

# Cross-Evaluation of Entity Linking and Disambiguation Systems for Clinical Text Annotation

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Low dose **pramipexole** is neuroprotective in  
the MPTP mouse model of **Parkinson's disease**

(\*)

Problems:

- 1 identify **entities** (nouns, noun phrases) within an text;
- 2 identify or resolve the meaning of such entities within such text by linking them to a sense repository
- 3 resolve meaning of **both domain-specific** and generic terms



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## Question

Are there annotation services capable of both?



# Annotators

## MetaMap

(Aronson and Lang, 2010)

clinical domain

sense repository:

UMLS

REST service

multilingual

sense: CUI

## BabelFly

(Moro et al., 2014)

general domain

sense repository:

BabelNet

REST service

multilingual

sense: [babelsynset](#)

## TagMe

(Ferragina and Scaiella, 2010)

general domain

“sense” repository:

Wikipedia

REST service

English/Italian

“sense”: [Wiki page](#)

## WordNet (Lesk)

(custom)

general domain

sense repository:

WordNet 3.0

Baseline

English

sense: [synset](#)

- **Problem:** Sense repositories a priori not aligned
- **Solution:** Use linked data in the form of DBpedia (Bizer et al., 2009) as [pivot](#) (partial mappings)



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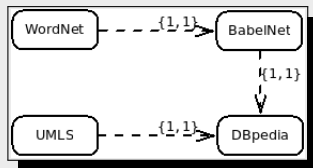
- **Problem:** Sense repositories a priori not aligned
- **Solution:** Use linked data in the form of DBpedia (Bizer et al., 2009) as [pivot](#) (partial mappings)

**!!** UMLS can be mapped to DBpedia via Medline and the LikedLifeData initiative (Momtchev et al., 2009)



# Annotations (Overview)

Use DBpedia as pivot:



	sense	sense ID	DBpedia URI
Clinical (Gold)	pramipexol	C0074710	<a href="http://dbpedia.org/resource/Pramipexole">http://dbpedia.org/resource/Pramipexole</a>
	Parkinson disease	C0030567	<a href="http://dbpedia.org/resource/Parkinson_disease">http://dbpedia.org/resource/Parkinson_disease</a>
MetaMap	pramipexol	C0074710	<a href="http://dbpedia.org/resource/Pramipexole">http://dbpedia.org/resource/Pramipexole</a>
	Parkinson disease	C0030567	<a href="http://dbpedia.org/resource/Parkinson_disease">http://dbpedia.org/resource/Parkinson_disease</a>
BabelFly	ATC_code.N04BC05	bn:03124207n	<a href="http://dbpedia.org/resource/Pramipexole">http://dbpedia.org/resource/Pramipexole</a>
TagMe	pramipexole	<a href="https://goo.gl/twrSVu">https://goo.gl/twrSVu</a>	<a href="http://dbpedia.org/resource/Pramipexole">http://dbpedia.org/resource/Pramipexole</a>
	Parkinson's disease	<a href="https://goo.gl/Xke6W3">https://goo.gl/Xke6W3</a>	<a href="http://dbpedia.org/resource/Parkinson's_disease">http://dbpedia.org/resource/Parkinson's_disease</a>

annotations for example (\*)

# SemRep Corpus (Kilicoglu et al., 2011)

- Experiments ran over the SemRep corpus
- Small annotated clinical corpus
  - 428 clinical excerpts (MedLine/PubMed)
  - 13,948 word tokens
  - 856 UMLS-annotated clinical terms
- For each sentence, two noun phrases annotated with their corresponding UMLS CUI by clinicians
- 606 terms can be associated to a corresponding DBpedia URI
- Example (\*) taken from SemRep



# Annotation Statistics

# of CUIs in corpus (total)	=	856
# of corpus DBpedia URIs	=	606
# of resolved corpus URIs	=	404
# of MetaMap DBpedia URIs	=	343
# of resolved MetaMap URIs	=	242
# of BabelFly DBpedia URIs	=	432
# of resolved BabelFly URIs	=	269
# of TagMe DBpedia URIs	=	469
# of resolved TagMe URIs	=	320
# of WordNet DBpedia URIs	=	182
# of resolved WordNet URIs	=	97



