Syntactic Parsing & Its Applications

CS 490A, Fall 2021

Applications of Natural Language Processing
https://people.cs.umass.edu/~brenocon/cs490a_f21

Brendan O'Connor & Laure Thompson

College of Information & Computer Sciences
University of Massachusetts Amherst

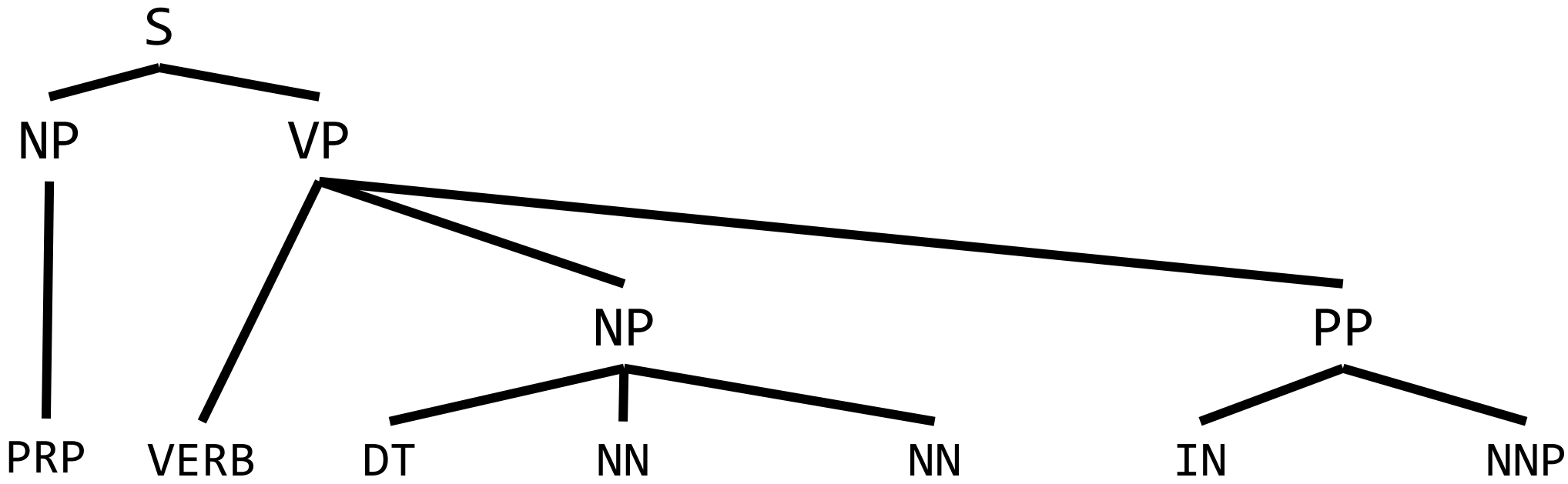
Administrivia

- HW3 due Friday 10/29
- Doing a PhD in CSS/NLP office hour

Syntactic Parsing

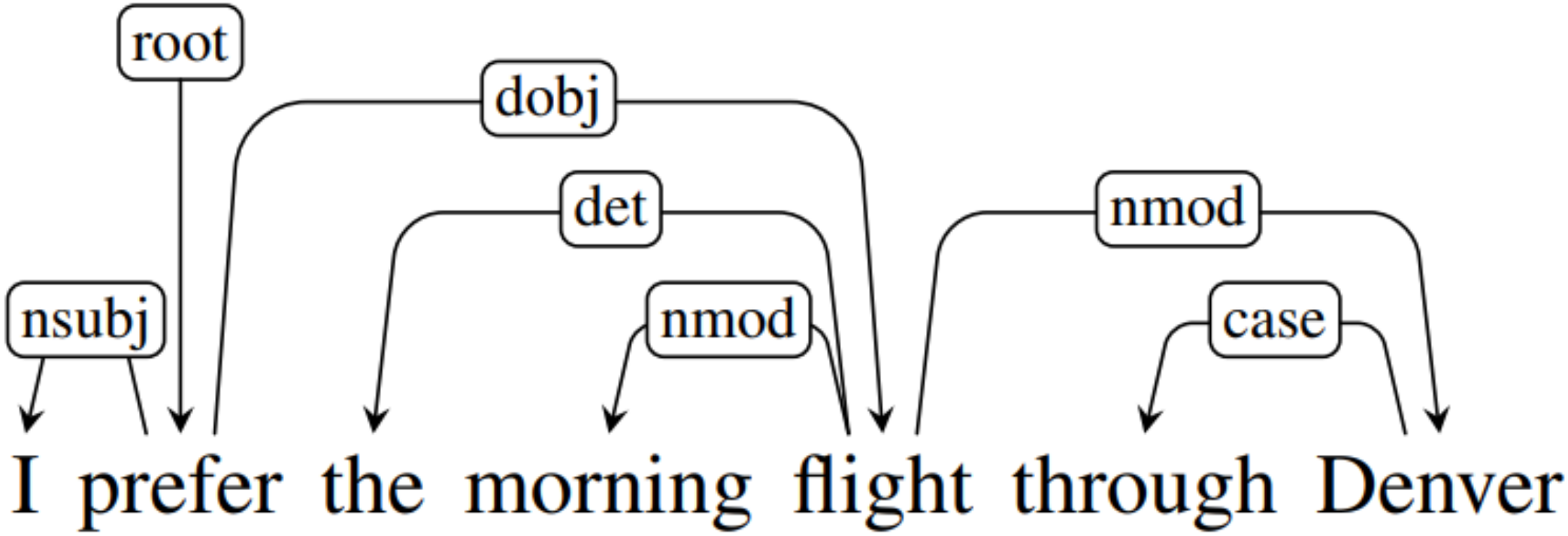
I prefer the morning flight through Denver

Constituency Parse Tree



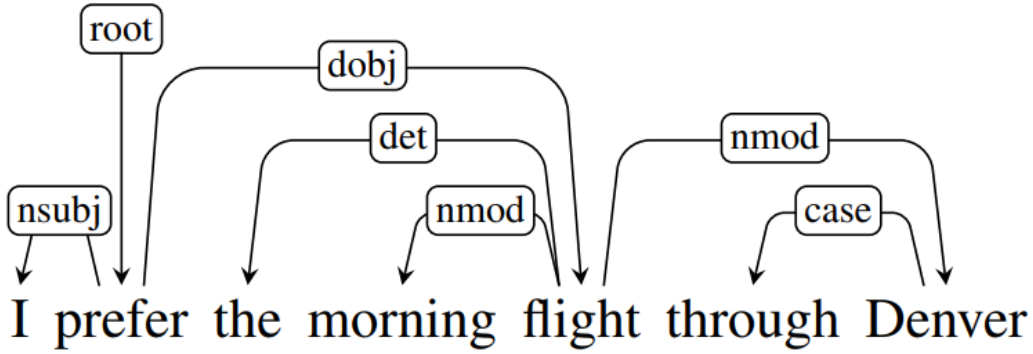
I prefer the morning flight through Denver

