A quantitative look at mixed category constructions

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Parts of speech

- Syntactic categories are central to generative grammar, yet their nature is still unclear

- Three views of syntactic categories:

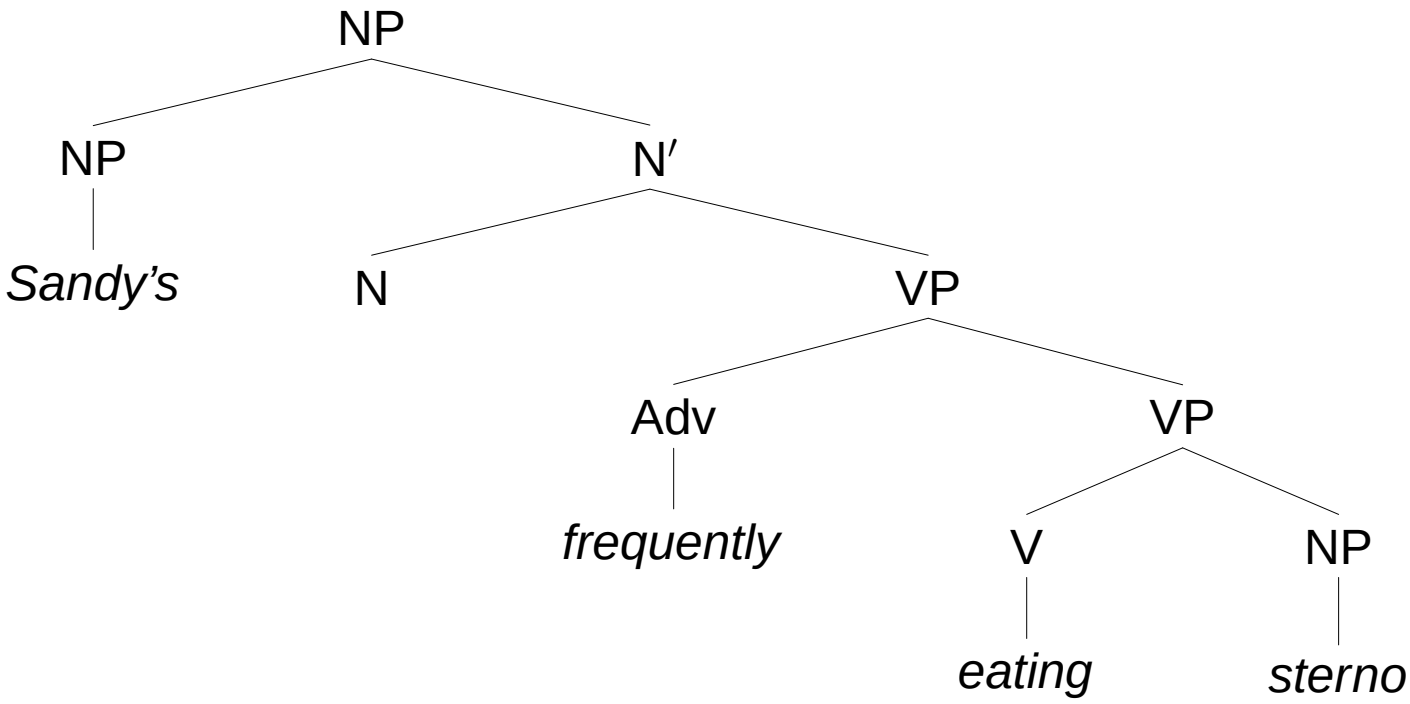
Traditional	small, universal inventory of categories
Structuralist	huge number of language specific categories, organized into overlapping classes
Functional	small, universal inventory of prototypes

Parts of speech

- Mixed category constructions, which show properties of more than one basic part of speech, look like an empirical challenge to traditional categories:

  (1) Pat worries about Sandy's frequently eating sterno.

- But:



Mixed categories

- Another class of mixed categories are words which idiosyncratically participate in constructions characteristic of more than one part of speech

- For example, *near* looks like a preposition:

  (2) a. Don't go near the water!
  b. This place is dead, but near the city there's lots going on.

