Exploring the assumptions of language acquisition models

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Models of language acquisition

“The girl chases the boy”

Models of language acquisition

"The girl chases the boy"

Models of language acquisition

“The girl chases the boy”

Models of language acquisition

“The girl chases the boy”

“The boy runs”

Semantic Role Labeling

PropBank corpus
[Palmer et al. 2005]
Core arguments:
- **A0** - Agent
- **A1** - Patient
- **A2** - Recipient
- …

Modifiers:
- Locative
- Temporal
- Manner
- …

"The girl chases the boy"
A0 pred **A1**

BabySRL [Connor et al. 2008; 2010]

BabySRL corpus

Adam, Eve, Sarah [Brown, 1973]

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Focus on verb predicates

“The girl chases the boy”

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Adult utterances (cleaned up)
Focus on verb predicates
1 verb 2 args (24% of sent.)

"The girl chases the boy"
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Experiment 1: Supervised learning

Given **perfect feedback**, do simple, **bottom-level** features capture anything useful about semantic roles/verb preferences?

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- Supervised classifier (average perceptron)
  - LBJava [Rizzolo and Roth, 2010]
- Train on BabySRL corpus
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  Intransitive: "The bunny **krads**"
  Transitive: "The boy **krads** the girl"
  Ditransitive: "The girl **krads** the boy a bunny"

Experiment 1: Features

- **Most freq**uent label

A0	**A1**
The girl	chases the boy

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A0	**A1**
The girl chases the boy	
chase-girl	*chase*-boy

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1st of 2	2nd of 2

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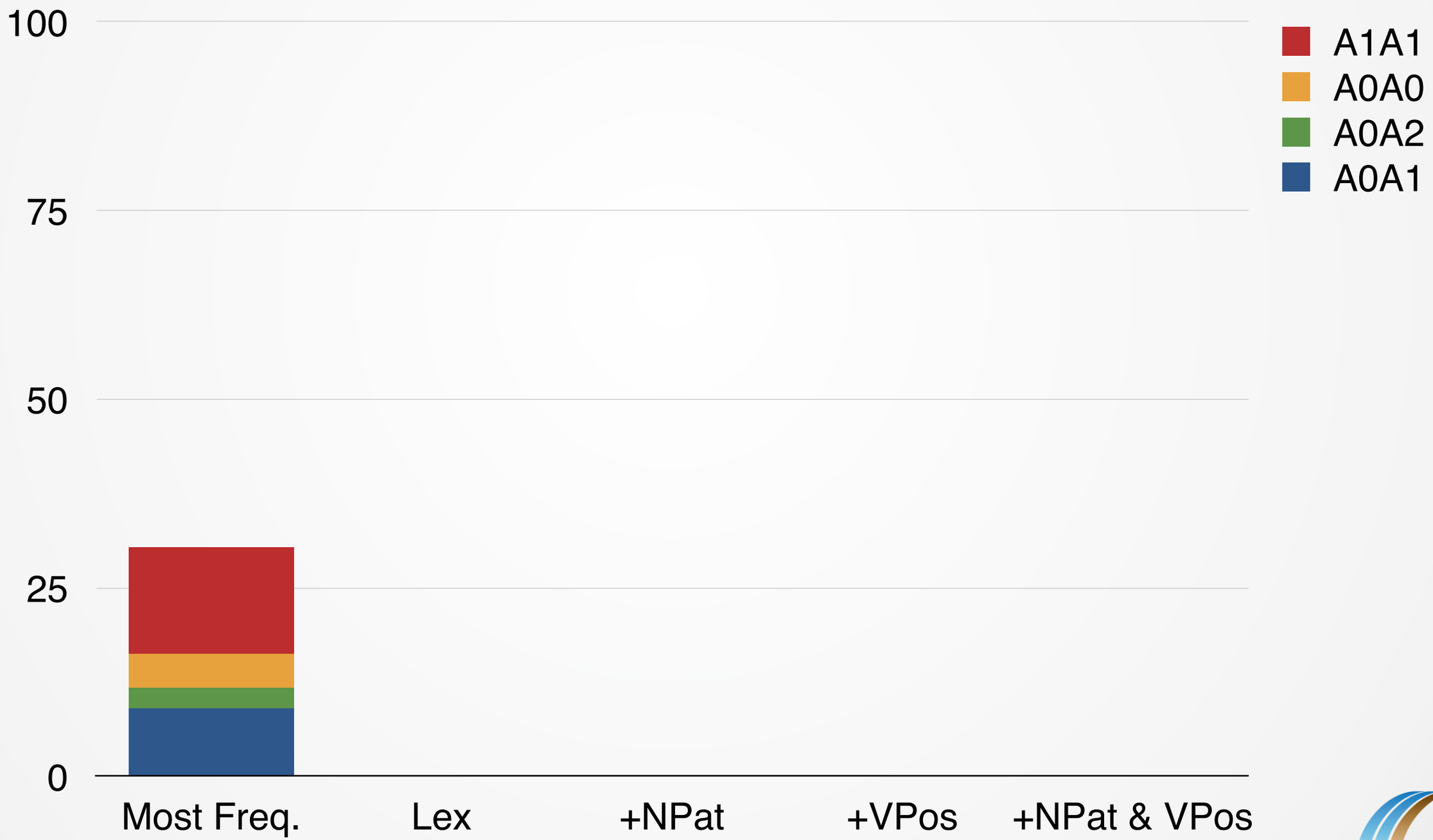
- **Most freq**uent label
- **Lex**ical features
- **N**oun **Pat**tern
- **V**erb **Pos**ition

A0	**A1**
The girl chases the boy	
chase-girl	*chase*-boy
1st of 2	2nd of 2
Before	After

Experiment 1: Results



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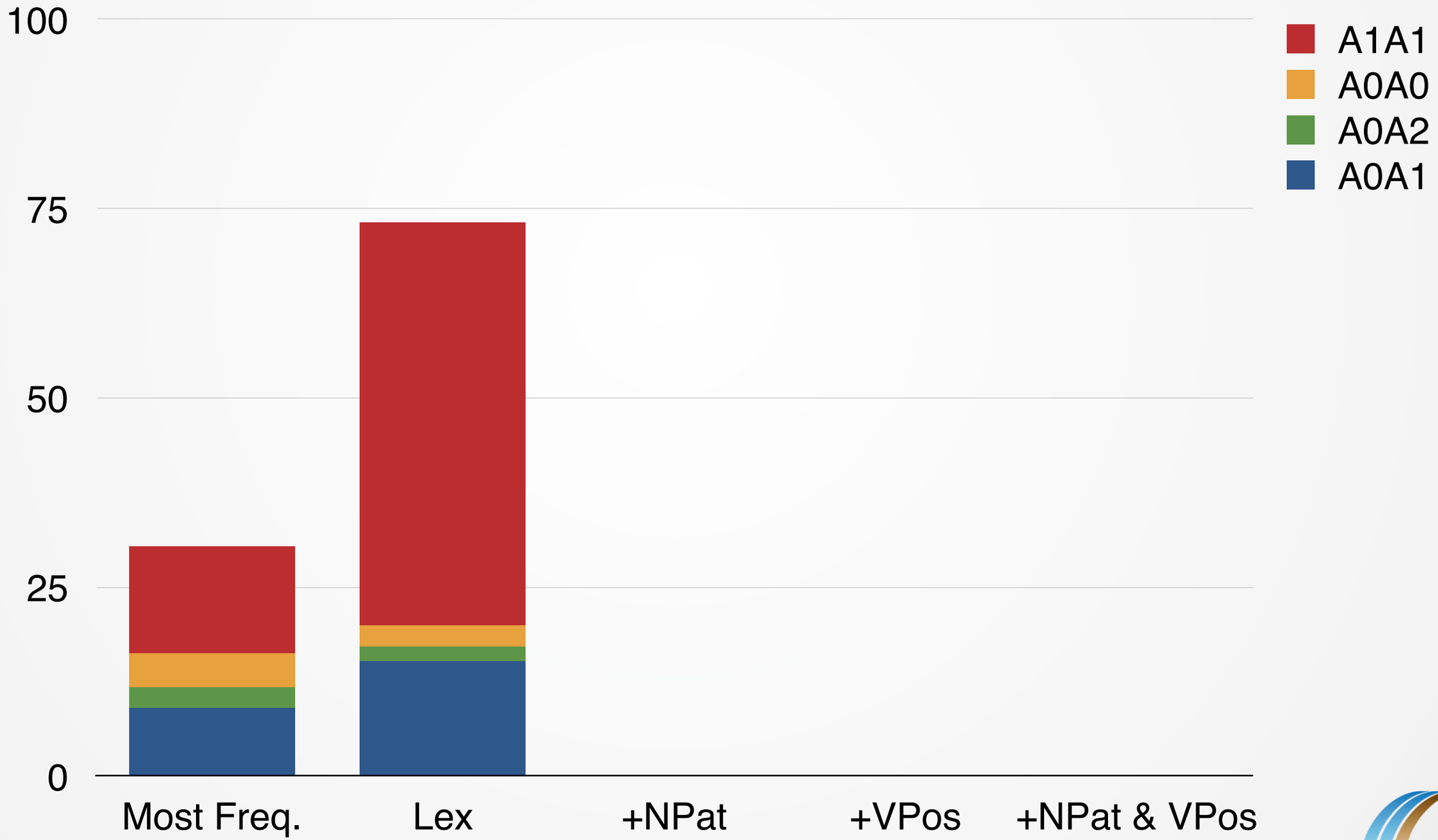