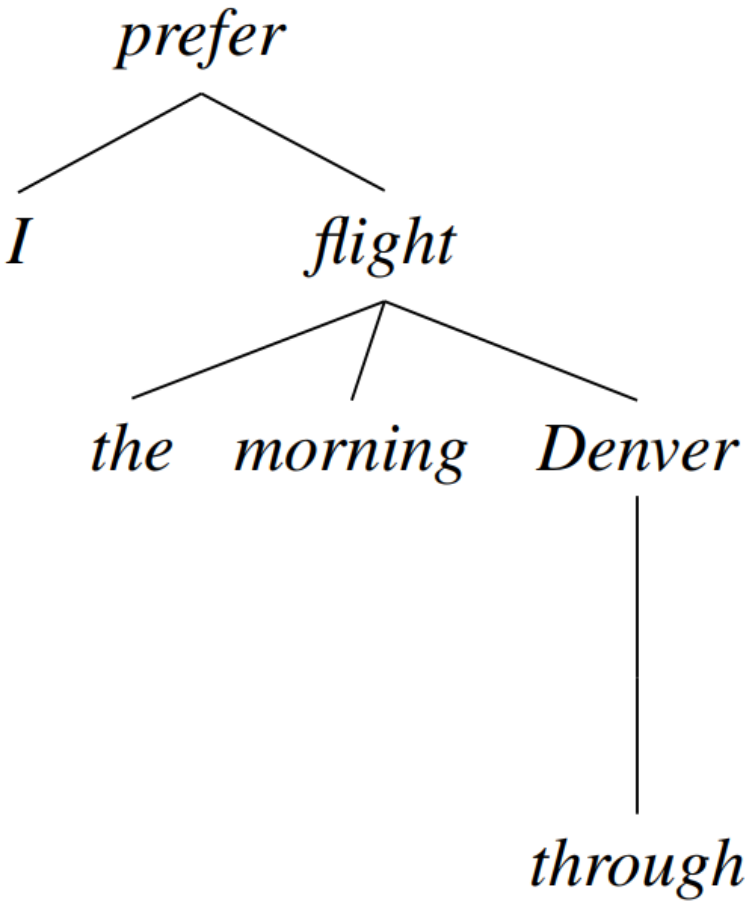
Dependency Parse Tree



J&M Textbook

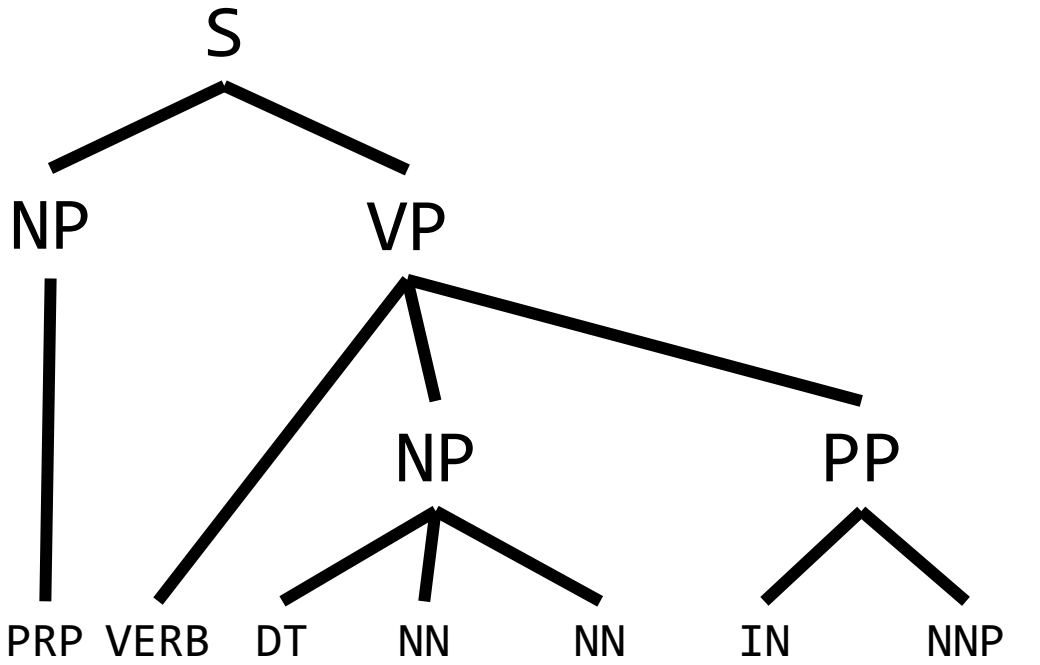
Dependency Parse Tree

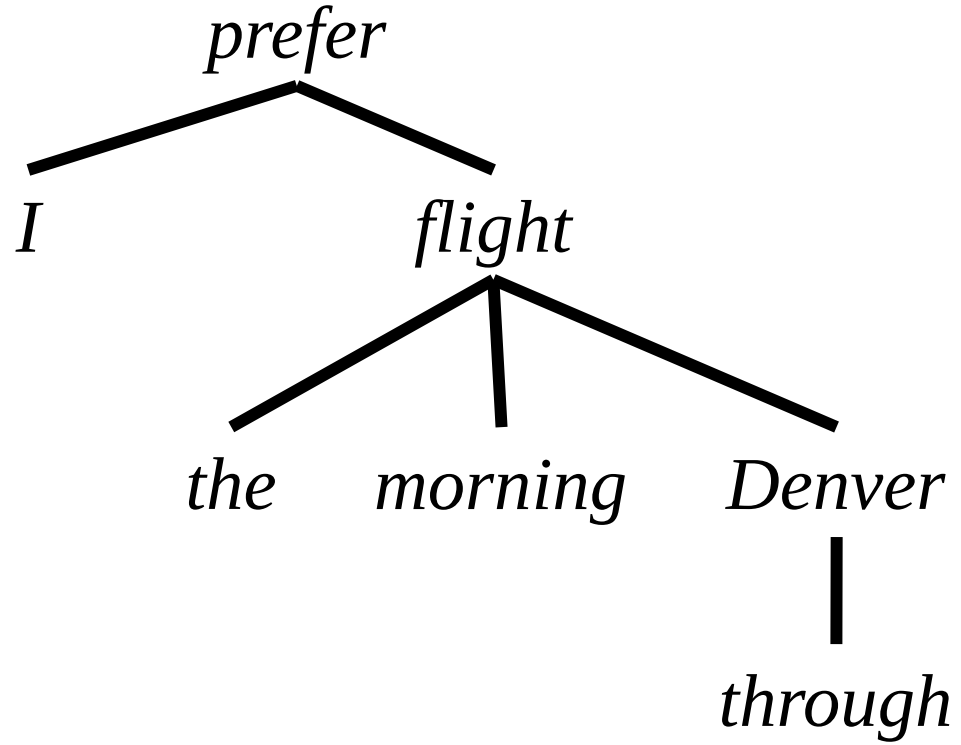




J&M Textbook

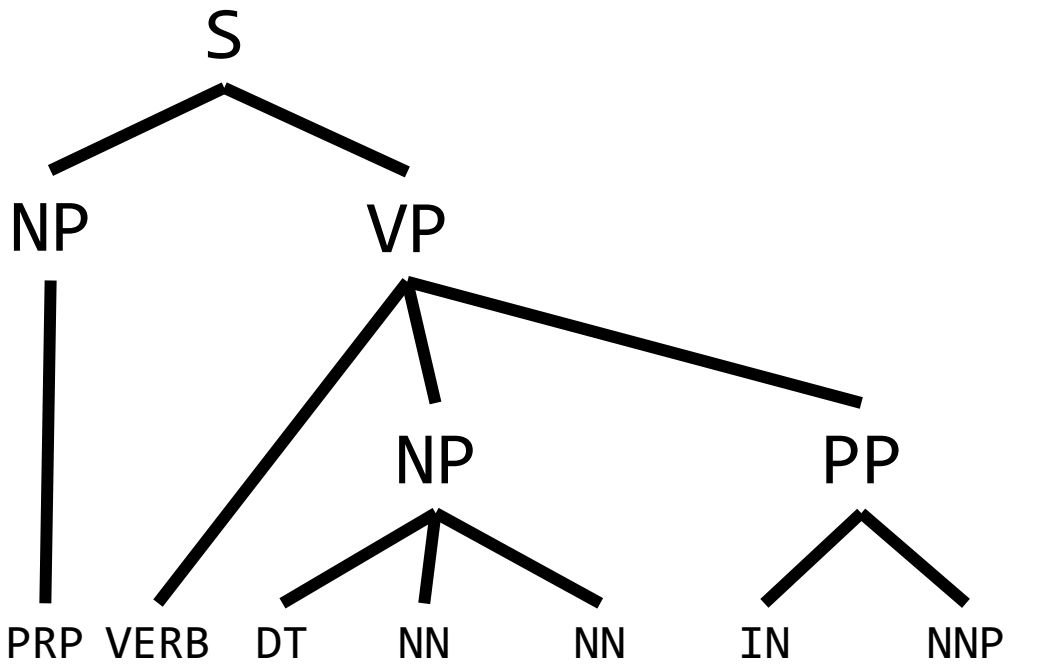
Q: How do constituency and dependency parse trees differ?



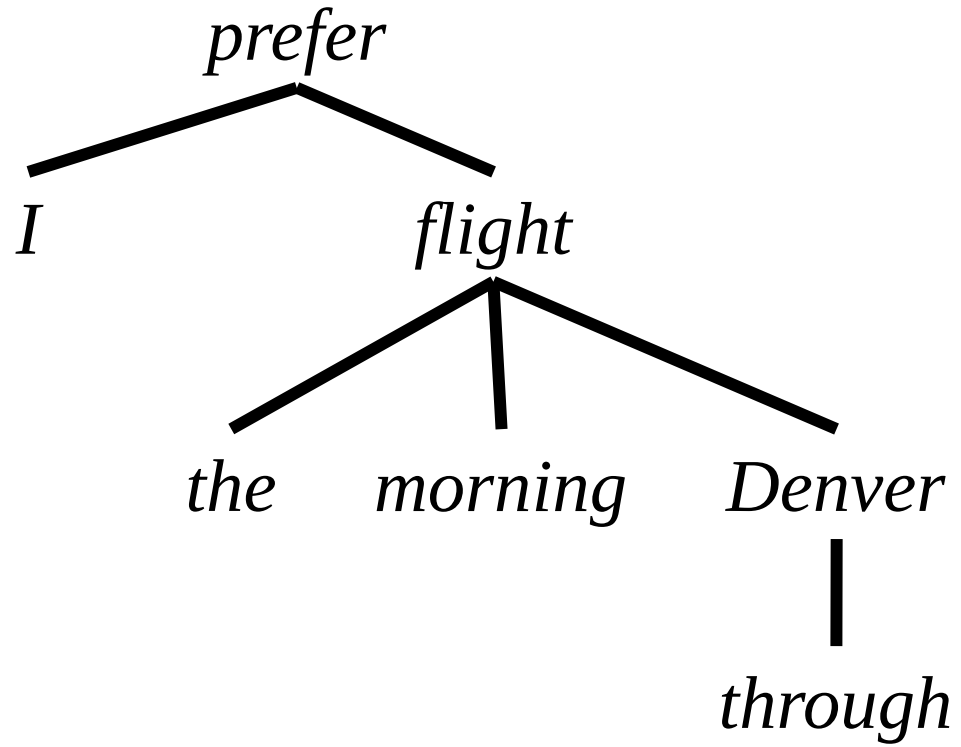


Q: How do constituency and dependency parse trees differ?