- But, *near* also looks like an adjective:

  (3) a. The ferry reached the near shore.
  b. When you get near to the east end of the trail, you come to a blind hairpin turn

- Ross (1972) places *near* somewhere in the middle on a continuum between prepositions and adjectives

Transitive adjectives

- Maling (1983) argues that *near* is an adjective:

(4) a. Kim moved the lamp { nearer / *more near } (to) the bed.

b. Chris didn't go { near enough / *enough near } (to) the water to get wet.

- And not a preposition:

(5) a. Kim moved the lamp { *byer / more by } the bed.

b. Chris didn't go { *into enough / enough into } the water to get wet.

- Unlike most adjectives, though, *near* optionally selects for a NP complement

Transitive adjectives

- Huddleston and Pullum (2002) point out more prepositional properties:

(6) a. They pushed it right under the bed.
b. *They were right enjoying themselves.
c. *I believe the employees to be right trustworthy.
d. *The project was carried through right successfully.

(7) We found it right near the house.

- And more adjectival properties:

(8) a. You have put it very/too near the pool.
b. *You have put it very/too in the pool.
c. It's gotten very/too wet.

- They remark: "It is thus highly exceptional in its syntax, combining a number of adjectival properties with those of the preposition."

Transitive adjectives

- Newmeyer (1998) argues that while *near* shows both adjectival and prepositional properties, particular **uses** of *near* generally are one or the other

- When *near* takes a *to NP* complement, then it also takes adjectival degree modifiers:

(9) a. The gas station is near to the supermarket.
b. The gas station is near enough to the supermarket.
c. *The gas station is right near to the supermarket.

- When *near* takes a bare *NP* complement, then it also takes prepositional degree modifiers:

(10) a. The gas station is near the supermarket.
b. *The gas station is near enough the supermarket.
c. The gas station is right near the supermarket.

Transitive adjectives

- Newmeyer's claim is that *near* can be an adjective or a preposition, but not both
- It does show limited morphological mismatch:

  (11) The gas station is nearer (to) the supermarket than the bank.

- Thus, *near* provides no evidence against the traditional part of speech theory of categories.
- Also no evidence for prototype categories

Transitive adjectives

- Newmeyer's argument leaves some open questions
- What about the adjectival degree modifiers like *very*?

(12) a. The gas station is very near (to) the store.

- Subtle and controversial grammaticality judgments:

(13) a. The gas station is near enough (to) the supermarket.
b. The gas station is right near (to) the supermarket.

Testing grammaticality

- To help resolve close grammaticality calls, we could look for natural occurrences in a corpus
- No examples in the North American News Text Corpus
- A Google search turns up 589 examples:

(14) a. We camped right near to Acadia National Park, just outside of Bar Harbor.
b. It is located right near to Samurai, so two of the best rides in the park are right close together.

(15) a. Having reached Barco, turn right near to the small church, thus arriving at the castle with its splendid angular tower.
b. Further on towards the dale of Hufield there is a child's grave on the right near to the burn.

Testing grammaticality

- Do a handful of Google citations constitute evidence for grammaticality?
- An observation: we find occurrences of *right near to* in unedited text (Google) but not in edited text (NA News Text Corpus)
- It is tempting to conclude that *right near to* is, strictly speaking, ungrammatical.
- But: the NA News Text Corpus is around 800 million words, while the corpus indexed by Google is on the order of 30 trillion words

Testing grammaticality

- We have a hypothesis: the difference in frequency of *right near to* in the two corpora reflects an underlying difference in their text types

	Text Type	
	Edited	Unedited
right near to	0	589
right near ¬*to*	40	85,711

- Chi-squared test is not applicable
- Fisher's exact test strongly indicates independence ($P \approx 1$)
- There is no evidence that *right near to* is ungrammatical

Testing grammaticality

- It can be difficult to settle questions of grammaticality by studying a corpus
- Instead, we can use corpus data to directly examine properties of syntactic categories
- Is there evidence for distinct adjectival and prepositional uses of *near*?
- What is the relationship between the type of modifier (*very, right*) and the complement type (*NP, to NP*)?
- What is the relationship between the external distribution of *near* phrases and their internal distribution?