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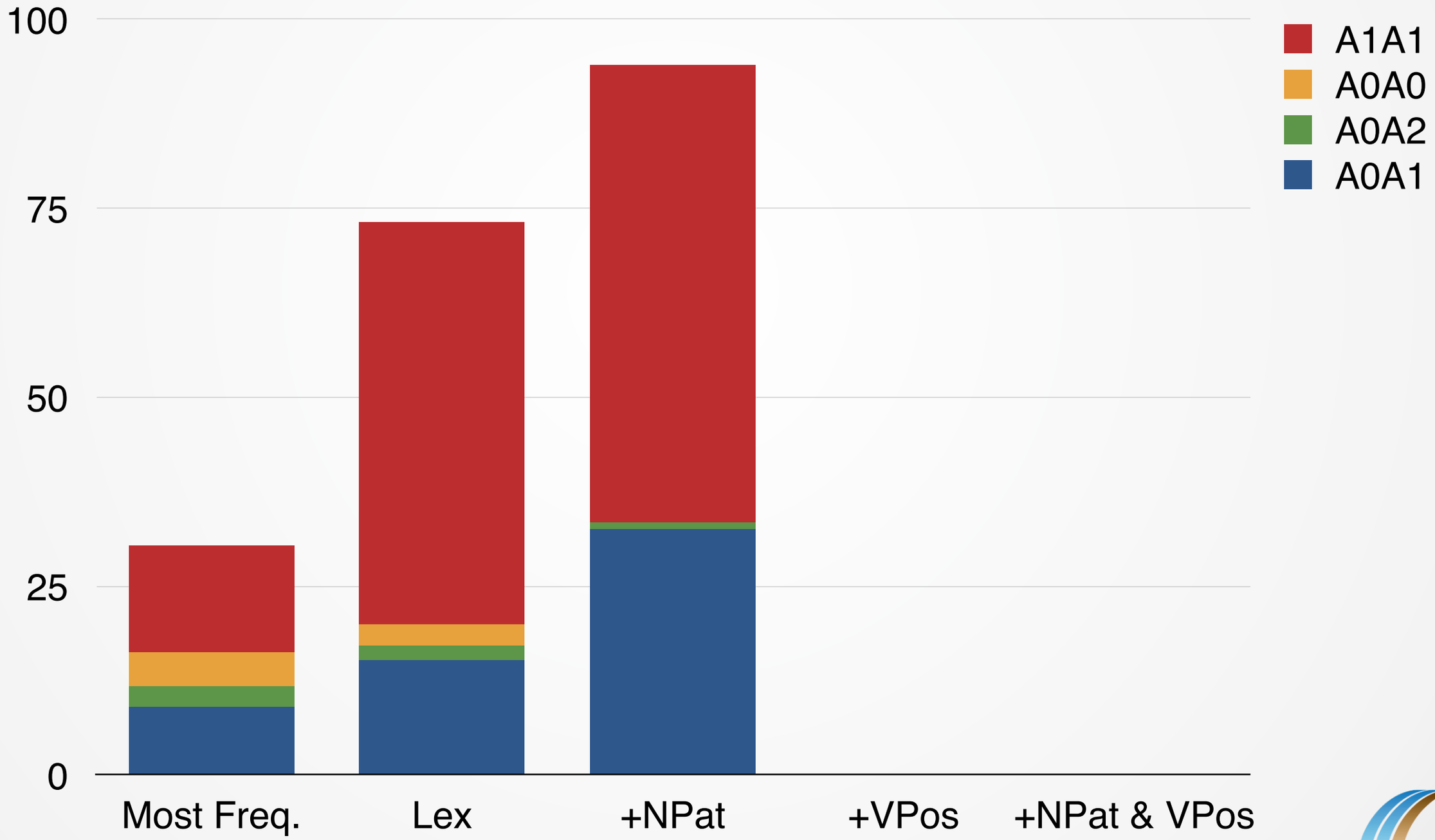

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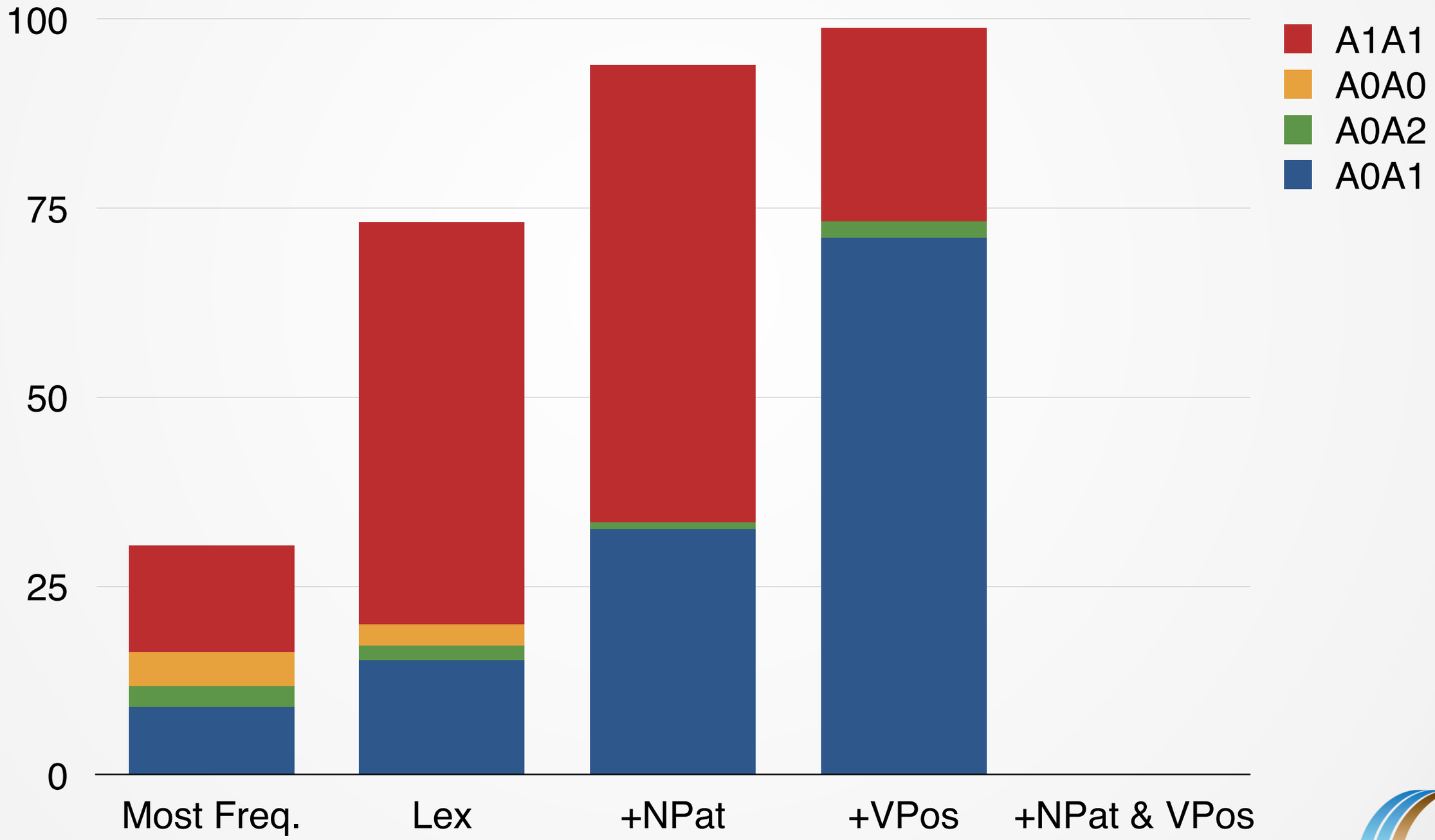

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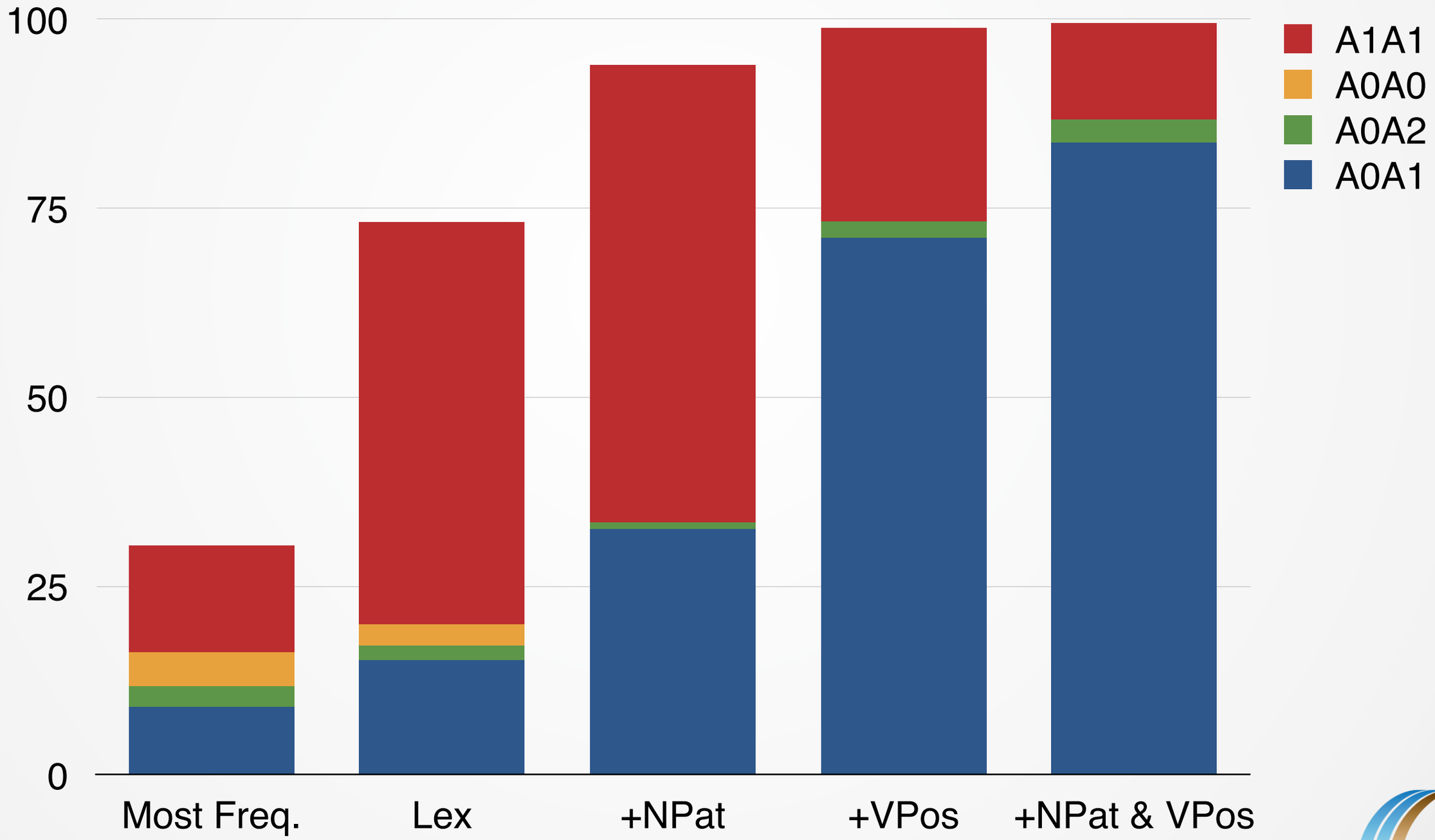