Focuses on *phrases*

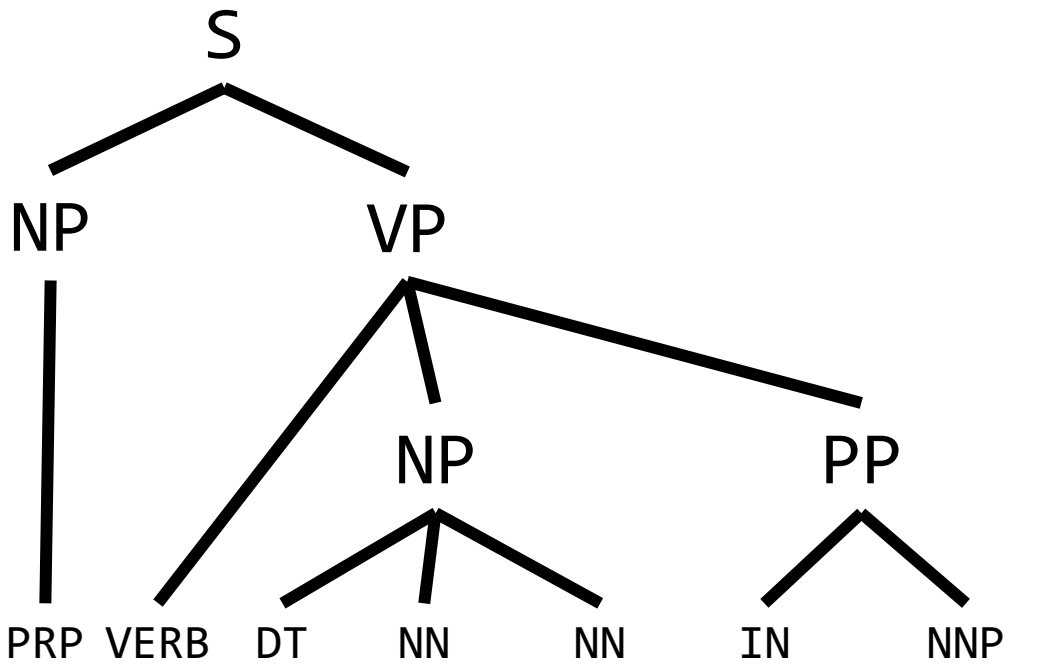


Focuses on *relations*

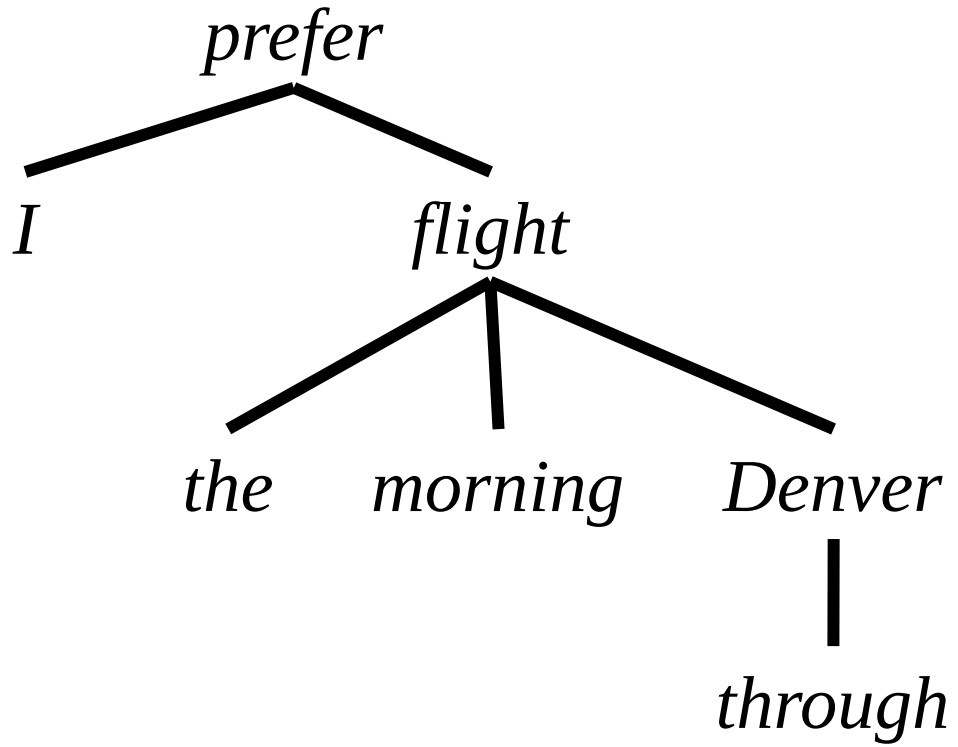


Q: How do constituency and dependency parse trees differ?