Generalized Linear Models

- Generalized Linear Models (GLMs) provide a mechanism for investigating the nature and magnitude of relationships among linguistic properties
- GLMs extend regression and ANOVA techniques to count and other type of data
- Much more informative than chi-squared test, which only tells you *if* there is a relationship
- GLMs are applicable to a wide range of experimental designs and sampling strategies
- Closely related to logistic regression (VARBRUL) and maximum entropy models
- Misclassification error may be a source of bias

Generalized Linear Models

- For a 2×2 contingency table:

	X	*not X*	Total
Y	50	100	150
not Y	500	1000	1500
Total	550	1100	

we model the count μ_{ij} in each cell by:

$$\log \mu_{ij} = \lambda + \lambda_i^X + \lambda_j^Y + \lambda_{ij}^{XY}$$

Generalized Linear Models

- Fitting a model means finding λ's such that the counts are accurately predicted by

$$\log \mu_{ij} = \lambda + \lambda_i^X + \lambda_j^Y + \lambda_{ij}^{XY}$$

- The intercept parameter λ reflects the size of the corpus
- The *main effect* parameters λ^X and λ^Y reflect the marginal totals for X and Y
- The *association parameter* λ^{XY} captures any statistical dependence between X and Y

Generalized Linear Models

- For this example:

λ	6.908
λ^X	-0.693
λ^Y	-2.303
λ^{XY}	0.000

- In words:
  - ⋆ there is a small preference for $\neg X$ over X
  - ⋆ there is a larger preference for $\neg Y$ over Y
  - ⋆ there is no association at all between X and Y

Generalized Linear Models

- We search Google for sequences *X near Y* and record the counts:

	to	not *to*
right	580	85,420
so much	8	215
very	28,800	430,800
so	63,200	134,200
other	640,666	5,178,002

- Fitting the model yields the parameter estimates:

(Intercept)	15.46	right:to	-2.902
right	-4.109	so much:to	-1.201
so much	-10.09	very:to	0.171
very	-2.491	so:to	0.551
so	-3.658		
to	-2.090		

Interpreting the model

- Intercept and main effects are not interesting
- Association parameters:

right:to	-2.902	very:to	0.171
so much:to	-1.201	so:to	0.551

- This shows a strong negative association between *to* complements and the prepositional modifiers *right* and *so much*
- There is also a positive association (though less strong) between *to* complements and the adjectival modifiers *very* and *so*
- These results show that prepositional properties appear together (*right near the store*) and adjectival properties appear together (*so near to the store*)
- Mixtures of prepositional and adjectival properties are possible, but occur less frequently

Generalized Linear Models

- How does the external distribution relate to the internal distribution?
- Select 167 occurrences of *near to NP* and 161 occurrences of *near NP* from NA News Text Corpus
- Annotate each with syntactic role (NP modifier, VP modifier, predicative) and for presence of a degree modifier
- Results:

		NP mod.	VP mod.	Pred.
Deg. mod.	*near NP*	1	1	0
	near to NP	6	9	22
No deg. mod.	*near NP*	87	55	17
	near to NP	26	21	83

