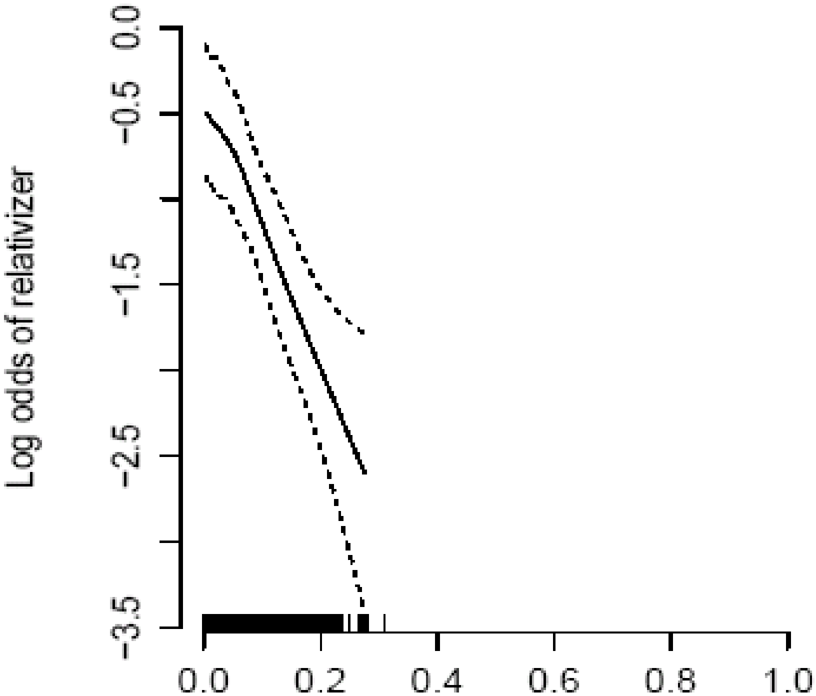
Results of model

- Predictability one of the most influential factors
  - Both RC* predictability and the predictability of the RC* onset affect *that*-rates *even when many other factors are considered*
- As predicted by Uniform Information Density



(b) RC* predictability

Contemporary American English with Penn Treebank III annotation – Text

- Parts of ATIS-3
- Parsed Brown corpus, release 3
  - approx. 24,000 sentences & 396,000 words
  - 15 different written text categories of (good standard reference; like BNC).
- Parts of Wall Street Journal corpus (WSJ), release 3
  - approx. 24k sentences & 505,000 words [1 million out of 30 million]
  - Newspaper articles
  - Also available:
    - RST discourse annotation (for parts)
    - Propositional/event structure annotation (113,000 verb tokens; 3,200 verb types)
    - Automatically annotated extension to 30 million words

Contemporary American English with Penn Treebank III annotation – Speech

- International Corpus of English (ICE-GB)
  - approx. 84,000 sentences & 1 million words
  - Speech and written language
  - Not quite Treebank III annotation style
- Parts of Switchboard corpus (Swbd), release 3
  - approx. 100k sentences & 800,000 words [1 million out of 2 million]
  - Spontaneous speech
  - Also available:
    - Disfluency annotation (all)
    - Sound files (all)
    - Phonetic & phonological annotation (~38,000 words)
    - Animacy annotation (~140,000 NPs)
    - Information Structure annotation (~60,000 NPs)

Diachronic American English with Penn Treebank III annotation

- The York-Toronto-Helsinki Parsed Corpus of Old English Prose (YCOE)
  - approx. 110,000 sentences & 1.5 million words
  - Also available:
    - Text source, genre, dialect, and publication date information

- Helsinki Parsed Corpus of Middle English, second edition (PPCME2)
  - Over 100,000 sentences & 1.3 million words
  - Prose text samples of Middle English
  - Also available:
    - Text source, genre, dialect, and publication date information

POS & Syntactically annotated corpora of other languages - (1)

- Parsed NEGRA corpus, version 2
  - German
  - approx. 200,000 sentences
  - Newspaper articles (Frankfurter Rundschau)
  - Also available:
    - Morphological analysis (first 60,000 words)

- Parsed TIGER corpus
  - German
  - approx. 40,000 sentences & 700,000 words
  - same source as NEGRA

- Prague Dependency Treebank, version 1.0
  - Czech
  - approx. 1.8 million words

POS & Syntactically annotated corpora of other languages - (2)

- Penn Chinese Treebank, version 6
  - approx. 600,000 words
  - Newswire text

- Penn Arabic Treebank, Part 3, version 1.0
  - approx. 340,000 words
  - Newswire text
  - Also available:
    - Vocalization and Lemmatization information
    - Aligned translations into English (for parts)

- Penn Korean Treebank,
  - approx. 5,000 sentence & 55,000 words
  - 33 constructed texts in Korean (translated into English) for purposes of language training in a military setting.