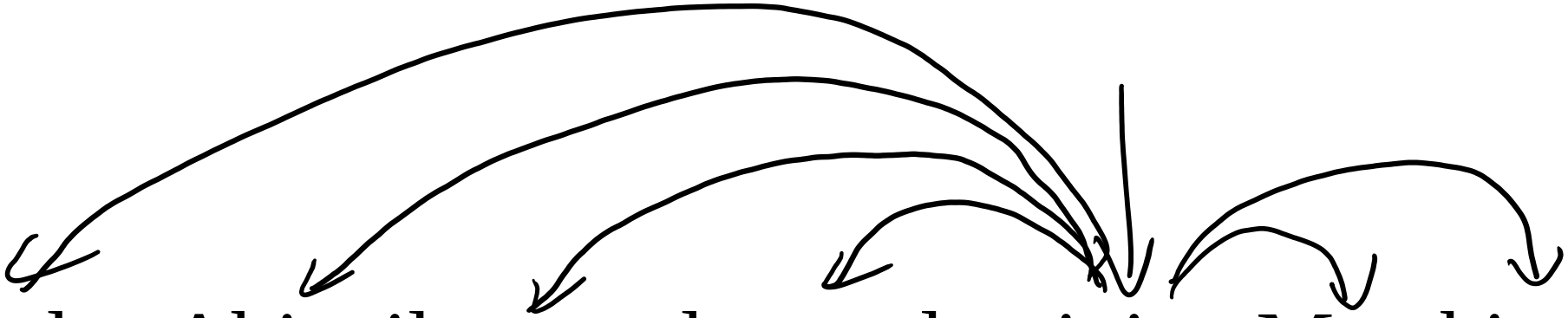
Constituents are *sequences*



Relations *not restricted* by word order

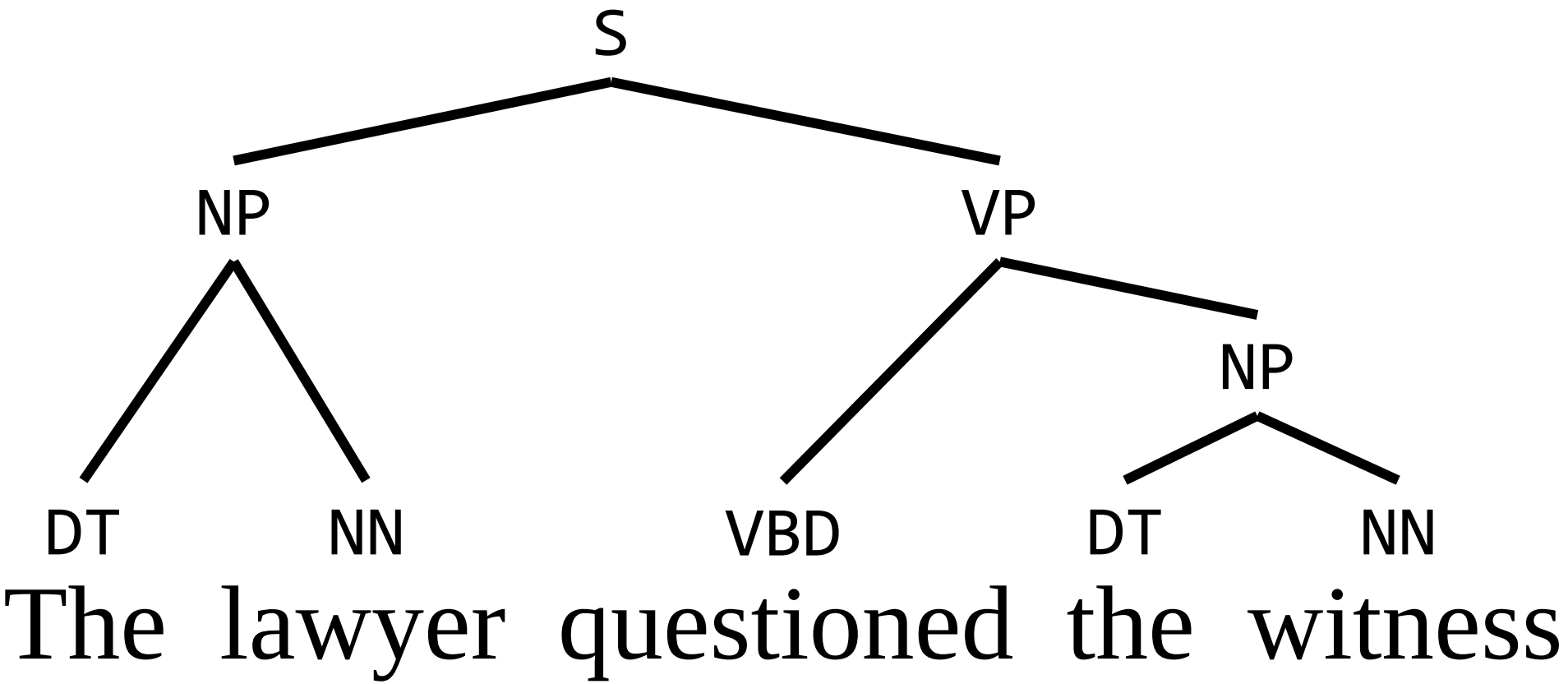


Dependency trees can be very flat

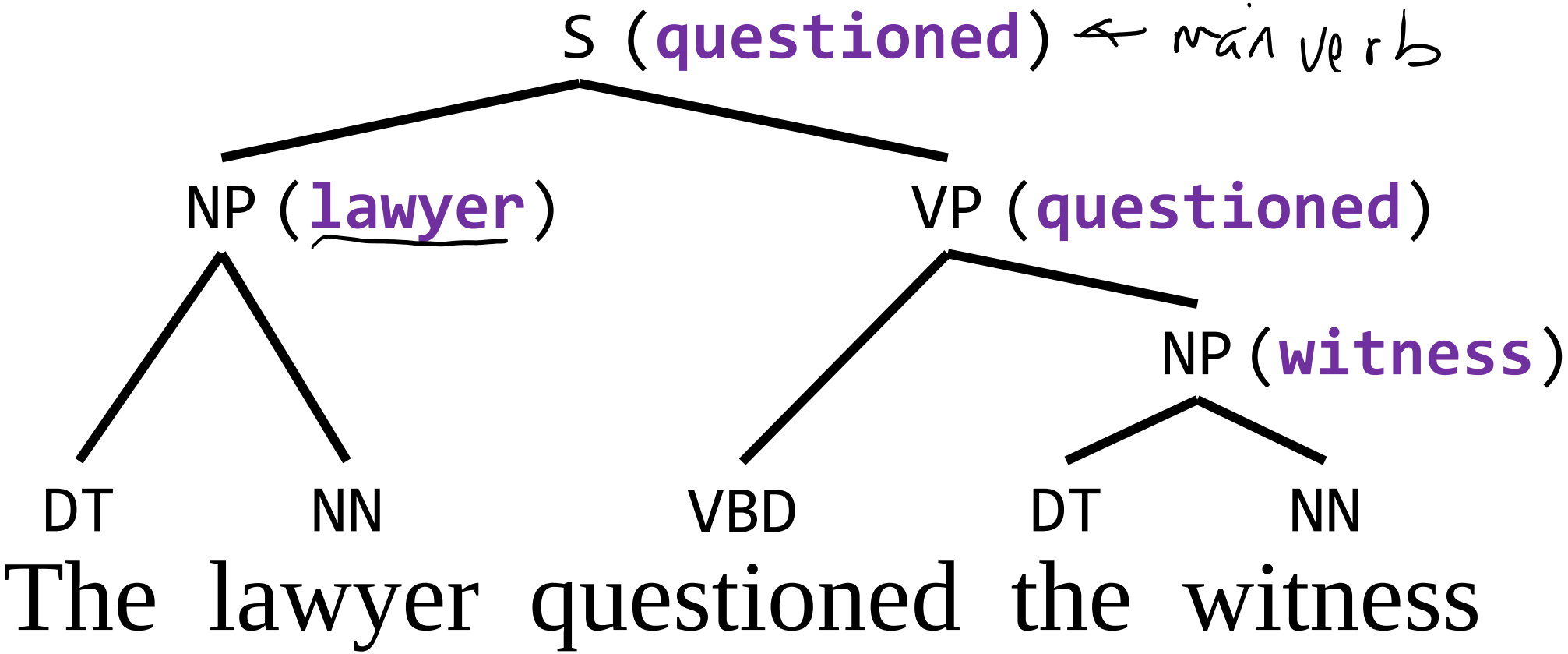


Yesterday Abigail was reluctantly giving Max kimchi

From Constituents to Dependencies



I. Identify head of each constituent



Determining heads of constituents

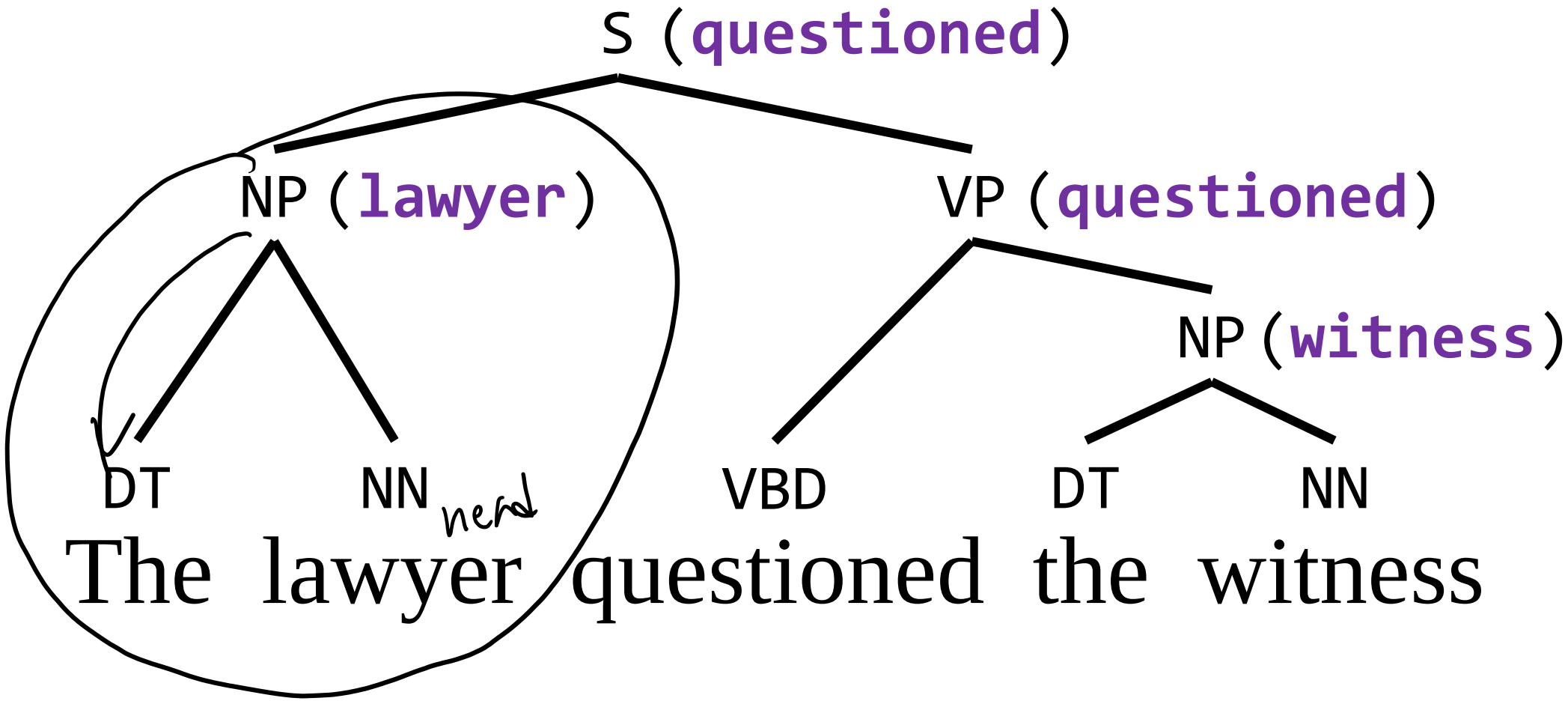
Idea: Every phrase has a head word

A *head rule* determines which of a tree's children will be its "head"

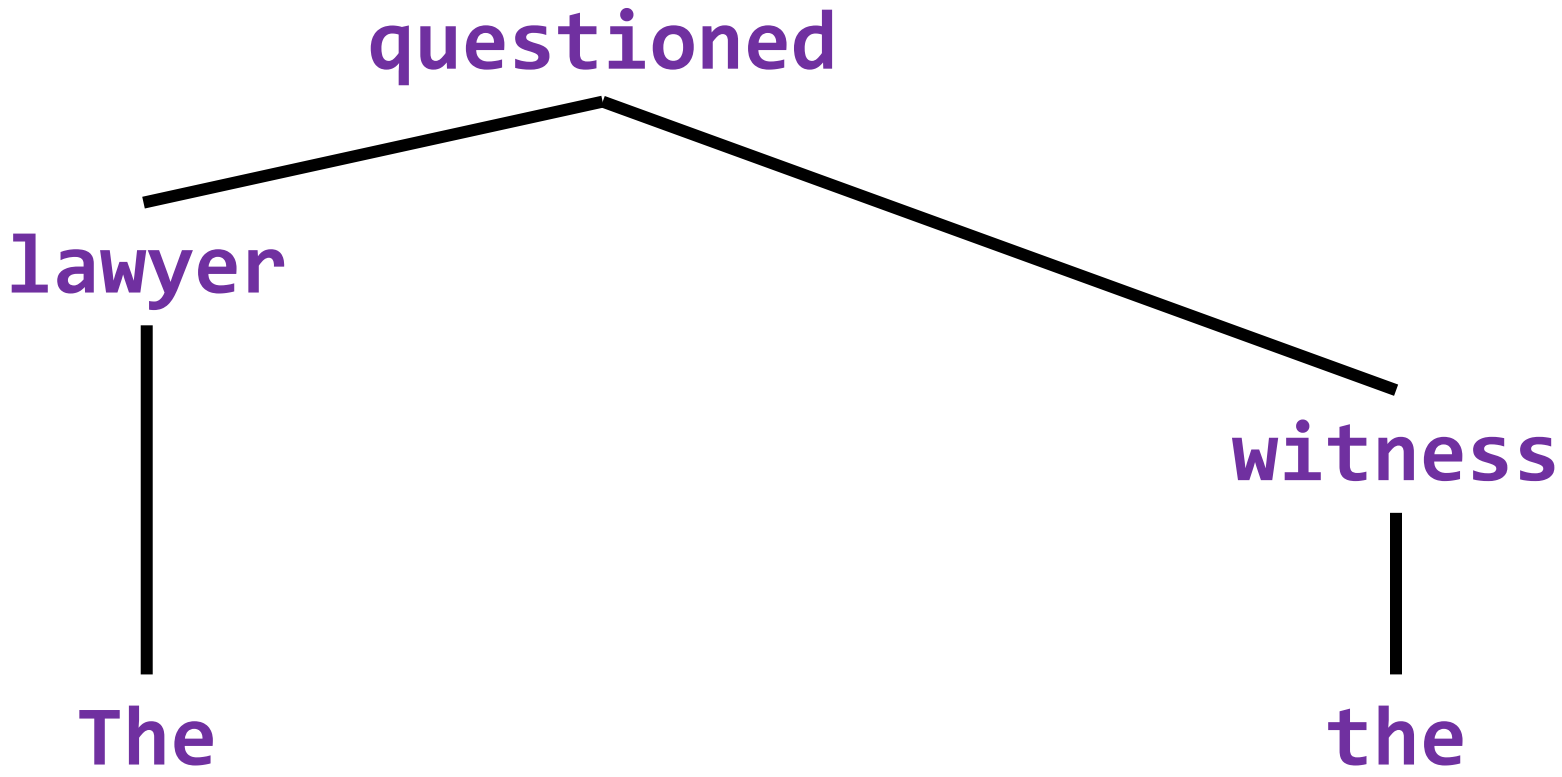
Example rule from Collins (1997):

```
If parent is NP:
    Then: Search from right-to-left for first child
          that's NN, NNP, NNPS, NNS, NX, JJR
    ELSE: Search from left-to-right for first child
          which is NP
```