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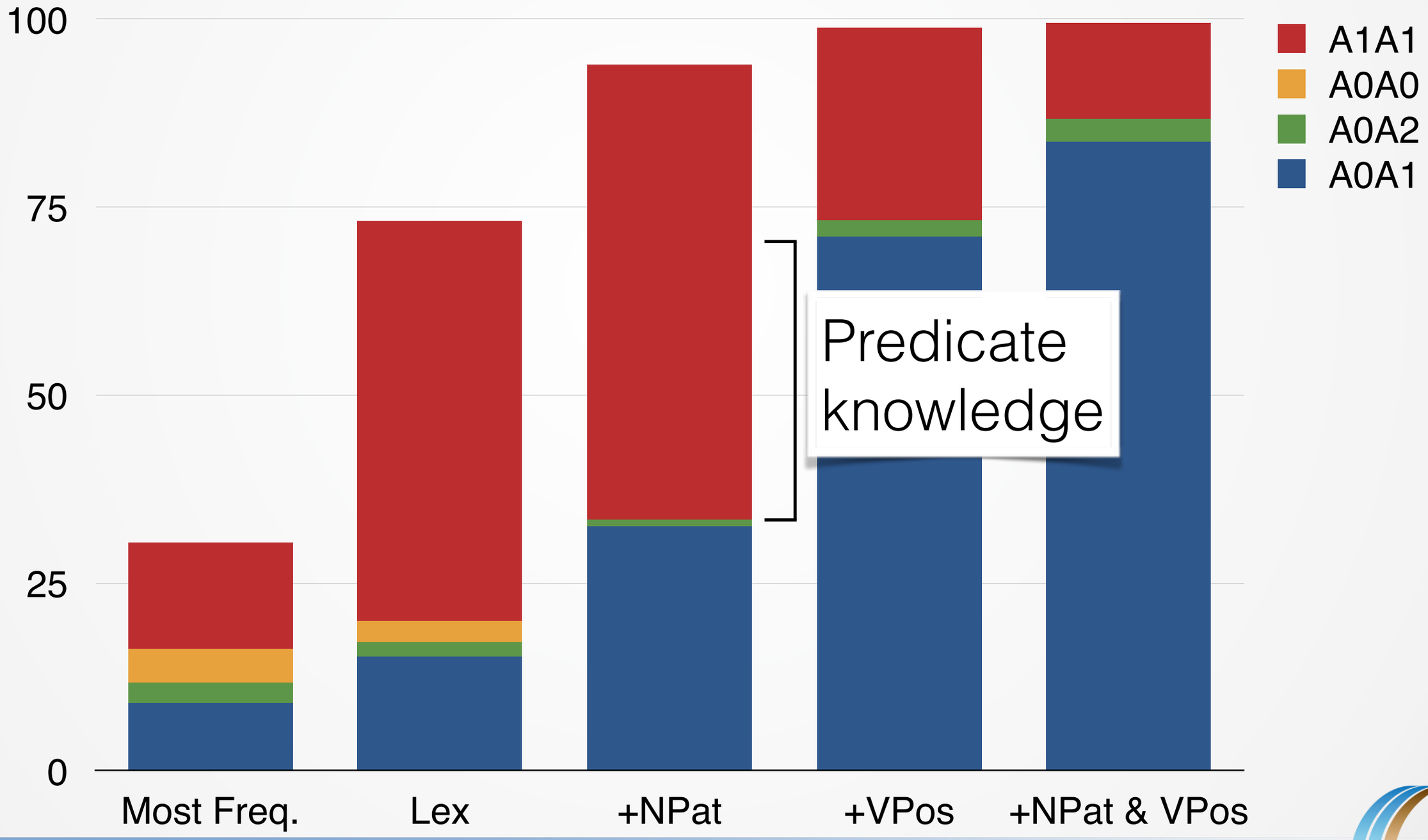

Multiple predicates

"**Remember** how we play the surprise game?"

A1

"Remember how we **play** the surprise game?"

A0 **A1**

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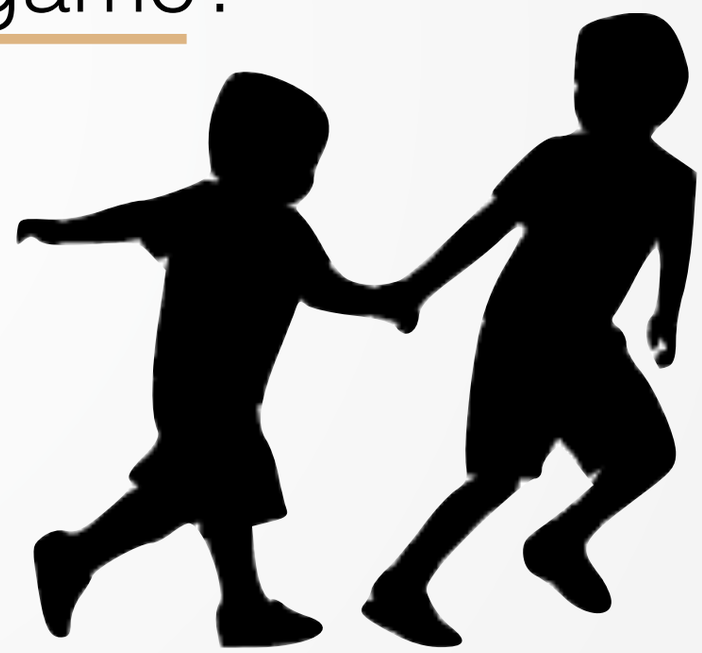
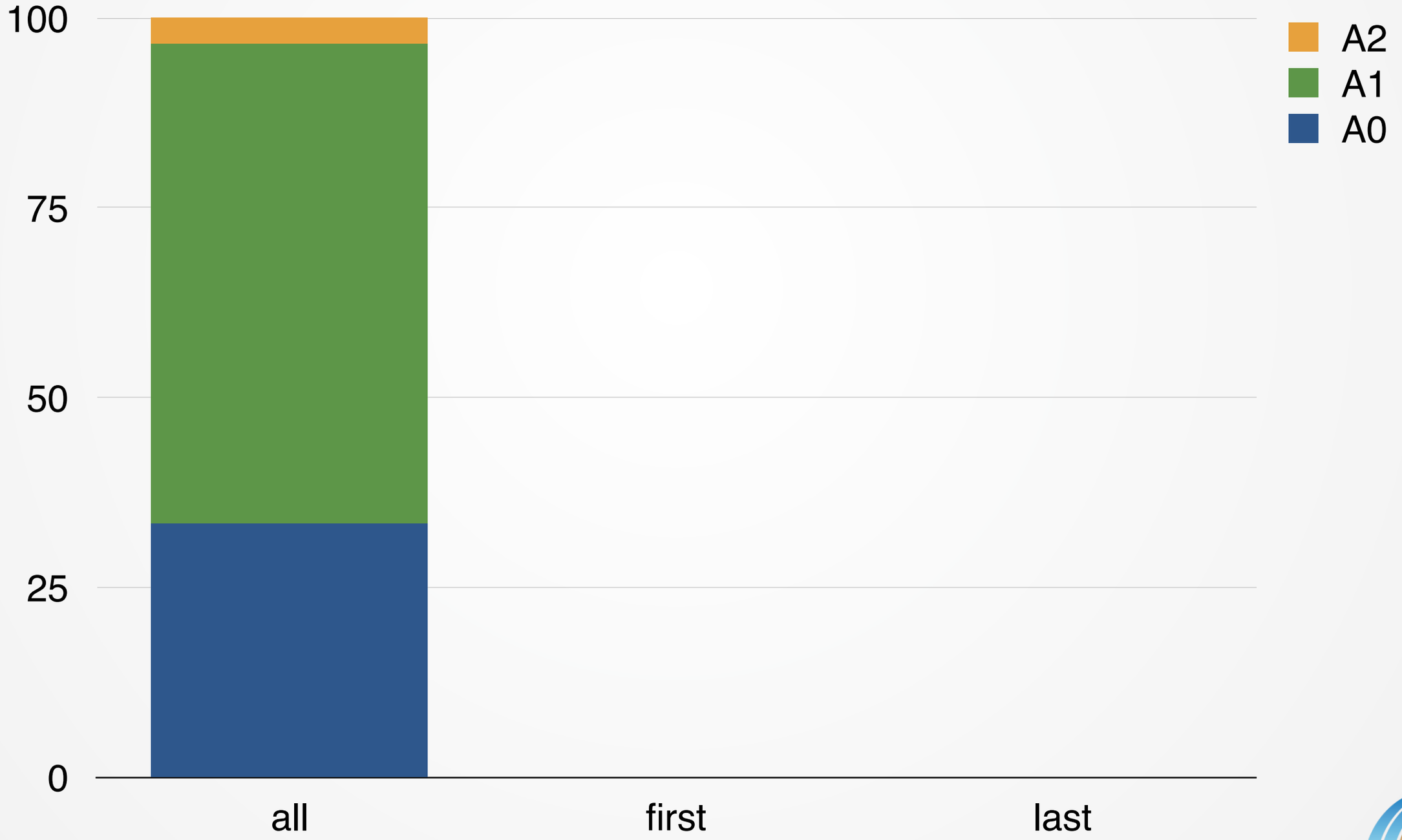


	# sent	%
1 verb	10,356	69.86
2 verbs	3,614	24.38

Effect of multiple predicates (Noun Pattern)



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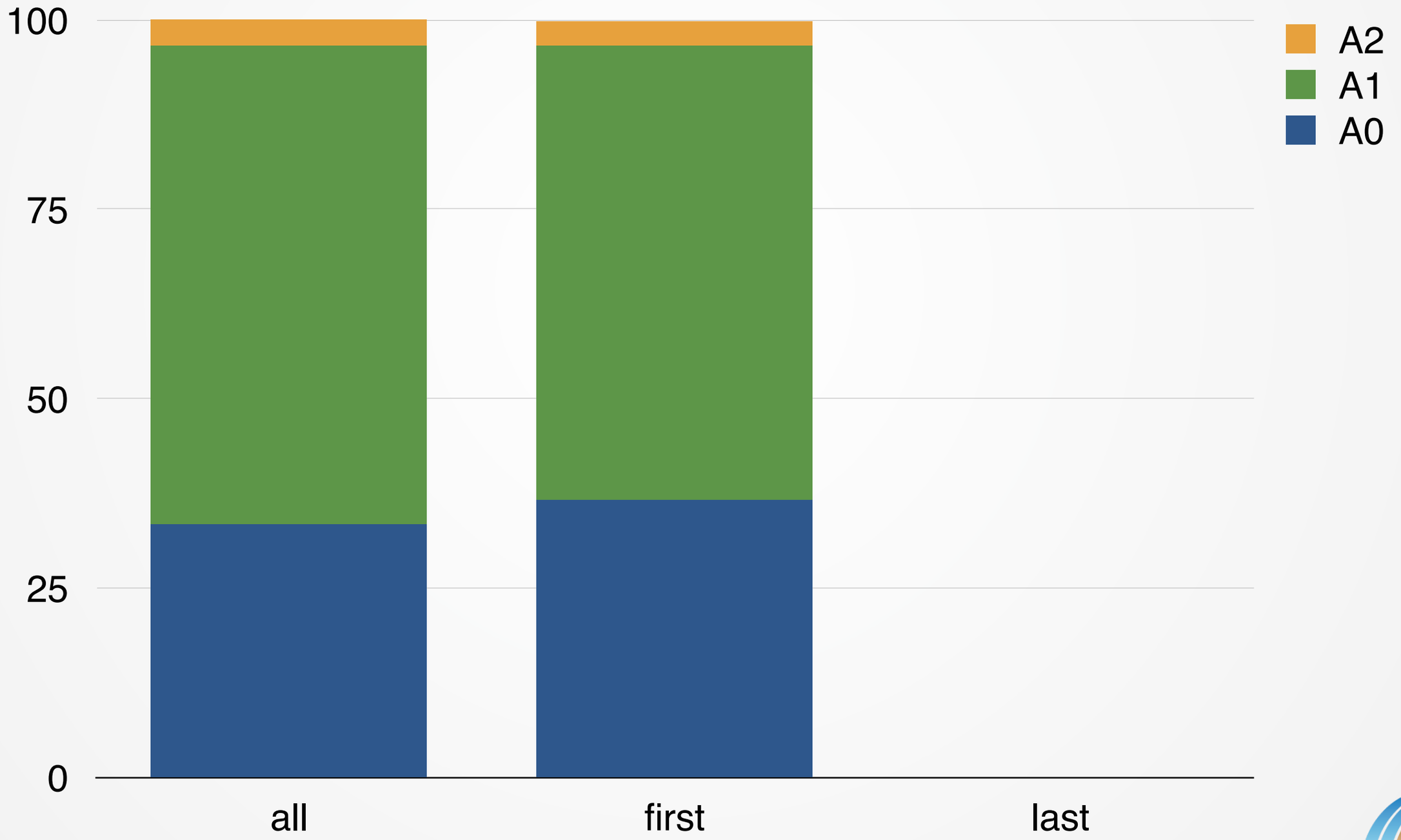