Generalized Linear Models

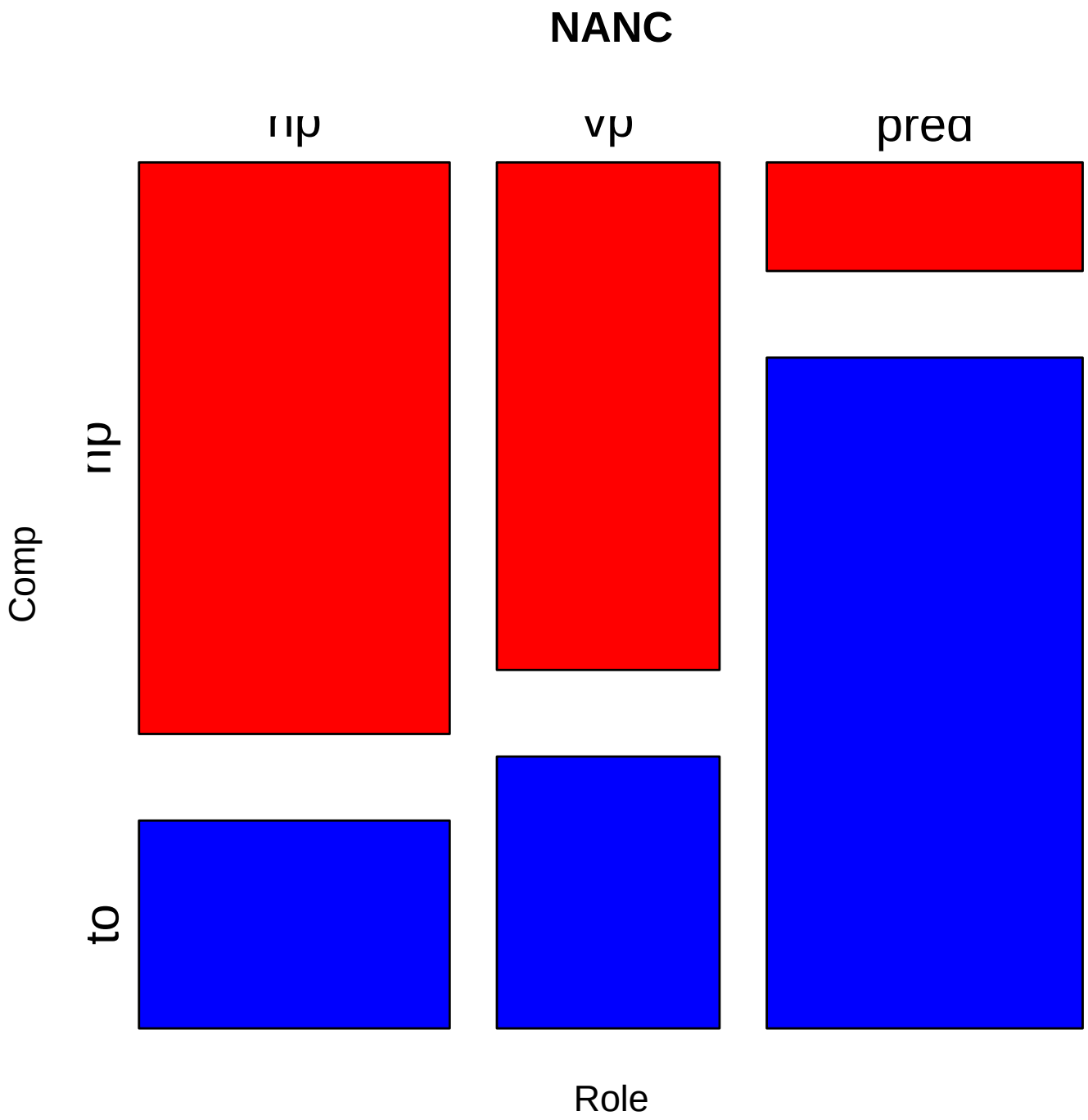
- The model:

(Intercept)	2.822	np:mod	—
np	1.645	vp:mod	—
vp	1.185	np:to	-2.814
mod	-4.534	vp:to	-2.563
to	1.599	mod:to	3.196

- Strong association between predicative contexts and *near to NP*, and between modifier contexts and *near NP*