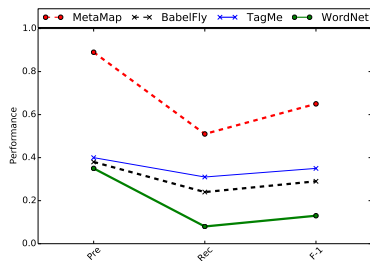


# Cross-Evaluation

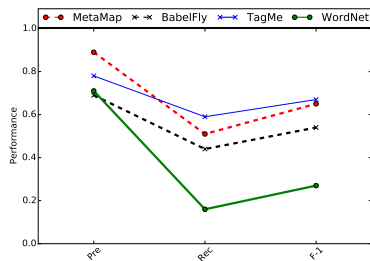
$$Pre = \frac{\#correct\ senses}{\#returned\ senses}$$

$$Rec = \frac{\#correct\ senses}{\#corpus\ senses}$$

$$F1 = \frac{2 \cdot Pre \cdot Rec}{Pre + Rec}$$



(unresolved URIs)



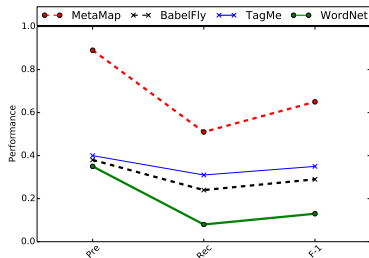
(resolved URIs)

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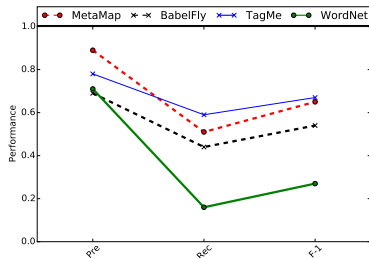
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(unresolved URIs)



(resolved URIs)

## Conclusion

When URIs are resolved via `same` as, generic EL systems such as TagMe and BabelNet `match` domain-specific annotators like MetaMap

# Semantic Relatedness Measures

$$\text{syn}(s, s') = \frac{\sum\{(w, w') \in g(s) \times g(s') \mid \text{wn}_{>0.2}(w, w')\}}{|g(s)| + |g(s')|}$$

$$\text{syn}^+(s, s') = \frac{\sum\{(w, w') \in g(s) \times g(s') \mid \text{wn}_{>0}(w, w')\}}{|g(s)| + |g(s')|}$$

$$\text{dsyn}(s, s') = \frac{\sum\{(w, w') \in g(s) \times g(s') \mid \text{dn}_{>0.2}(w, w')\}}{|g(s)| + |g(s')|}$$

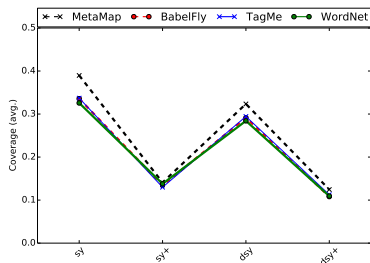
$$\text{dsyn}^+(s, s') = \frac{\sum\{(w, w') \in g(s) \times g(s') \mid \text{dn}_{>0}(w, w')\}}{|g(s)| + |g(s')|}$$

We measured:

- ① **WordNet similarity** (low coverage, but better accuracy) under two “synonymy” thresholds (“strict”  $> 0.2$ , “loose”  $> 0$ )
- ② **word embedding relatedness** (standard Wikipedia-trained word2vec word space models) under two “synonymy” thresholds (“strict”  $> 0.2$  and “loose”  $> 0$ )



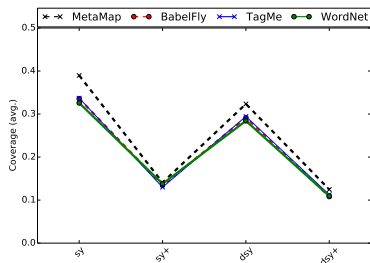
# Annotation Relatedness



Annotations	Avg. len. (sent.)
Corpus sense glosses	66.41 words
BabelFly sense glosses	199.43 words
TagMe sense glosses	325.51 words
MetaMap sense glosses	191.76 words
WordNet sense glosses	50.50 words

Test	Null hyp.	<i>p</i> -value
Kruskal-Wallis	identical	0.897

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## Conclusion

No significant differences w.r.t. semantic relatedness

# Summing up...

- We have cross-evaluated generic WSD and linking systems (BabelFly, TagMe) with domain-specific (MetaMap) annotators
- Generic WSD and linking systems show competitive results over the SemRep gold standard
- In particular, their greater coverage yields improvements in F1-score (TagMe outclasses MetaMap in F1-score, but by a small margin)
- In the future we plan to investigate if domain adaptation yields better results and improve linking





**Thank You!**

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