Let’s do some practice

- Login to/login into/log into the corpus server

- If your username is **lsa1** to **lsa30** log onto the corpus server:

  ssh <username>@174.129.5.193

- If your username is **lsa31** to **lsa99** log onto the corpus server:

  ssh <username>@174.129.205.212

Sanity check

- Type *env* (and press enter):
  - TGREP2_CORPUS=/corpora/TGrep2able//swbd.t2c.gz
  - TGREP2ABLE=/corpora/TGrep2able/

  - TDTlite=/corpora/TDTlite/
  - TDT_DATABASES=/corpora/TDTlite/databases/

  - PATH=...:/corpora/TDTlite

TGrep2

- Type *tgrep2*

- *tgrep2 -c* <corpus> *-af* <output-options|output-formating> <macro-file> <pattern|pattern-file>

  -*c* <corpus> defaults to TGREP2_CORPUS
  -*af* gives all matches exactly once
  -*i* makes TGrep2 case-insensitive (default is case-sensitive)

  <output-options> and <macro-file> are optional

TGrep2

- … a very simple call: let’s find sentences in the default corpus (Switchboard)

tgrep2 “TOP” | more

[*more* gives output page-by-page – press ENTER or SPACE]

TGrep2

- let’s find NPs

  tgrep2 “NP” | more

- Now let’s **count**:

  tgrep2 “NP” | wc -l

  [*wc -l* counts lines of the output; TGrep2 *defaults* to one match per line]

TGrep2 – Different outputs

- We can format the output:

  tgrep2 -l “NP” | more

  tgrep2 -t “NP” | more

  tgrep2 -u “NP” | more

  [be cautious with the *tgrep2 –l | wc -l*]

- There are more options for later …

TGrep2 – Regular Expressions

- Let's count *all* instances of *any type of* NP in the corpus:

  tgrep2 -af "NP" | wc –l

  tgrep2 -af "/^NP/" | wc -l

- Investigate why there is a difference:

  tgrep2 -af "/^NP/" | more

→Each node can be described as a regular expression /…/

[/^ …/ means that the node has to *start* with whatever follows the ^]

Across Corpora

- Count all instances of any type of NP in the **Wall Street Journal, Brown, and Switchboard corpus**

  ```
  ls $TGREP2ABLE
  ```

  ```
  brown.t2c.gz
  wsj_mrg.t2c.gz
  swbd.t2c.gz
  ```

  ```
  tgrep2 -c $TGREP2ABLE/<corpus-file> -af “/^NP/” | wc -l
  ```

- **What’s the ration of NPs (/^NP) to VPs (/^VP/) in the three corpora?**

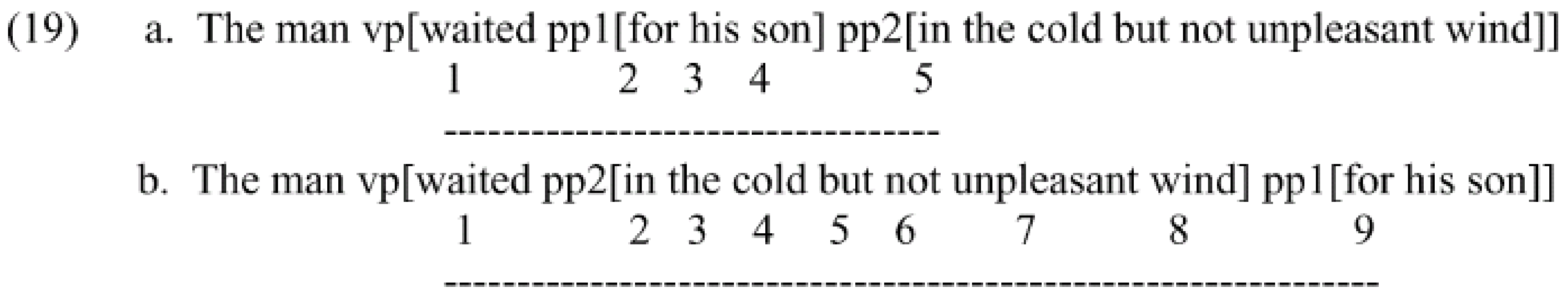
How many of these NPs have lexical content (as opposed to traces)?

```
tgrep2 -af “/^NP/ << (/^'{0,1}[a-zA-Z].*/ !< *)”   | wc –l
```