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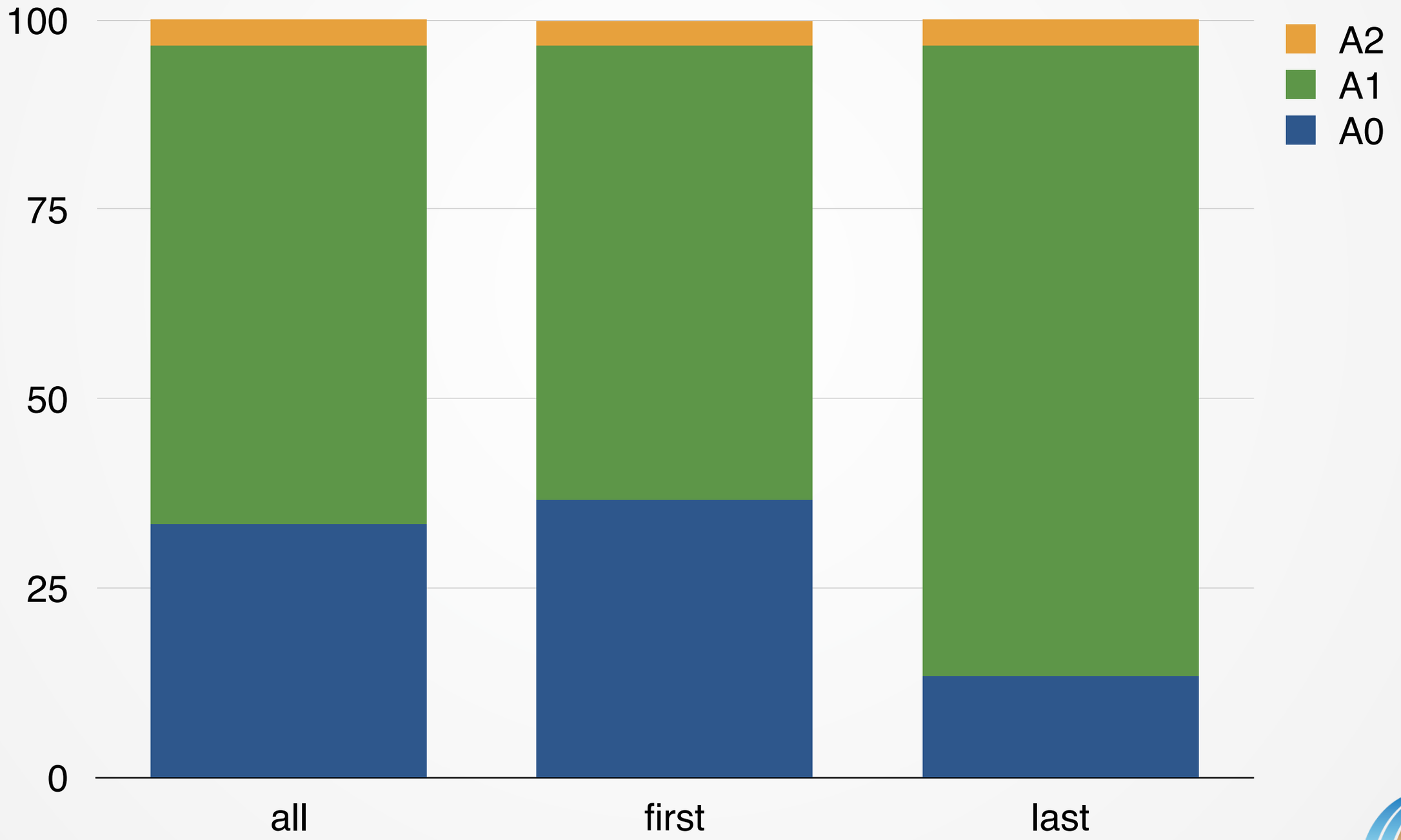

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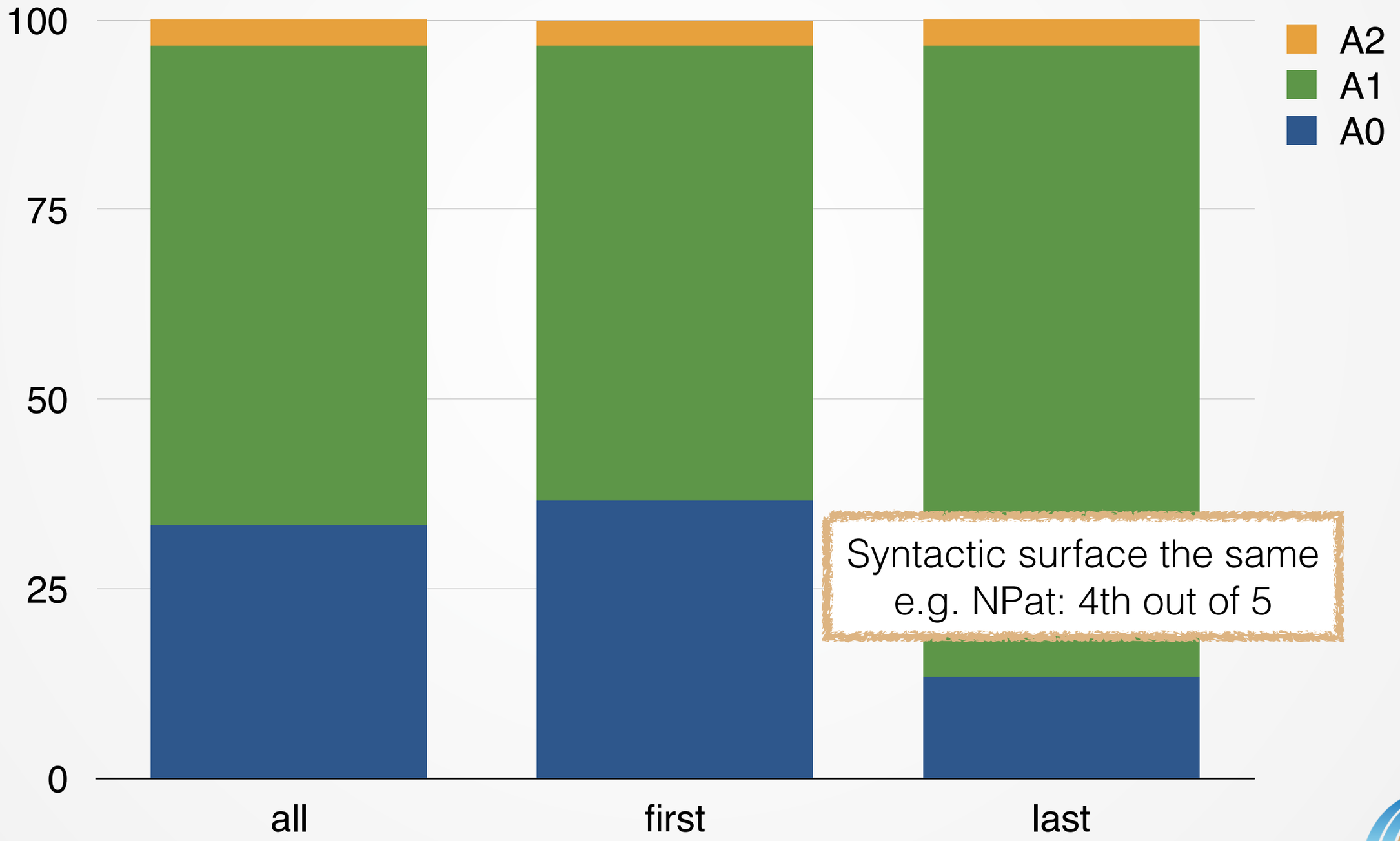

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Yes, but predicate knowledge is crucial

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Syntactic Bootstrapping via Structure-Mapping

[Gleitman, 1990; Fisher et al. 2010]

Experiment 2: Unsupervised learning

- HMM over 2.2M tokens (CHILDES)
  - 80 induced clusters, list of function words
- List of seed nouns [Dale and Fenson, 1996]
- Noun identification

  “Cluster contains more than ***k*** seed nouns”