II. Set other children to depend on head

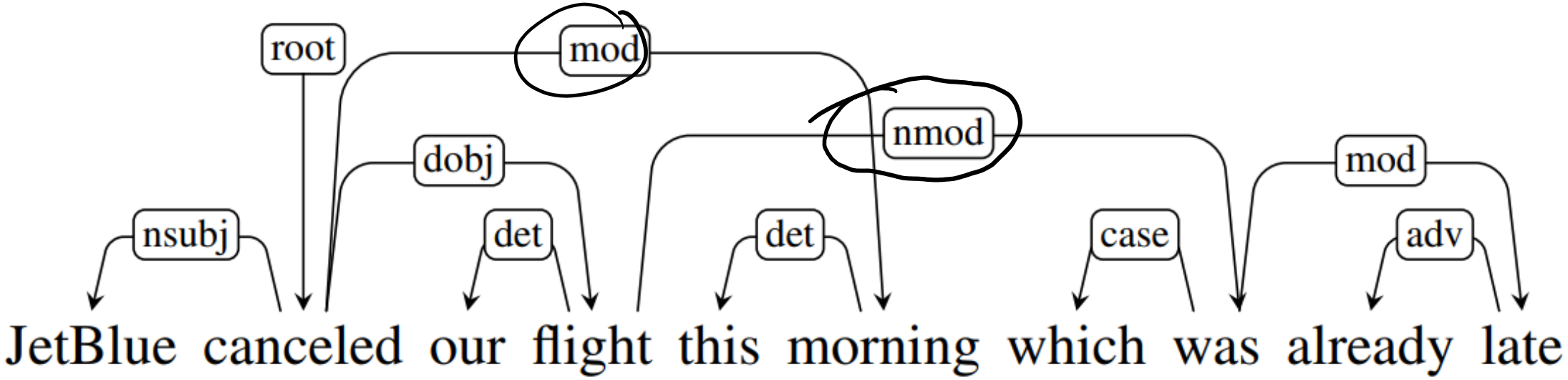


II. Set other children to depend on head



Projectivity

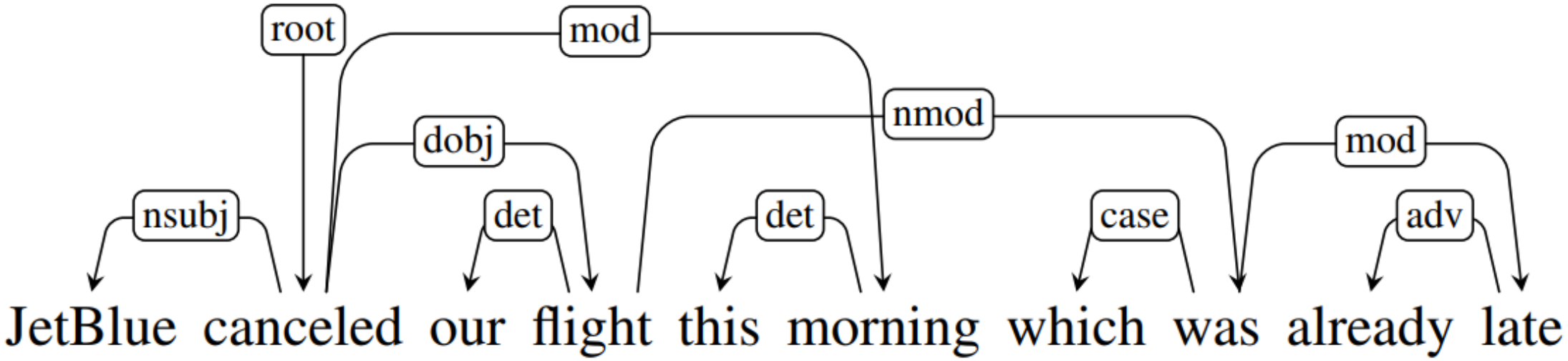
Not all dependency parses have corresponding constituency parses!



J&M Textbook

Projectivity

Non-projective dependency trees are *not* context-free! So, they cannot be described by a context free grammar.



J&M Textbook

Applications

I. Parse Trees as Features

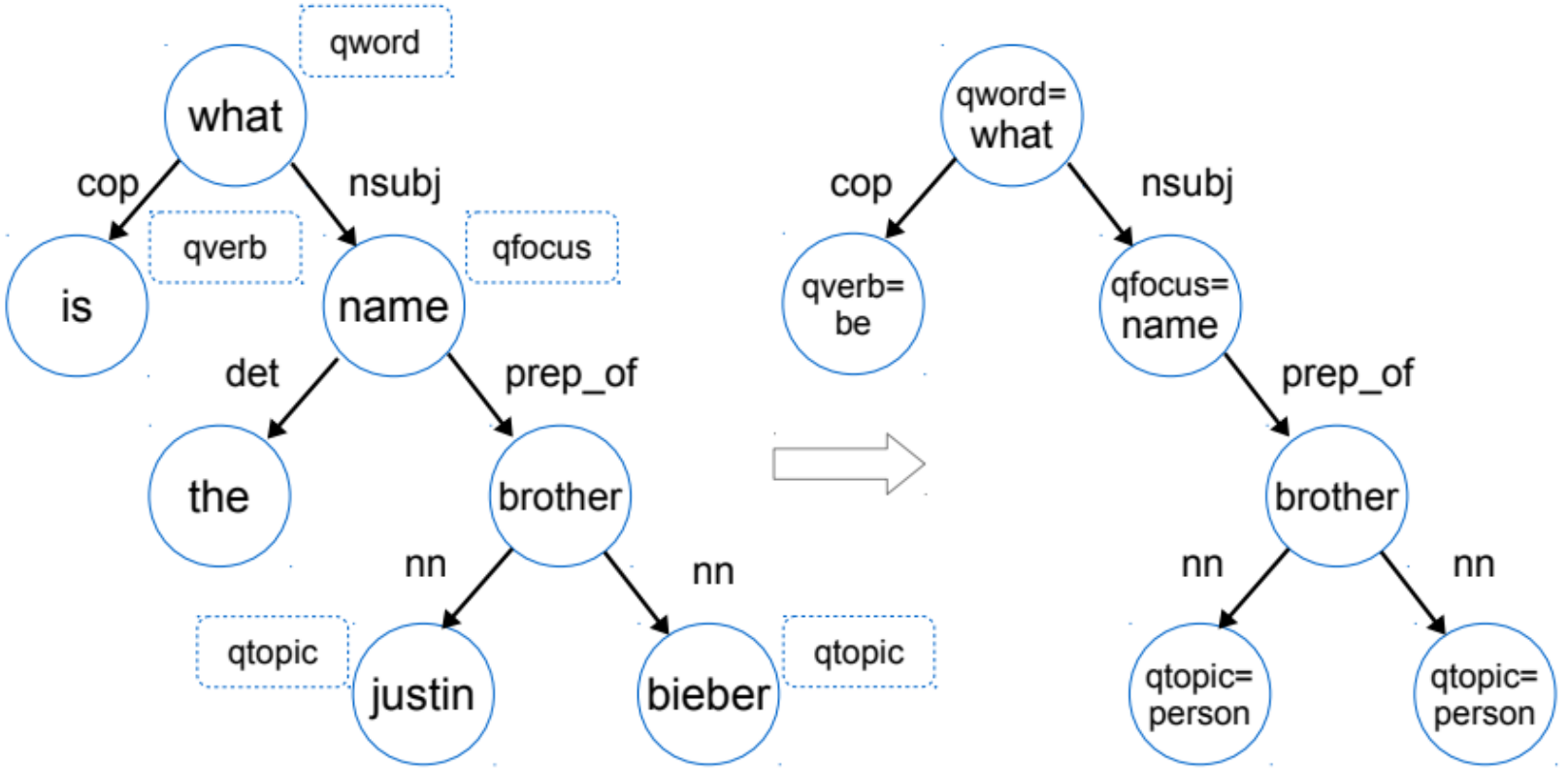
Information Extraction over Structured Data: Question Answering with Freebase

Core Question:

Can answering natural language questions with Freebase be improved by pairing Freebase with “modest” information extraction methods?

Yao & Van Durme 2014

Information Extraction over Structured Data: Question Answering with Freebase



(a) Dependence parse with annotated question features in dashed boxes (left) and converted feature graph (right) with only relevant and general information about the original question kept. Note that the left is a real but incorrect parse.

Yao & Van Durme 2014

Asking too much? The Rhetorical Role of Questions in Political Discourse

Core Question:

What are the rhetorical roles of questions in political discourse?