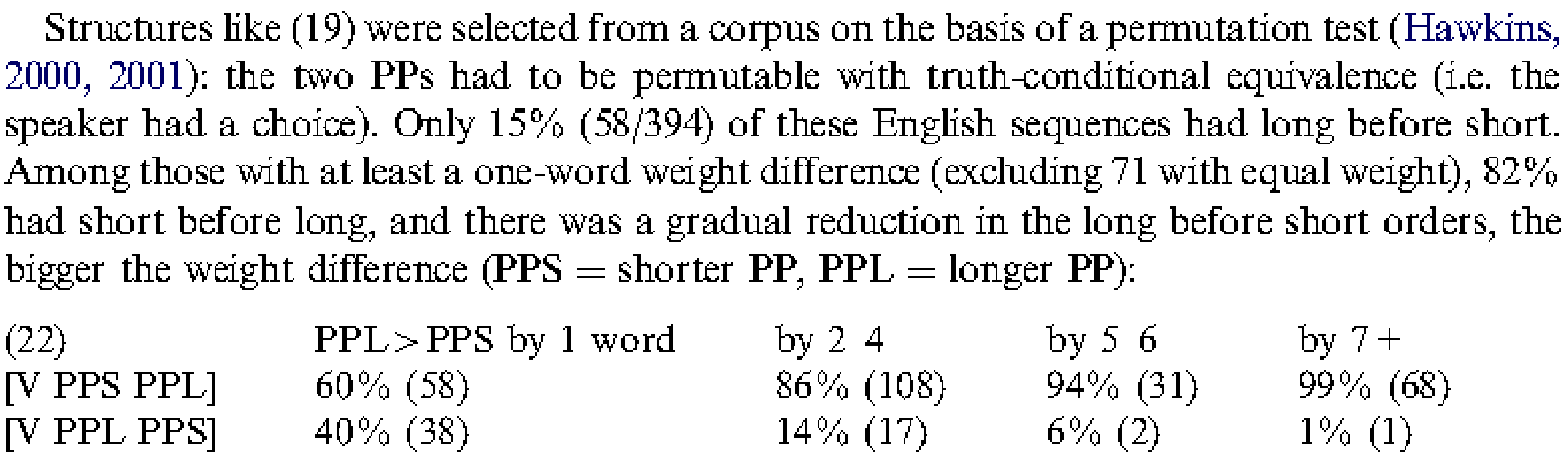
- NB:
  - Left-headedness

Time to get real: PP-ordering in English

(Hawkins, 1999; taken from Hawkins, 2007:97)



```
(19)   a. The man vp[waited pp1[for his son] pp2[in the cold but not unpleasant wind]]
                     1           2  3  4        5
                     -----------------------------------
       b. The man vp[waited pp2[in the cold but not unpleasant wind] pp1[for his son]]
                     1           2  3   4   5   6       7        8         9
                     --------------------------------------------------------------------
```



Structures like (19) were selected from a corpus on the basis of a permutation test (Hawkins, 2000, 2001): the two PPs had to be permutable with truth-conditional equivalence (i.e. the speaker had a choice). Only 15% (58/394) of these English sequences had long before short. Among those with at least a one-word weight difference (excluding 71 with equal weight), 82% had short before long, and there was a gradual reduction in the long before short orders, the bigger the weight difference (**PPS** = shorter **PP**, **PPL** = longer **PP**):

(22)	PPL>PPS by 1 word	by 2 4	by 5 6	by 7+
[V PPS PPL]	60% (58)	86% (108)	94% (31)	99% (68)
[V PPL PPS]	40% (38)	14% (17)	6% (2)	1% (1)

Time to get real …

- What should be the cases we extract to get **all and only** the relevant cases? (avoid inclusion and exclusion errors)

- VPs
- VPs with PPs
- VPs with PPs that are sisters to each other
- VPs with adjacent PPs that are sisters to each other
- VPs with exactly two adjacent PPs that are sisters to each other

Cheat sheet

- **TGrep2 is left-headed!**
- Syntactic relations: < > << >> $ ~ =
- Linear relations: , .
- Labeling of nodes: =xx
- Disjunction | []
- Negation: !

```
/^VP/=VP1 < (/^PP/=PP1
             $.. (/^PP/=PP2  !$ (/^PP/ != =PP1)
                          !,, (* !< * ,, =PP1
                                !>> (EDITED|UH|PRN|/-UNF/
                                >> =VP1))))
```

Macros

- Macros keep those precious fingers soft and smooth by avoiding to much typing

```
@ NP              /^NP/;
@ VP              /^VP/;
@ PP              /^PP/;
@ AP              /^(ADJ|ADV)P/;
@ WH              /^WH/;
@ SBJ_ZERO        (@SBJ) < (@ZERO);
@ SBJ_NERO        (@SBJ) !< (@ZERO);
@ SSBJ_ZERO       S < (@SBJ_ZERO);
@ SSBJ_NERO       S < (@SBJ_NERO);
```