Experiment 2: Verb Identification

	She	krads	a	red	truck
HMM	45	51	19	60	73
N Ident.	N				N
Funct.			F		

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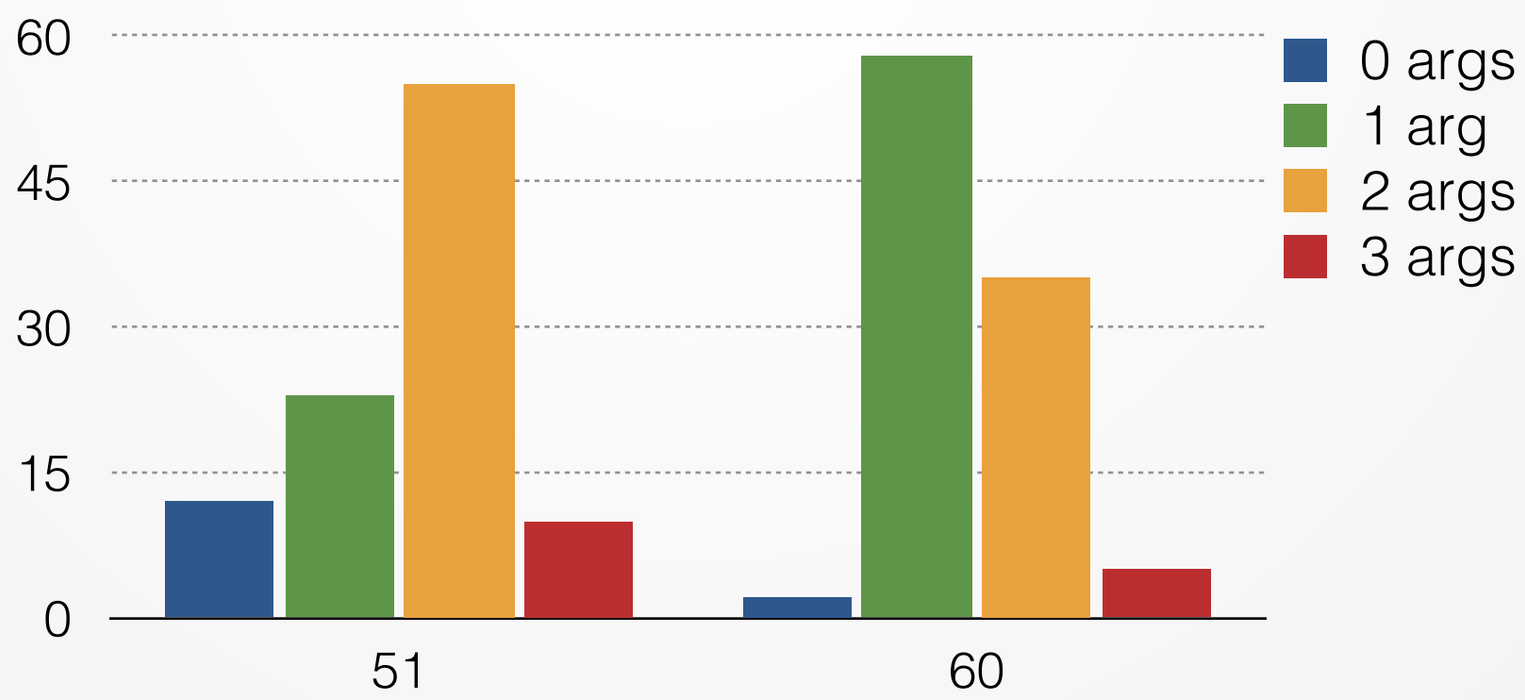

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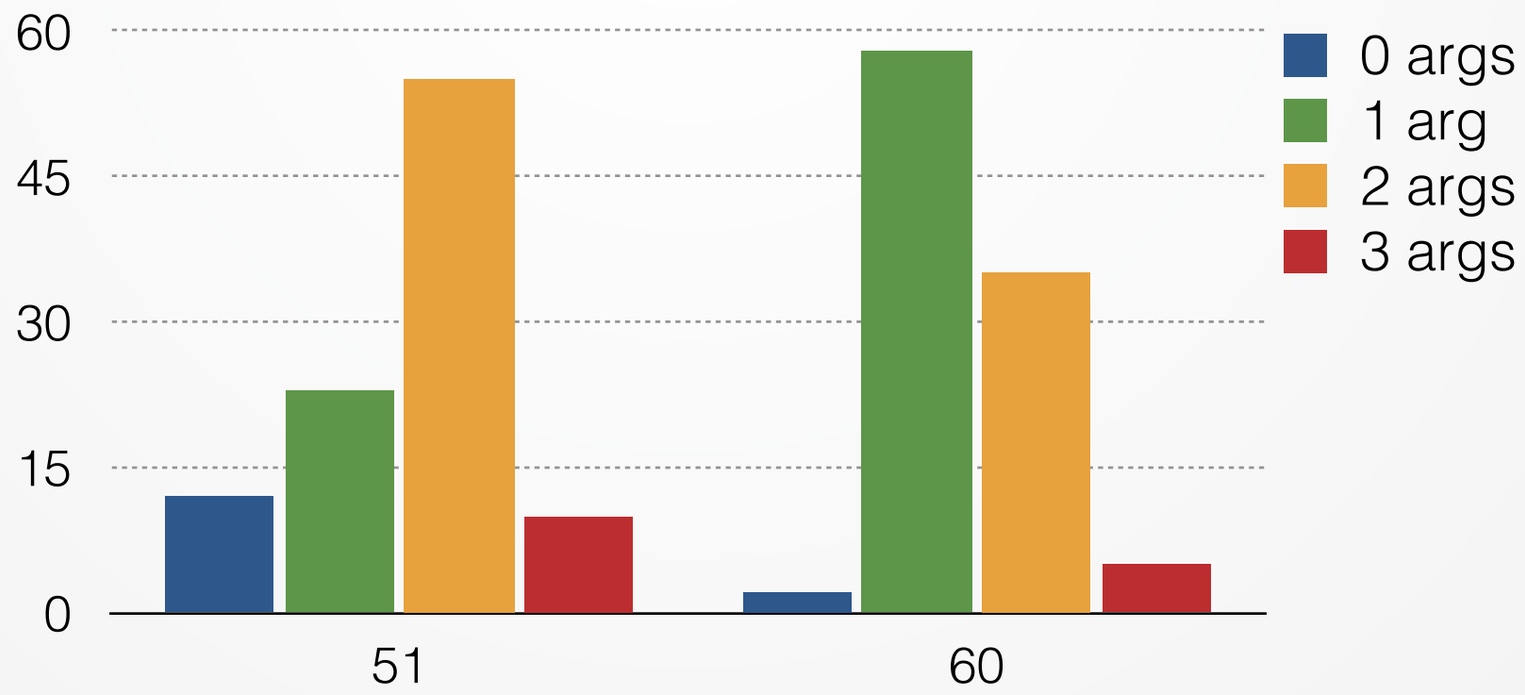

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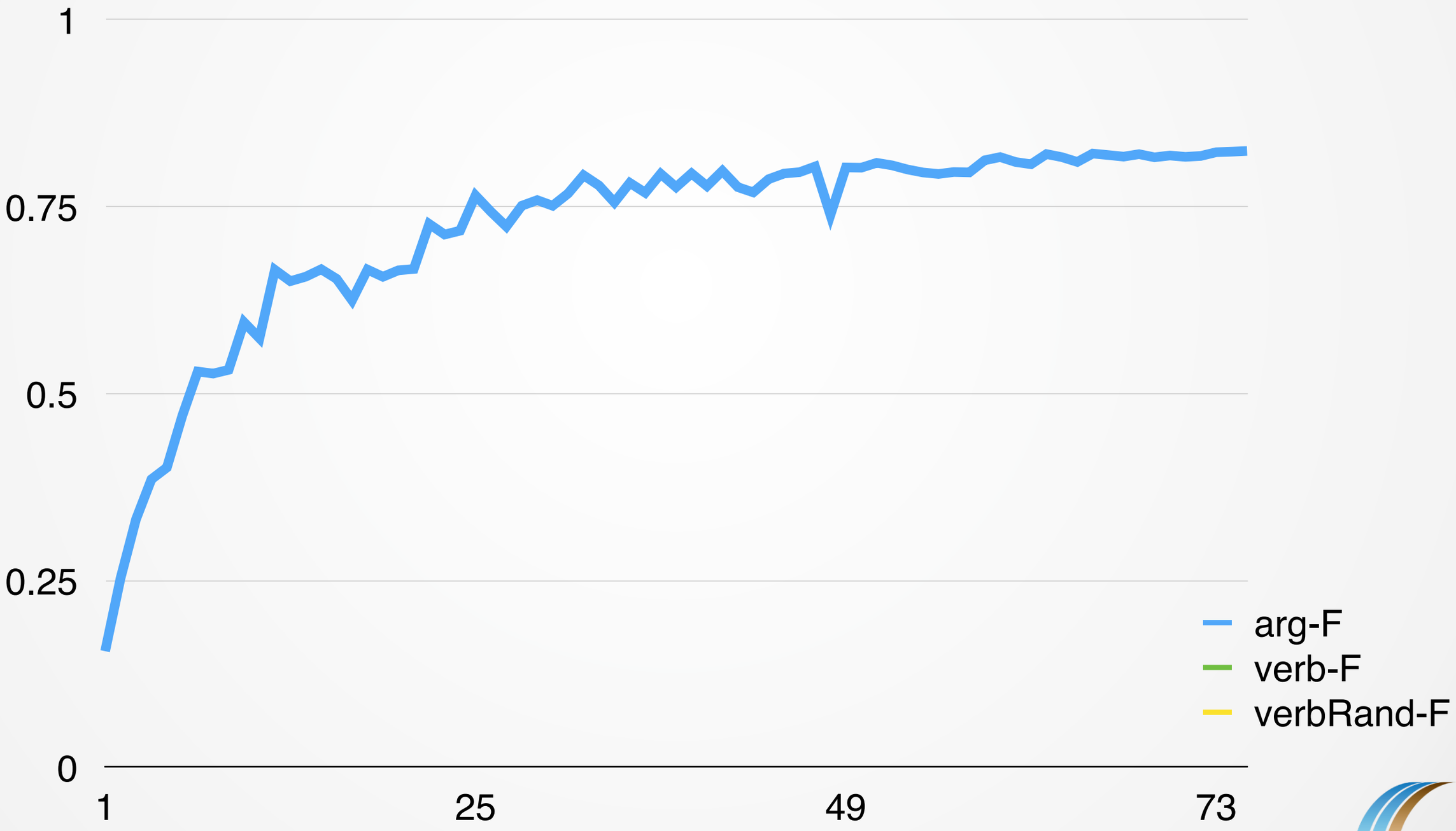