Zhang et al. 2017 (slides)

Questions serve informational roles

Zhang et al. 2017 (slides)

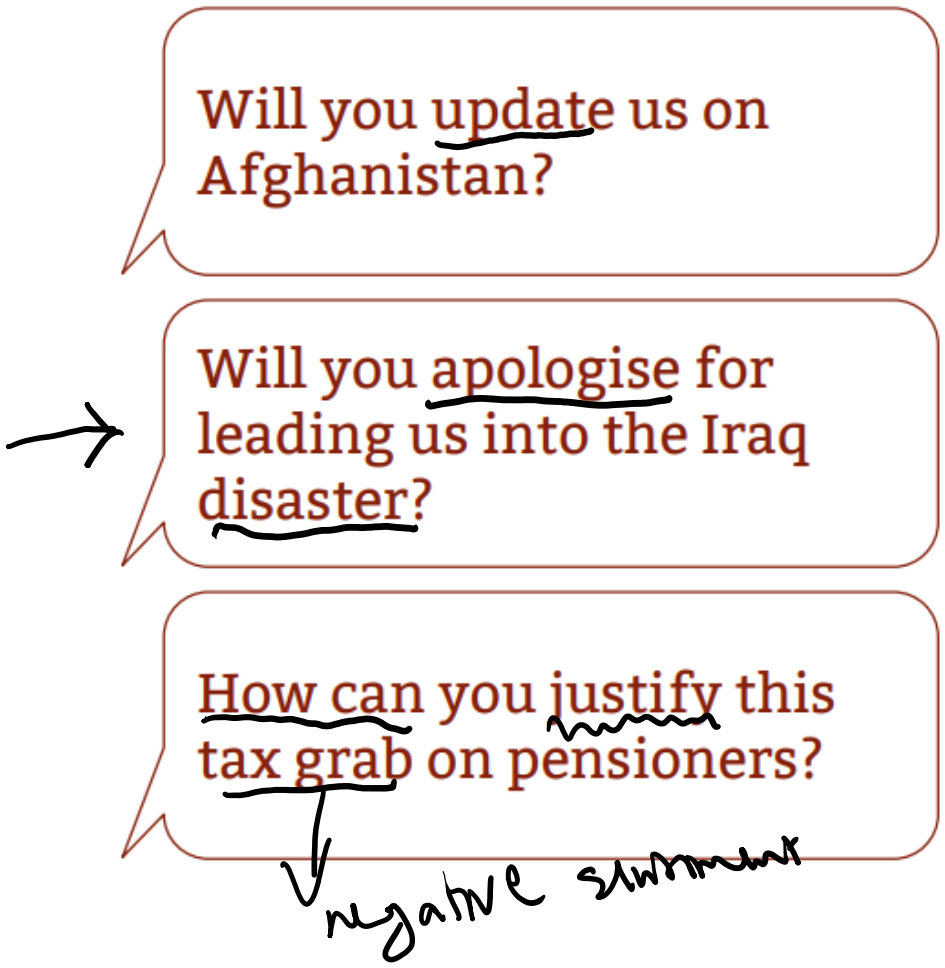
…but they also serve many rhetorical roles

https://www.bbc.com/news/av/uk-politics-21444663

"The Prime Minister is rightly shocked by revelations that many food products contain 100% horse. Does he share my concern that, that if tested, many of his answers may contain 100% bull?"

Zhang et al. 2017 (slides)

Goal: Identify rhetorical role of questions



Rhetorical role:

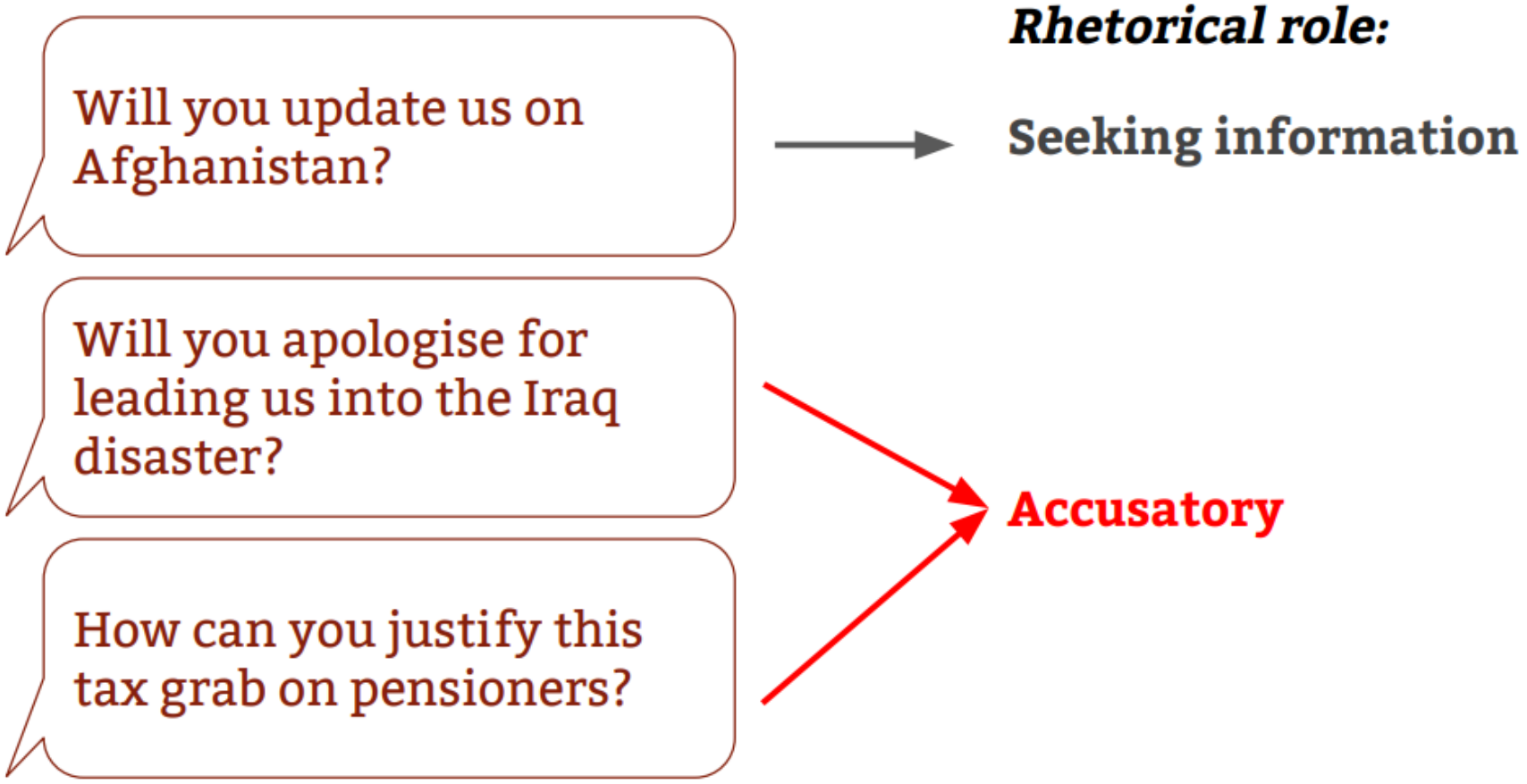
information seeking

accusatory

[illegible]

Zhang et al. 2017 (slides)

Goal: Identify rhetorical role of questions

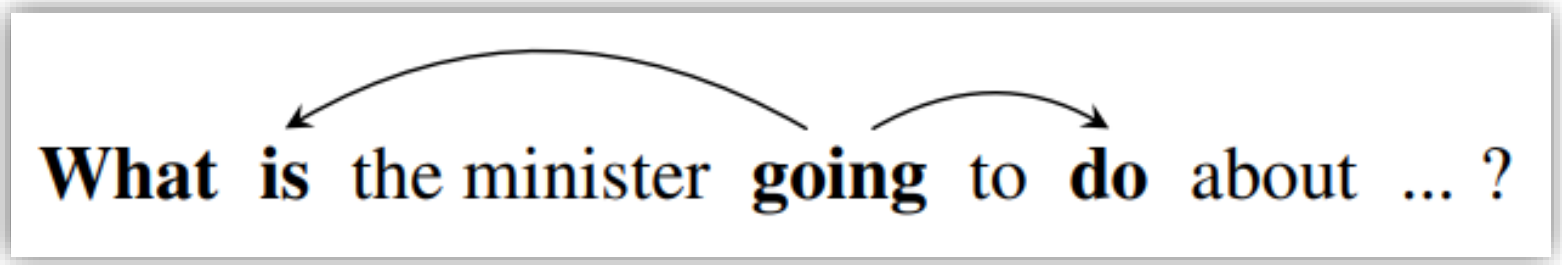


Zhang et al. 2017 (slides)

Question Motifs

Question motifs are “lexico-syntactic patterns recurring in a collection of questions”

I. Extract relevant fragments from **dependency parse trees** of questions



5 Fragments: what, what is, going→*, is←going and going→do

Zhang et al. 2017 (slides)

Question Motifs

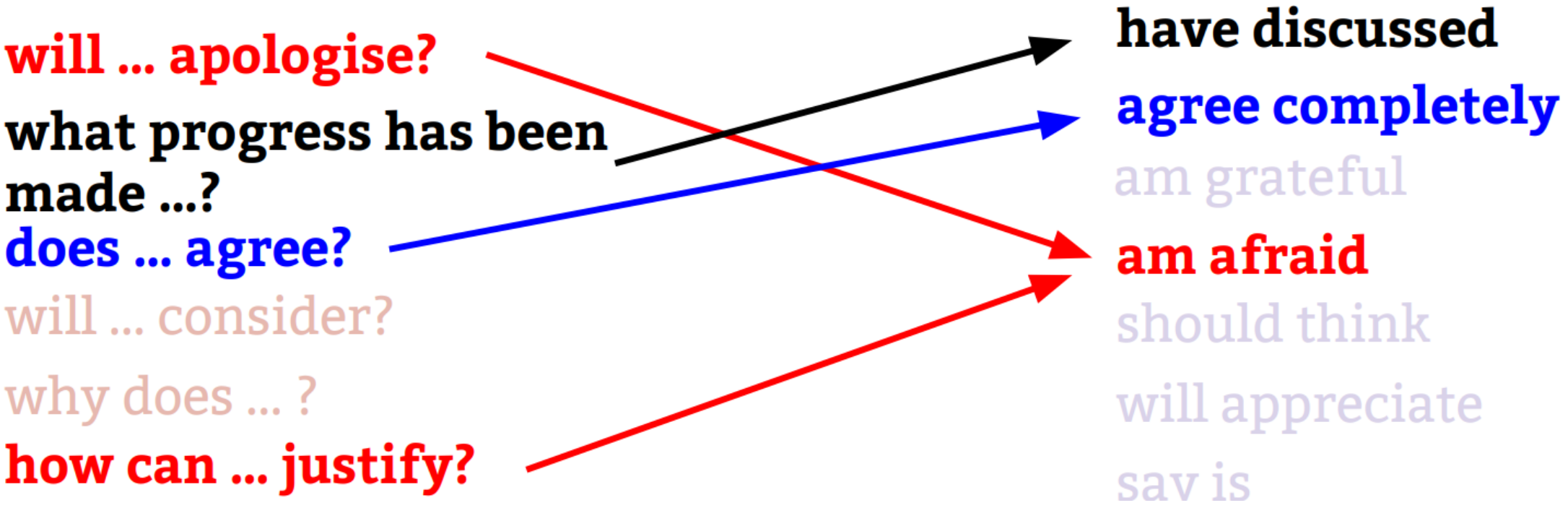
I. Extract relevant fragments from dependency parse trees of questions

II. Group fragments into motifs based on how they cooccur

Zhang et al. 2017 (slides)

How to identify rhetorical roles?