- Strong association between (adjectival) degree modifiers and *near to NP*

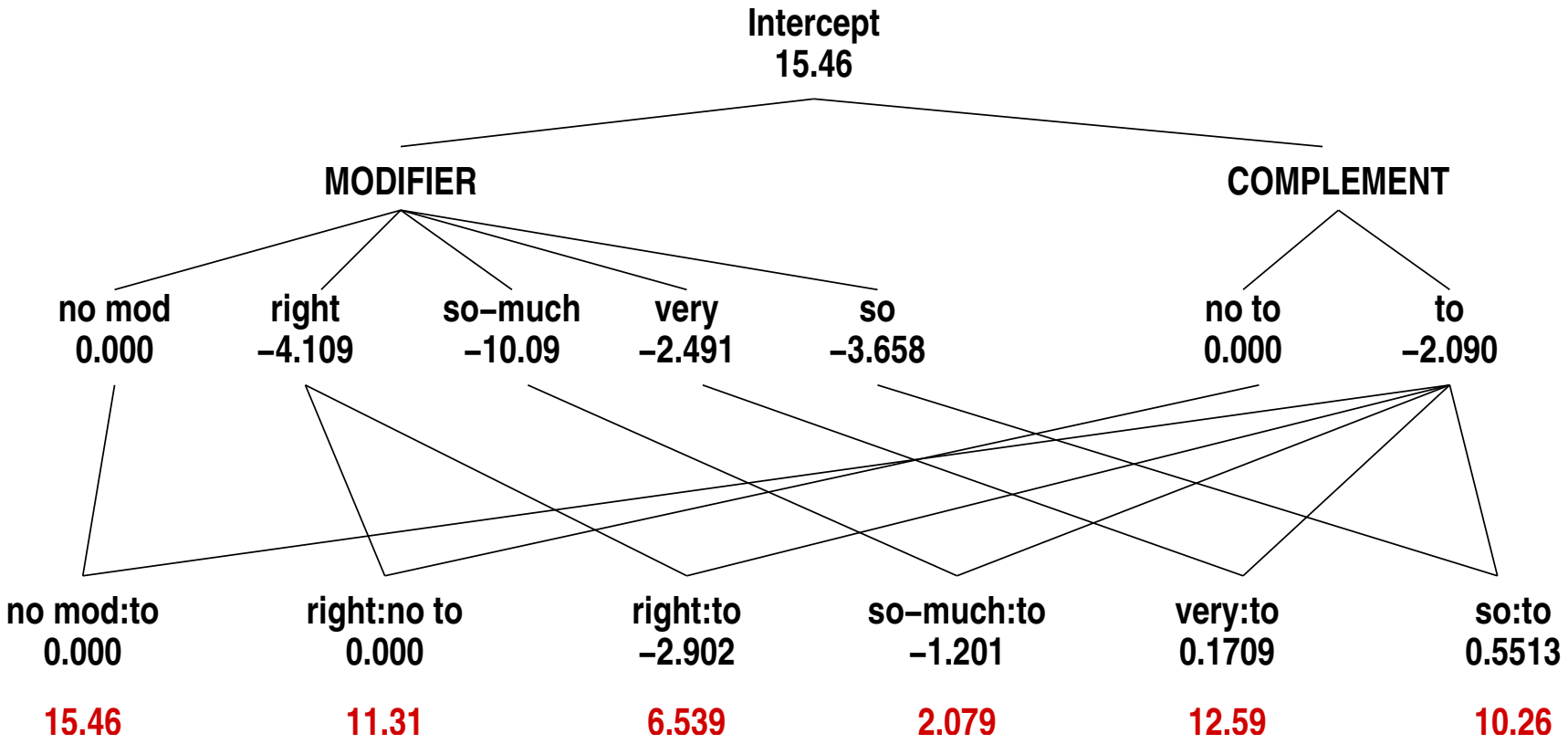
- No independent association between context and modifier


NANC
np
vp
pred
Comp
np
to
Role

Some conclusions

- Newmeyer was right (sort of)
  - ⋆ Both experiments show a clear preference for strictly adjectival or strictly prepositional uses of *near*
- Huddleston and Pullum were right (sort of)
  - ⋆ Mixed uses of *near* are well attested, and are not even particularly rare
- Neither approach to syntactic properties is able to capture all the facts
- Results are consistent with a prototype model (Ross and many others)
- What is the correct formal representation for syntactic categories?

Hierarchical models



Conclusions

- Simply eyeballing a corpus may not shed light on problematic grammaticality judgments
- Quantitative analysis may reveal regularities that are not obvious from patterns of grammaticality judgments or from casual inspection of a corpus
- With *near,* we see evidence for a prototype effect: mixed uses are possible, but dispreferred
- Speculation: A combination of inheritance hierarchies with generalized linear models may be a way of capturing these prototype effects in a formal grammar