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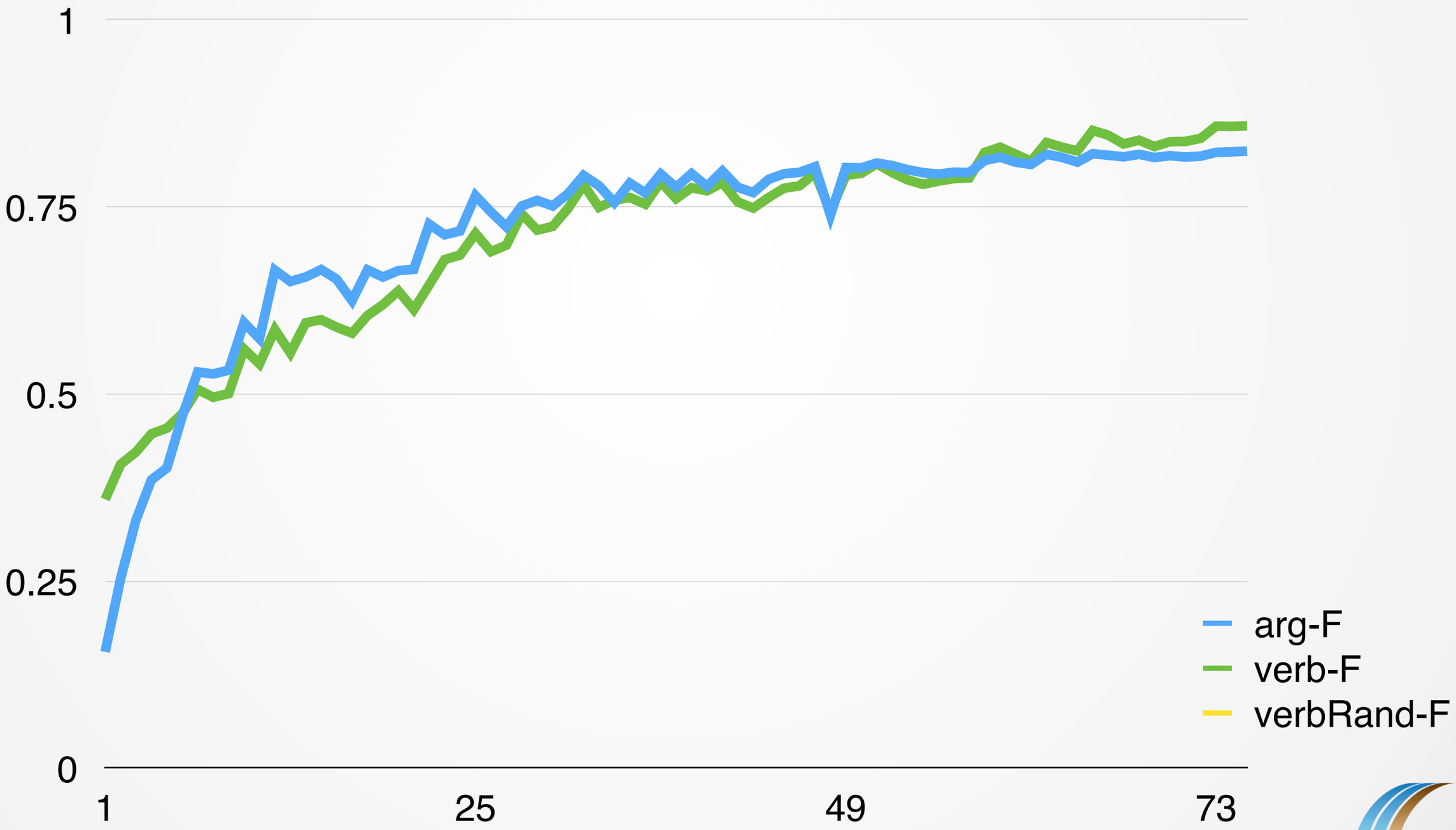

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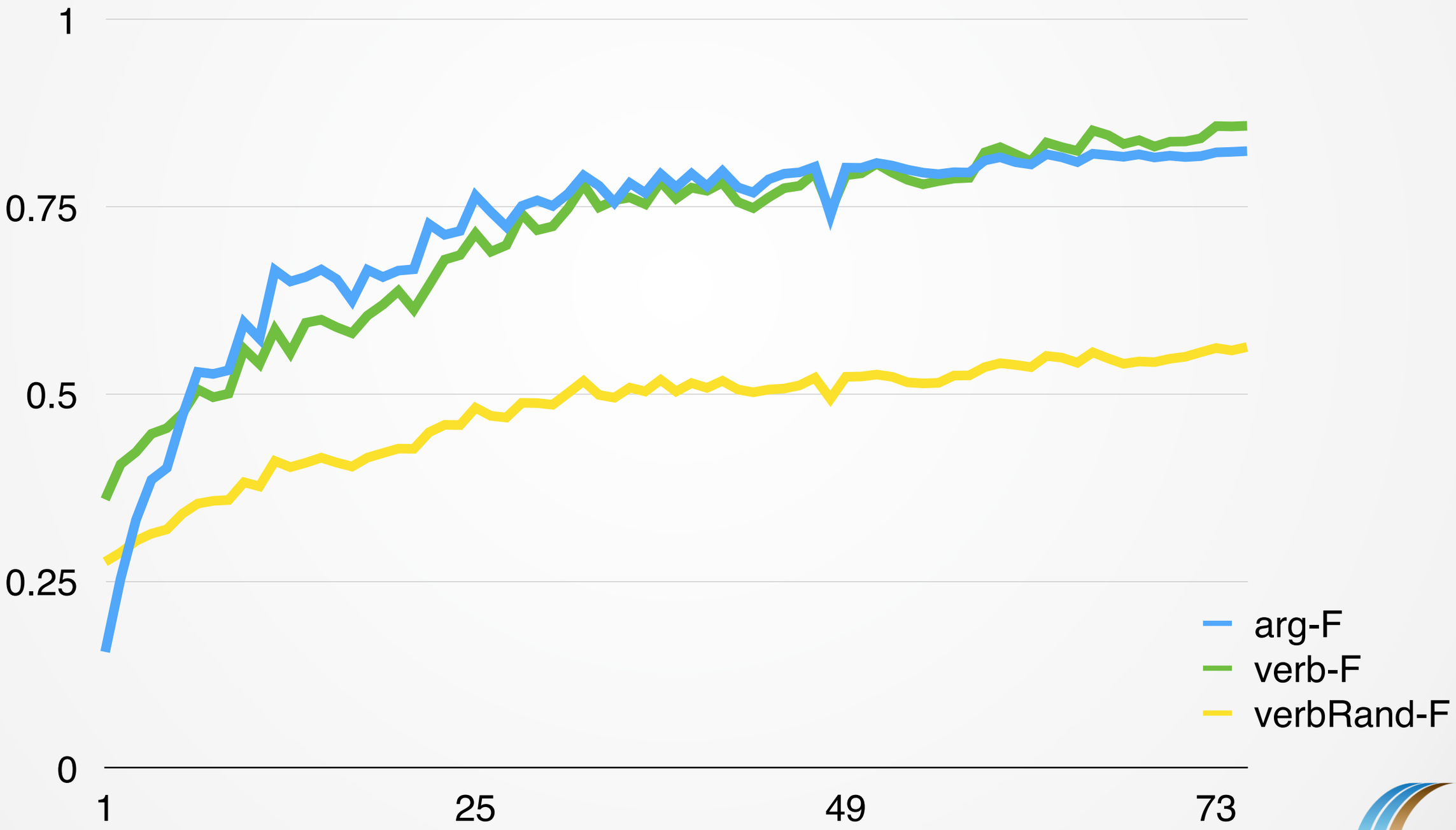

Experiment 2: Parameters

- Random/frequent seed noun selection
- Variants + plurals of seed nouns
- Verb/predicate evaluation
- Multiple predicates
- Seed noun threshold ***k***
- Null predictions
- Function words

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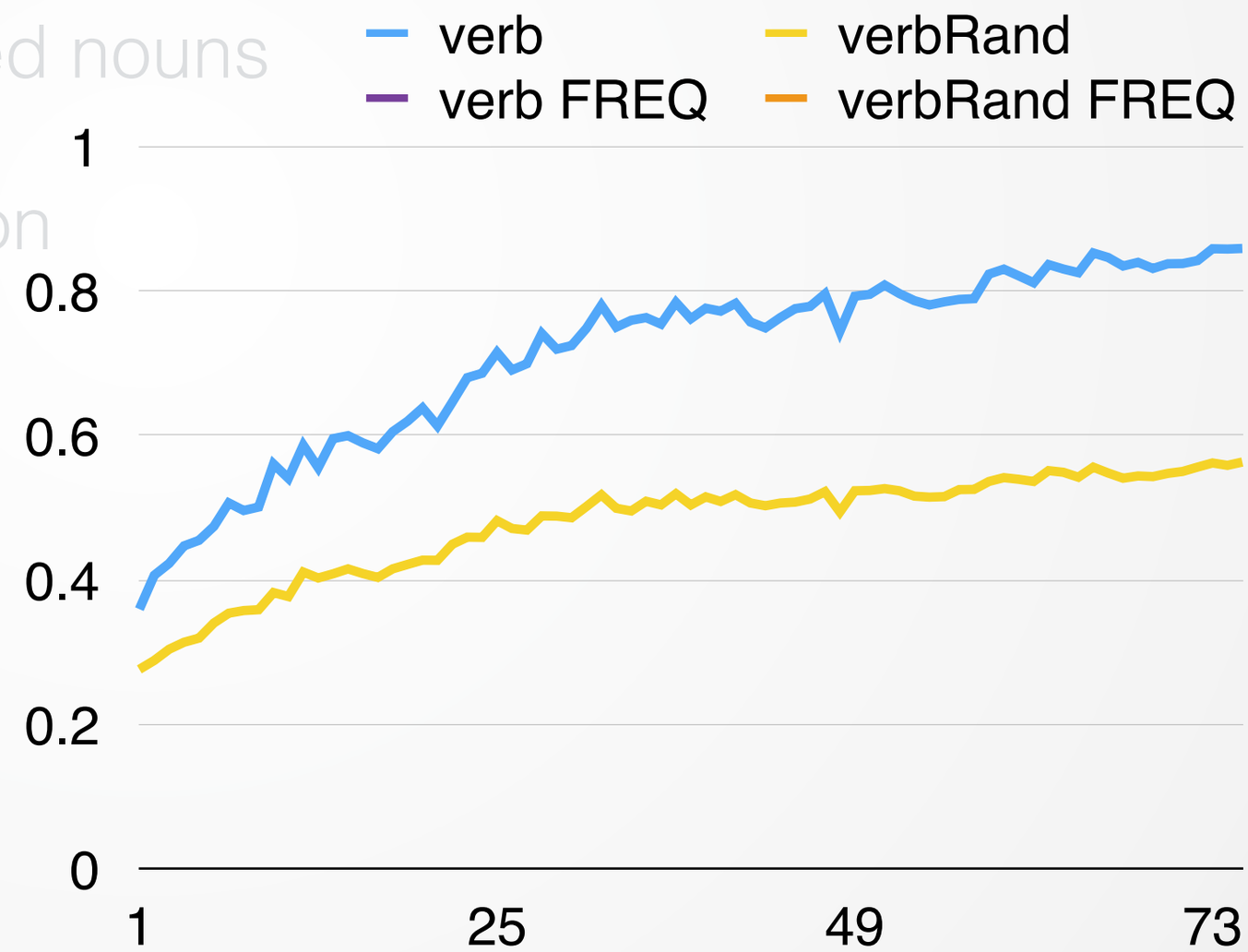