Questions with similar rhetorical functions will map to similar answers



Zhang et al. 2017 (slides)

Some of the rhetorical types

4: Agreement

Airing a laudatory remark about a policy that the minister and MP clearly already agree on. Often these questions effectively serve as attempts to curry favor with the minister and bolster their (mutual) party.

Q: **Is** it not **important** that the Department continues its excellent work [in] building flood defeneces?

Q: **Does** [the Secretary of State] **agree with** me that part of protecting Britain's national interests is that Britain should develop relationships with emerging economies?

Q: **Does** the Minister **agree** that UK taxpayers **need** to be considered at every single step of the way when it comes to our aid spending?

Question motifs: {does←agree, agree→is}, {is→important}, {does←agree, agree→with}, {does←agree, agree→need}

Zhang et al. 2017 (slides)

Some of the rhetorical types

6: Concede, accept

Aggressive demand for minister to concede to, or accept, a fault. The premise of such questions is that the minister has been incompetent, or that the government has the wrong policy; these questions do not constitute a genuine attempt to obtain information.

Q: **Is** it **not** now completely **true** that the Labour Government are out of touch with gut British instincts?

Q: **Will** [the Secretary] **acknowledge** the importance of not completely abandoning the research on sustainable biofuels?

Q: **Will** [the Deputy Prime Minister] now **concede** to the House that the Royal Mail was sold off too cheaply?

Question motifs: {will←accept}, {is→not, is→true}, {will←acknowledge}, {will←concede}

Zhang et al. 2017 (slides)

II. Relation Extraction

Relation Extraction

Who did *what* to *whom?*

Relation Extraction

Who did *what* to *whom?*

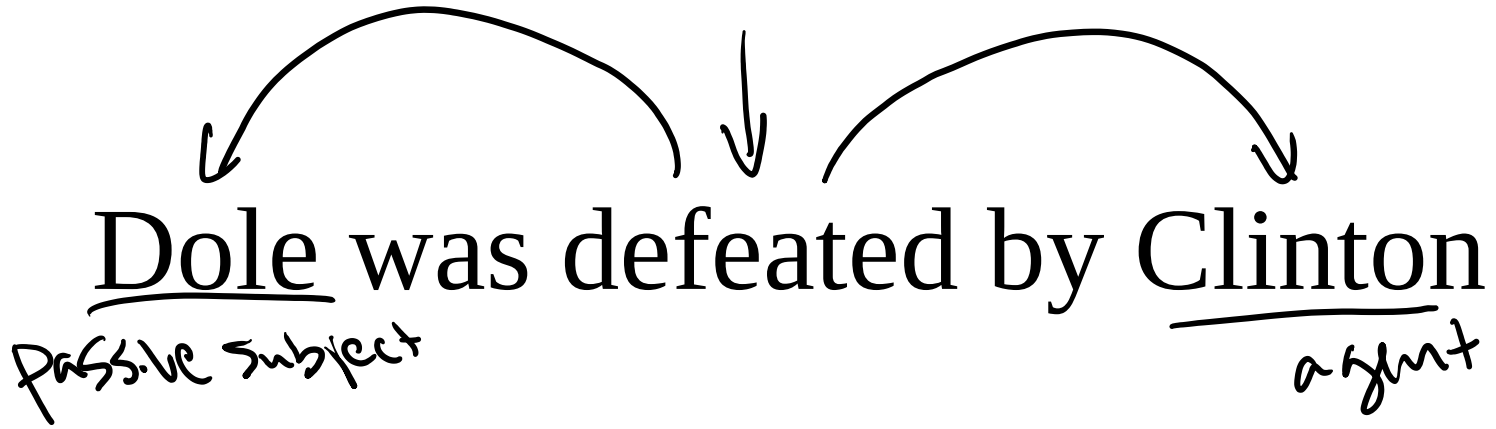
defeats(Clinton, Dole)

Clinton defeated Dole

(Clinton; defeated; Dole)

Relation Extraction

Who did *what* to *whom?*



Relation Extraction

Who did *what* to *whom?*

Dole was defeated by Clinton

`(Clinton; defeated; Dole)`

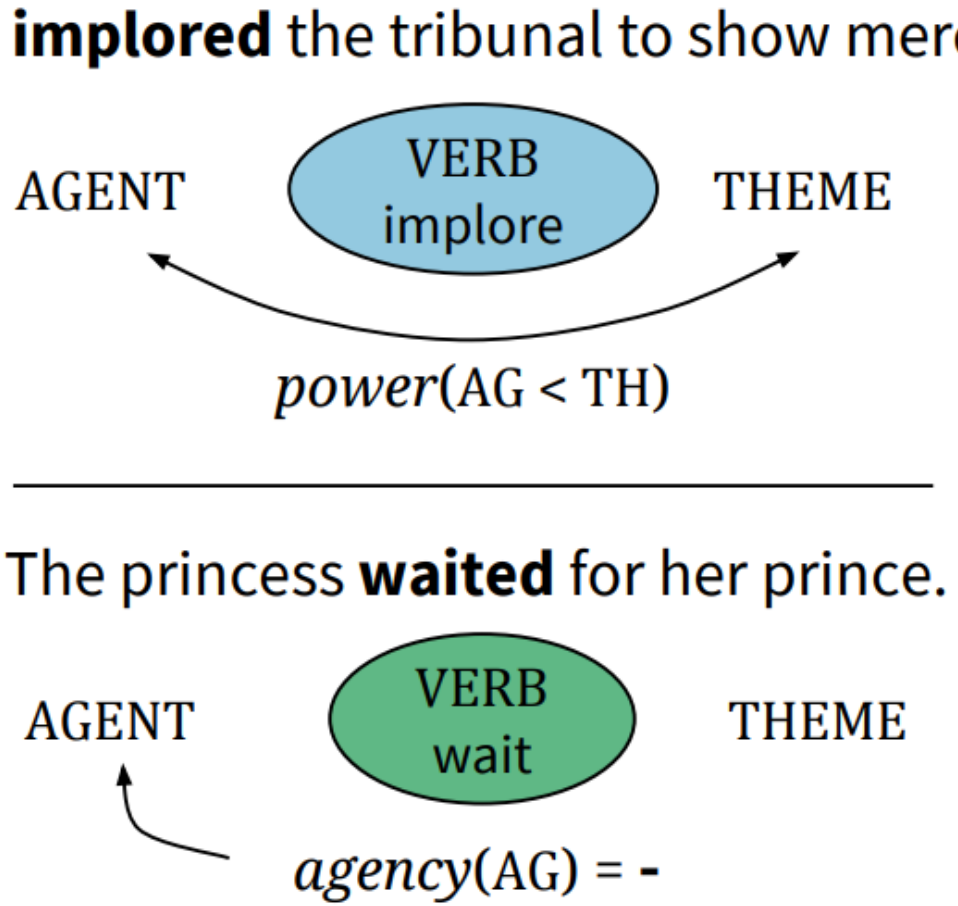
Connotation Frames of Power and Agency in Modern Films

Core Question:

Can the power and agency dynamics reflected in verbs be used to measure the gender bias prevalent in films? How do these measures of power and agency compare to the Bechdel test?

Sap et al. 2017 (demo)

Connotation Frames of Power & Agency



Sap et al. 2017 (demo)

Crowdsourced Predicate Annotations

Task Description: For each verb, determine whether the subject or the object seems to have more authority (higher status) relative to each other.

Examples:

- X has more authority:
  - "X vetoes Y" --> X is clearly presumed to outrank Y.
- X and Y have similar authority:
  - "X loves Y" --> X and Y are mutually involved and appear to be similar status
- Y has more authority:
  - "X idolizes Y" --> Y is presumed to have some power over X.