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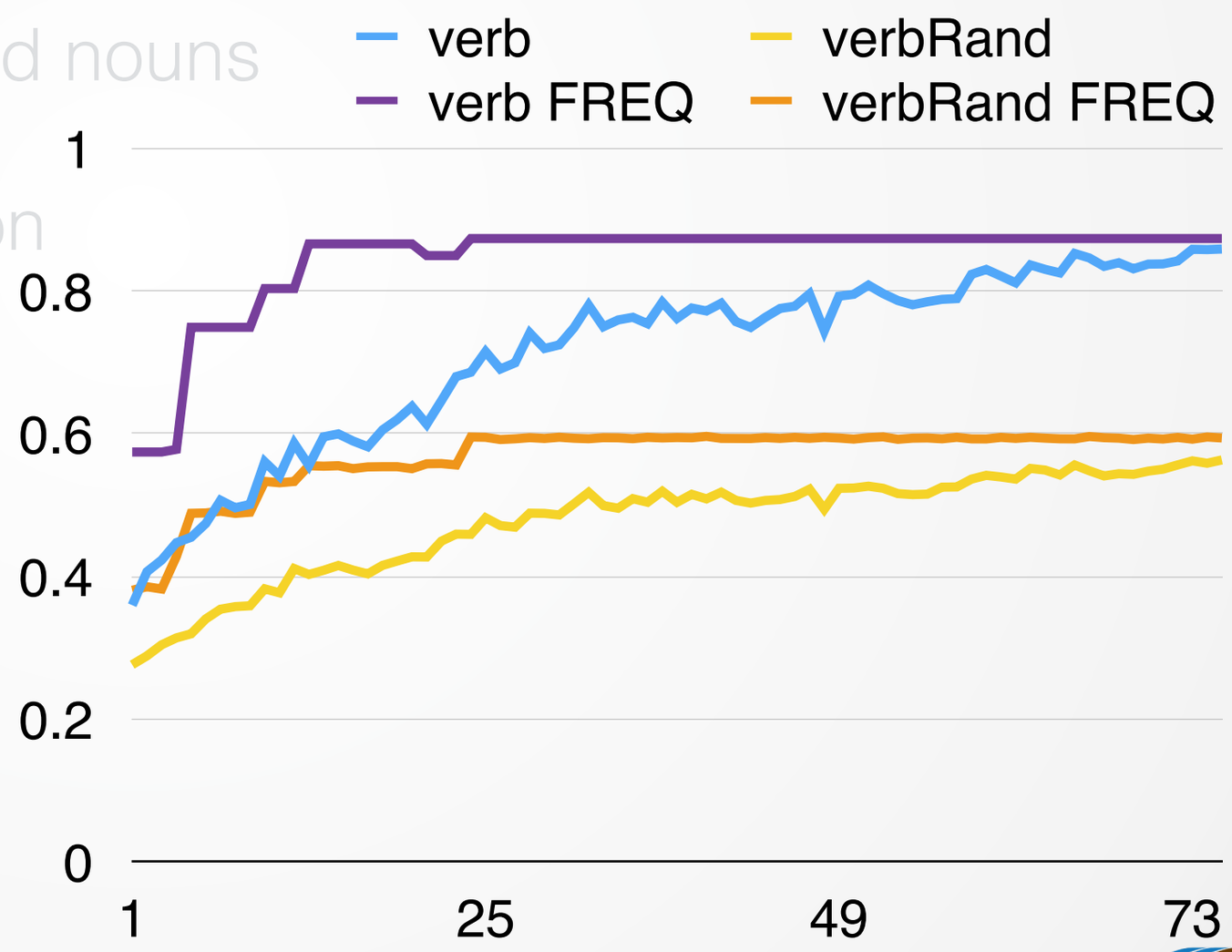

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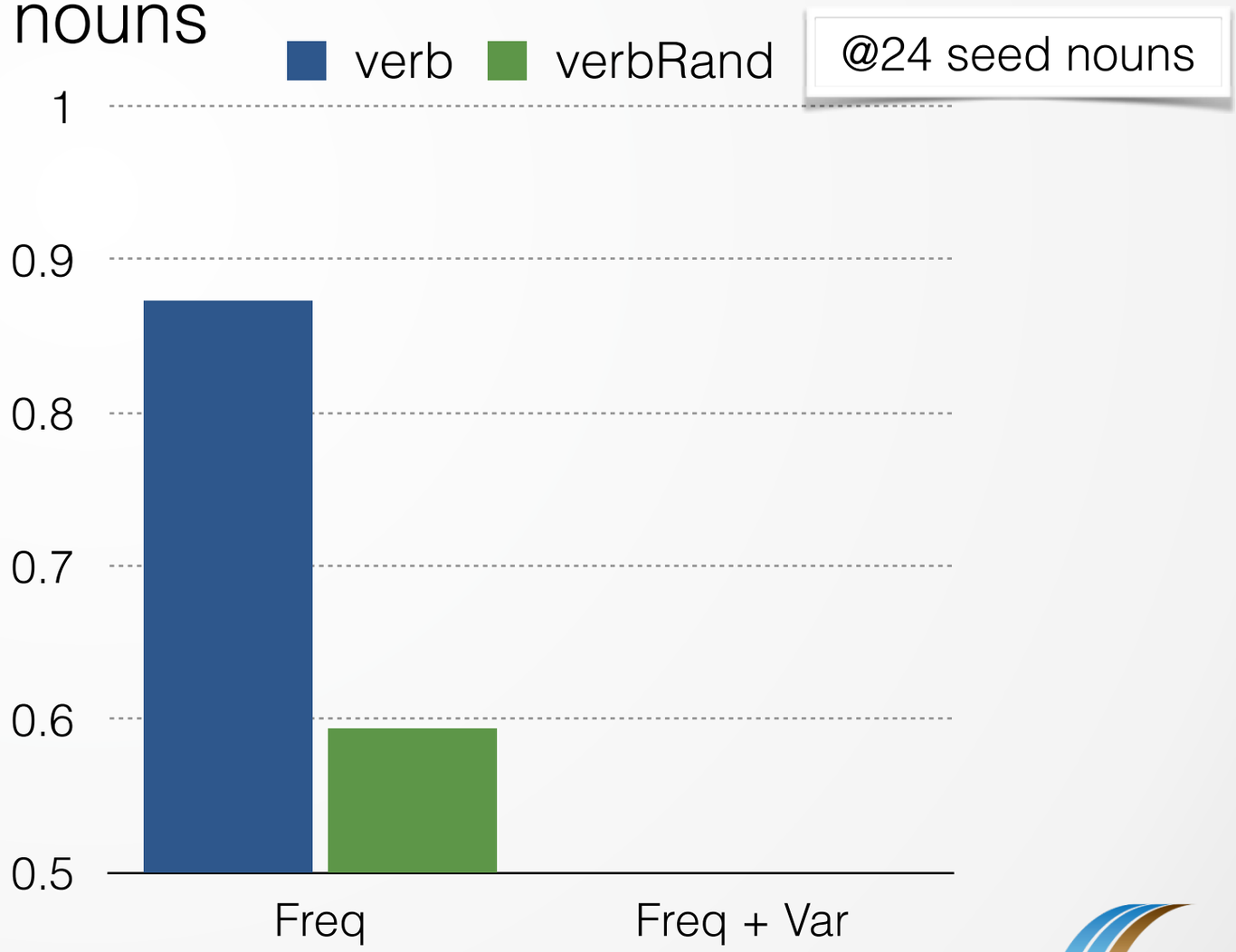

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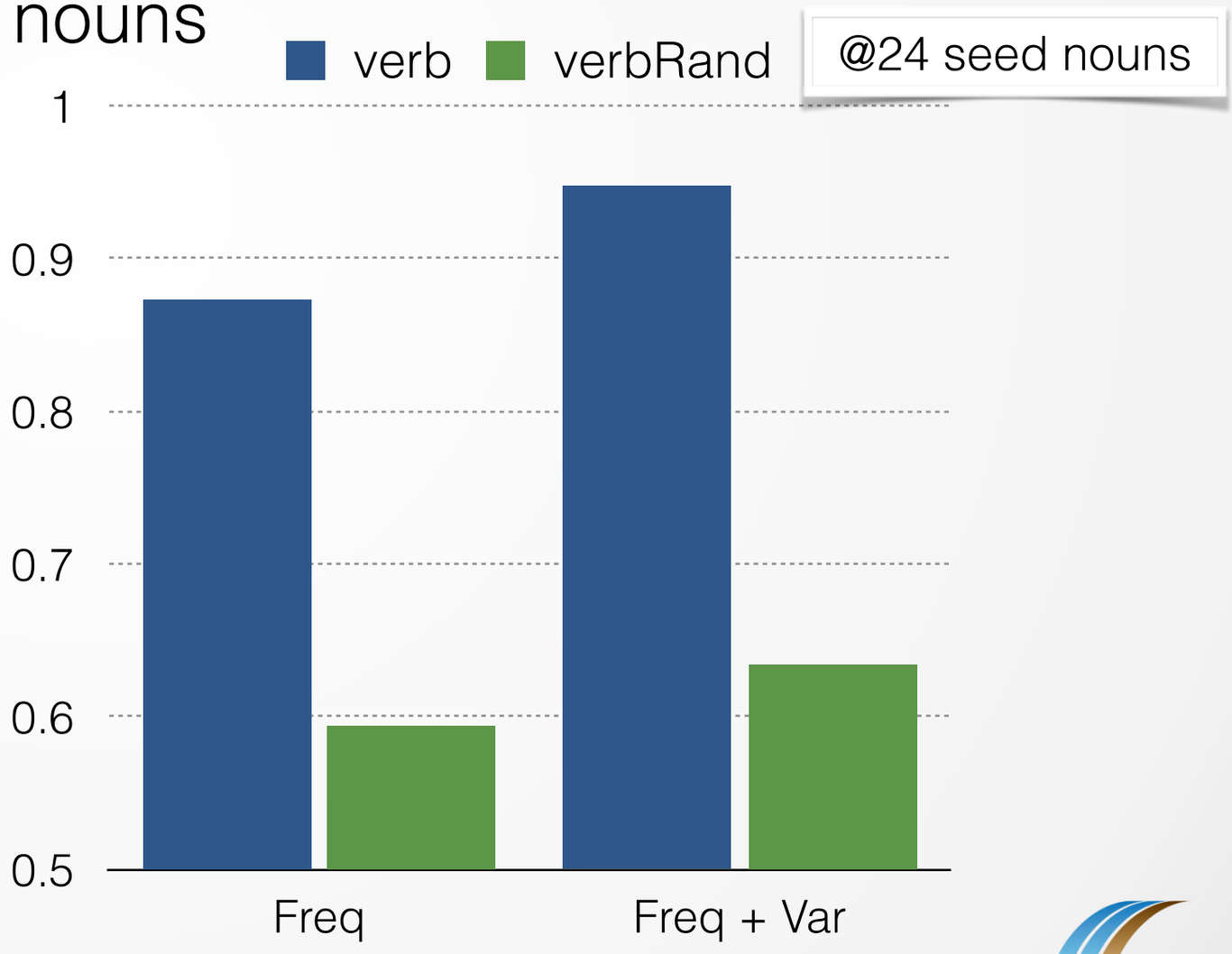

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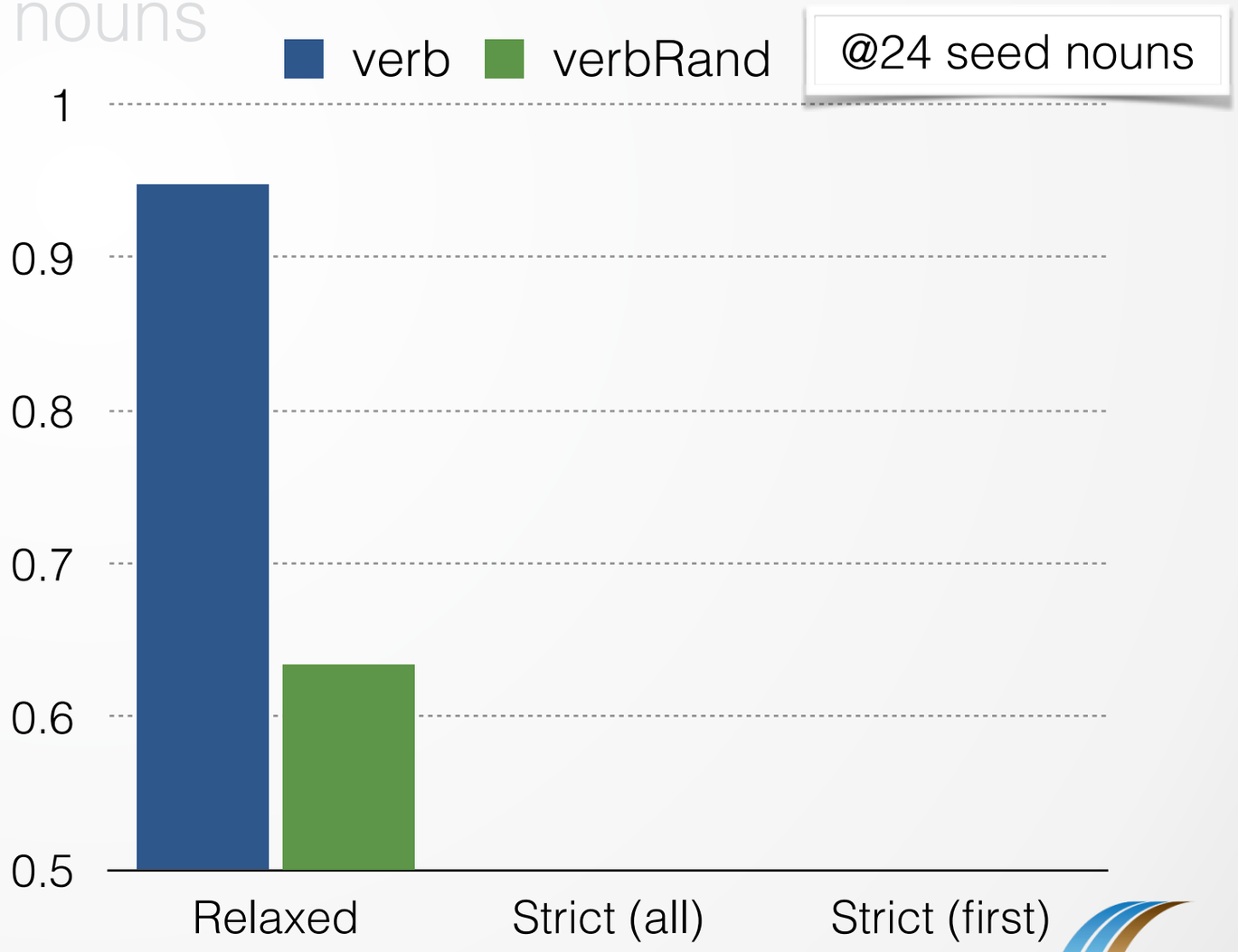

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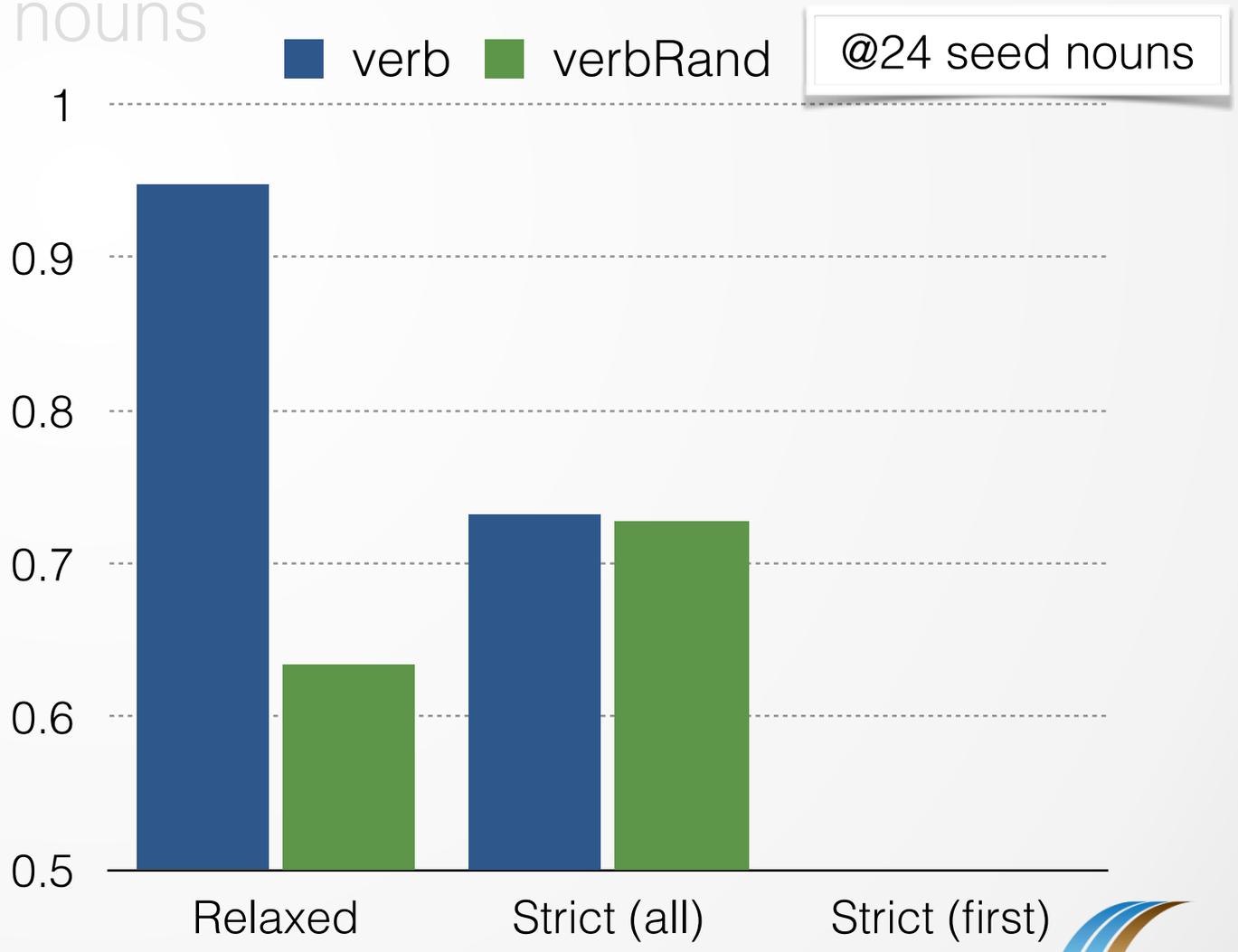

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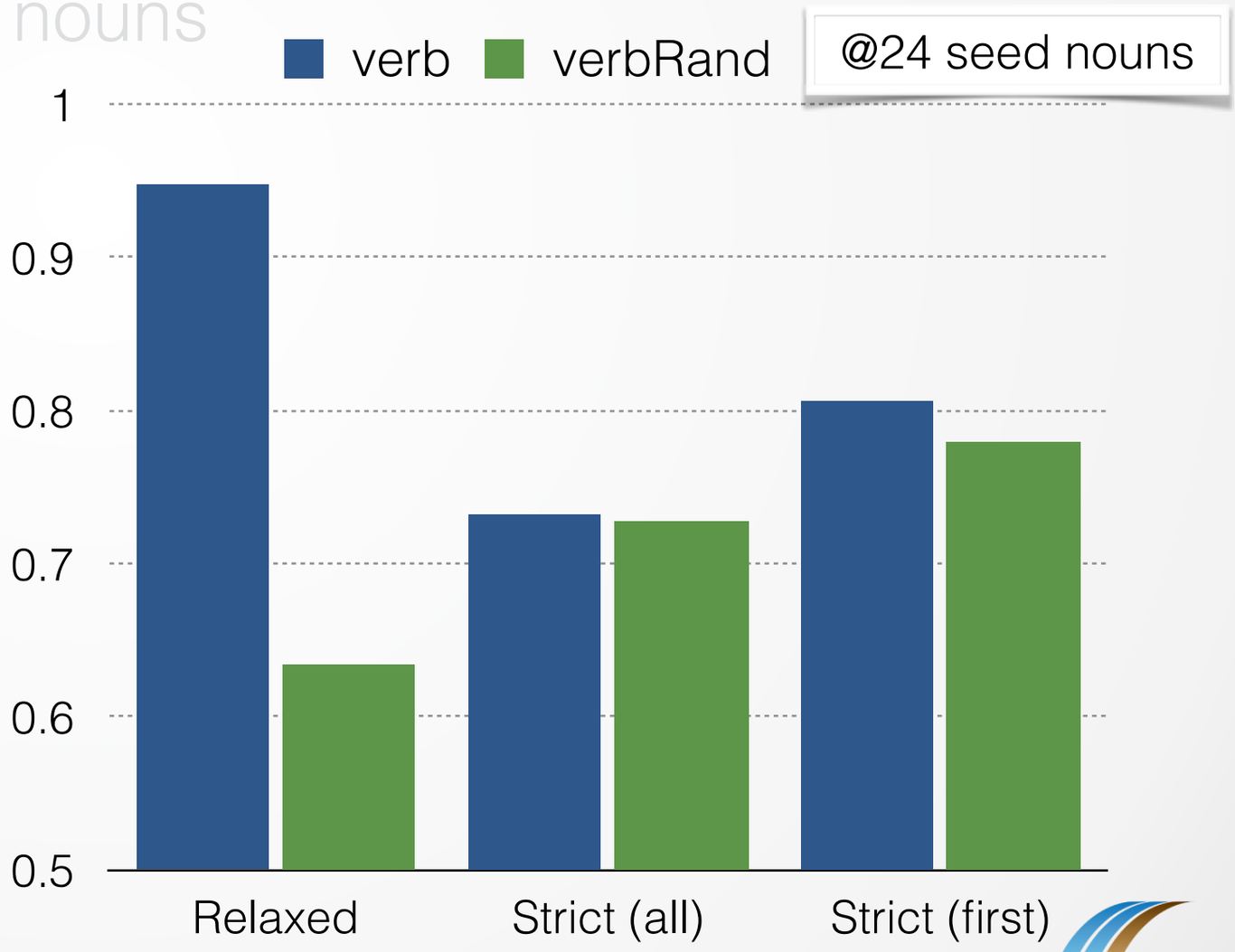

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need to consider multiple predicates

Conclusions

- BabySRL model of language acquisition
  - Evidence for syntactic bootstrapping
- Exploration of assumptions
  - Data representation
  - Evaluation
  - Psycholinguistic validity

Future Directions

- BabySRL from scratch [Connor et al. 2012]
- Beyond single predicates
  - Multiple verbs
  - Prepositions
- Relaxing perfect feedback (scene ambiguity)
  - Superset
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