More Examples:

X has more authority	X and Y have similar authority	Y has more authority
X overrules Y, X vetoes Y	X fights Y, X marries Y	X idolizes Y, X salutes Y

For the following verbs, which has higher authority:

1) X **rescues** Y: ○ X has more authority ○ similar ○ Y has more authority

2) X **serves** Y: ○ X has more authority ○ similar ○ Y has more authority

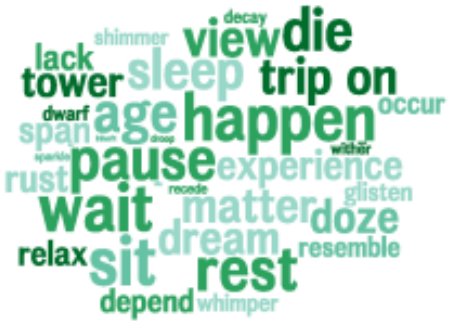
Sap et al. 2017 (demo)

Crowdsourced Predicate Labels

$power(\text{AG}<\text{TH})$

$power(\text{AG}>\text{TH})$

$agency(\text{AG})=-$



$agency(\text{AG})=+$

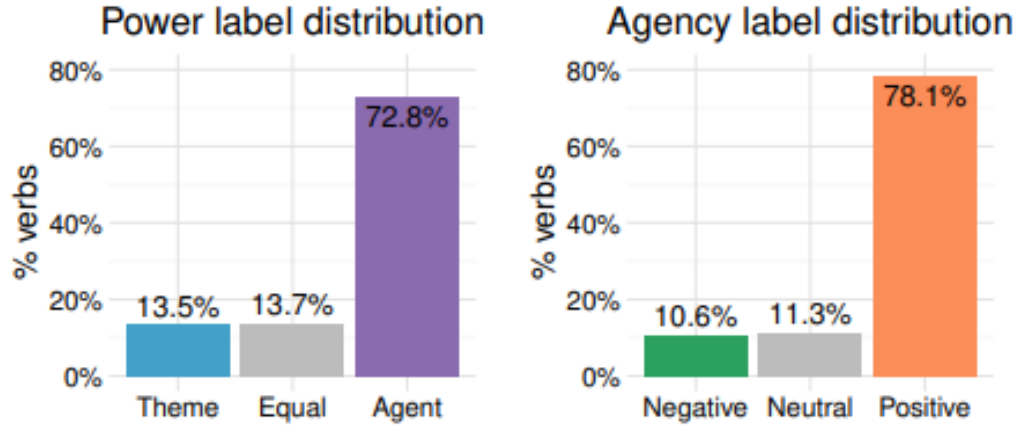


Figure 4: Label distributions for *power* and *agency* based on the crowdsourced annotations.

Sap et al. 2017 (demo)

Power, Agency, and Gender

Frame	β	gender
agency(AG)=+	−0.951	**M****
power(AG>TH)	−0.468	**M****
agency(AG)=−	0.277	**F****
power(AG<TH)	*not sig.*	

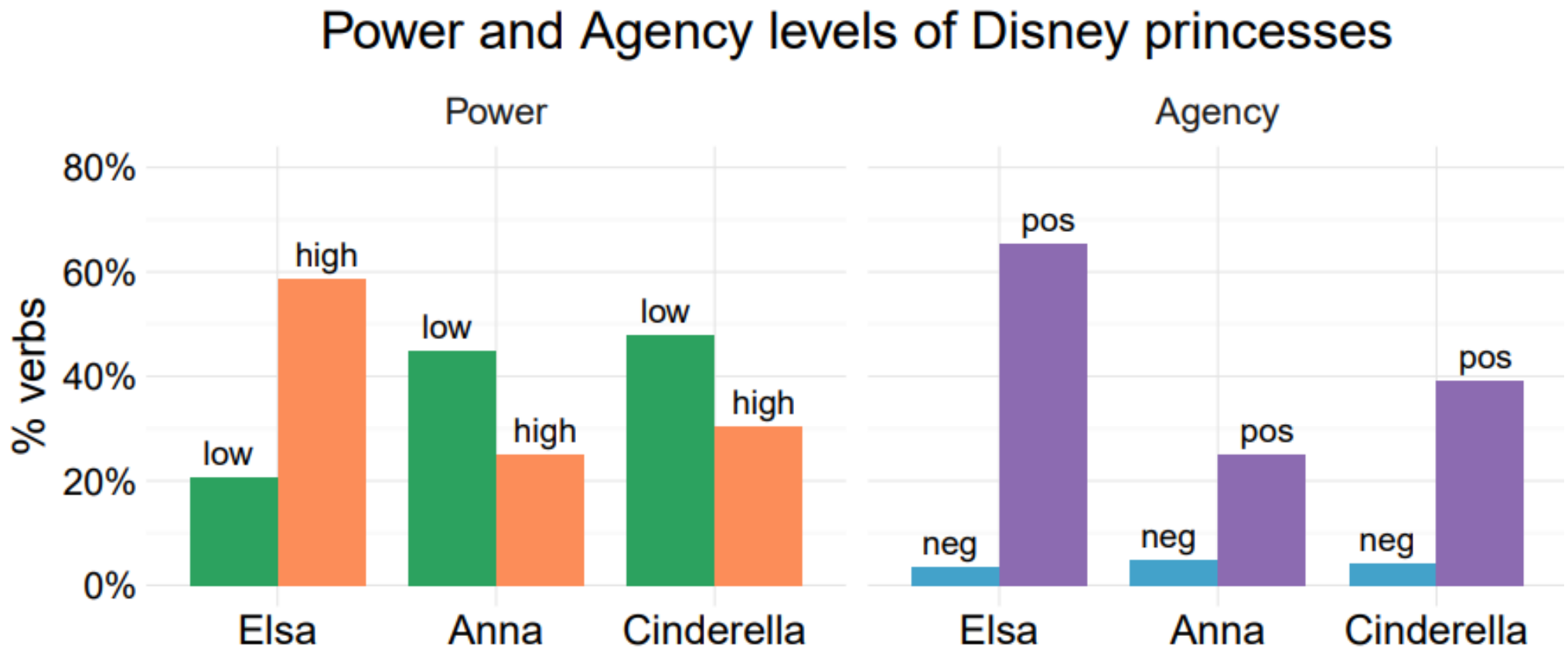
Table 1: Power and agency connotation frames for male and female narratives, controlled for length of narrative text. β represents the change in log-odds of a character being male/female were the corresponding frame to change by one unit. Significant results (** : $p<.001$) are in bold. "Male" was coded as 0, "Female" as 1.

Metric/Frame		β	P/F
F dial.	# Words	10.02	pass**
F dial.	*agency*(AG)=+	−9.65	fail**
F dial.	*power*(AG>TH)	2.05	pass*
F narr.	*power*(AG>TH)	−1.19	fail*

Table 3: Significant correlates of passing the Bechdel test. *F*: metric for female characters, computed on the dialogues (*dial.*) or on the narratives (*narr.*). * : $p<.05$; ** : $p<.001$.

Sap et al. 2017 (demo)

Passing the Bechdel test is not enough



Sap et al. 2017 (demo)

Narrative Paths and Negotiation of Power in Birth Stories

Core Question:

What are the narrative structures and persona hierarchies expressed across birth stories posted online?

Antoniak et al. 2019

Measuring power via connotation frames

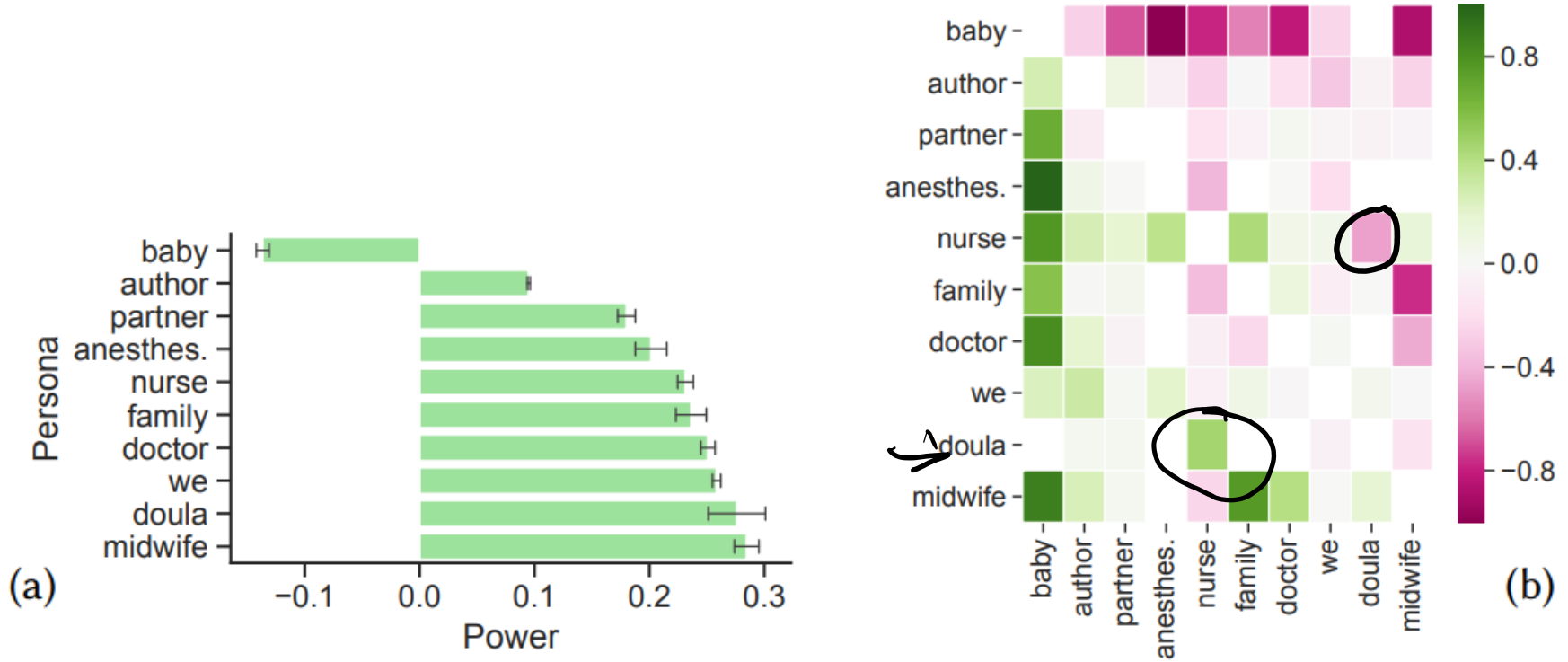


Fig. 7. (a) Power scores for each persona. Error bars show standard deviation over 20 bootstrap samples of the collection. (b) Estimated power of personas (rows) over other personas (columns). The NURSE is consistently framed as more powerful than the other personas, except for the DOULA.

Antoniak et al. 2019