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Luke Gessler

*Georgetown University*, [lukegessler@gmail.com](mailto:lukegessler@gmail.com)

Shira Wein

*Georgetown University*, [sw1158@georgetown.edu](mailto:sw1158@georgetown.edu)

Nathan Schneider

*Georgetown University*, [nathan.schneider@georgetown.edu](mailto:nathan.schneider@georgetown.edu)

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# Supersense and Sensibility: Proxy Tasks for Semantic Annotation of Prepositions

Luke Gessler Shira Wein Nathan Schneider

Georgetown University

{lg876, sw1158, nathan.schneider}@georgetown.edu

**Introduction**<sup>1</sup> Prepositions are highly ambiguous function words which can express a wide variety of relationships (Litkowski and Hargraves, 2006; Tratz, 2011). Supersenses have been proposed as an analytic framework for studying their lexical semantics, but extant gold-annotated corpora (e.g. Schneider et al., 2018) are small because preposition supersense annotation is a complex annotation task that requires much training and time.

Here, we present two **proxy** task designs for crowdsourcing from which supersense labels can be sensed – that is, recovered indirectly. These designs involve in-context **substitution** and **similarity** judgments. Based on four in-house pilot experiments, we conclude that both designs are promising methods for building a large preposition supersense-annotated corpus, and that they differ in difficulty for the annotators and for the researchers.

**Prepositional Supersenses** Prepositions can express many different kinds of semantic relations. Schneider et al. (2018) present SNACS, an annotation framework for prepositions encoding these relations. The meanings of prepositions are expressed in terms of supersenses, of which there are 50 in SNACS v2.5. For instance, the preposition *in* can be used to express time, place, and other relations: “I rented an apartment in<sub>LOCUS</sub> Boston”, “I hope to see you in<sub>TIME</sub> the future”.

**Task 1: Preposition Substitution** This design consists of two crowdsourced tasks and requires an unlabeled corpus  $\mathcal{U}$ . First, in the **substitute generation task**, we identify an unlabeled instance  $\langle s, t \rangle \in \mathcal{U}$ , where  $s$  is a sentence and  $t \in s$  is the **target preposition** to be disambiguated. A crowdworker provides a substitute  $t'$  for  $t$  which approximately

<sup>1</sup>This work is an abstract of work presented at LAW XIV. Please refer to the full paper for more detail, and prefer to cite the full paper over this abstract: <https://www.aclweb.org/anthology/2020.law-1.11/>

they fixed my garage doors >> in << literally less than an hour .

- ☐ at
- ☐ around
- ☐ with
- ☐ within
- ☐ during
- ☐ through
- ☐ throughout
- ☐ for
- ☐ [omit]
- ☐ Other:

Figure 1: An example instance for the substitute selection task.

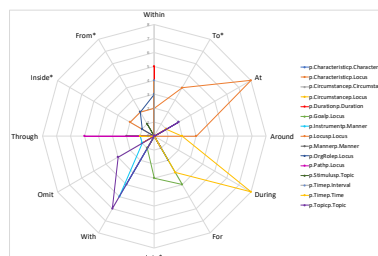


Figure 2: Substitutes for “in” selected in the substitute selection task. Each “spoke” is a substitute, and every point on each colored line represents the frequency of a substitute used for an instance that was gold-labeled with a particular supersense tag.

preserves the meaning of  $s$  when substituted with  $t$  and does not contain  $t$ . E.g., for the sentence “The book is **by** the lamp”, “close to” and “near” would both be good substitutes because “The book is **close to** the lamp” and “The book is **near** the lamp” both have similar meanings. By the end of this task, each several potential substitutes  $t'_1, \dots, t'_n$  will have been proposed by workers, but this data alone is not enough to infer a supersense for  $t$  in  $s$ .

More information is collected in the second task, the **substitute selection task**. The substitutes from the generation task  $t'_1, \dots, t'_n$  populate a multiple-choice list, and crowdworkers choose all items on the list which are acceptable substitutes for  $t$  in  $s$ . Once enough crowdworkers have completed the

I do n't recommend this place >>to<< anyone or even anything to eat . \*

☐ I rly seek the chef out to introduce myself - but the second time we went - i made a point of asking our wait person to introduce my friend and myself >>to<< the chef to tell him just how good our meals were .

☐ It had listed that there was a hot breakfast but all this meant is that they added a waffle maker >>to<< the common continental affair at most cheap hotels .

☐ Would NOT recommend this place >>to<< anyone - in fact - save your money and go somewhere else .

☐ None

Figure 3: An example instance for the neighbor selection task.

| Case                               | Tagger | Crowd | "None" |
|------------------------------------|--------|-------|--------|
| 1 (Tagger correct, gold present)   | 17/17  | 17/17 | 0/12   |
| 2 (Tagger incorrect, gold present) | 0/12   | 6/12  | 5/12   |
| 3 (Tagger correct, gold absent)    | 3/3    | 0/3   | 2/3    |
| 4 (Tagger incorrect, gold absent)  | 0/8    | 0/8   | 5/8    |

Table 1: Supersense tagger accuracy and crowd accuracy for a pilot study with 40 instances, which were deliberately selected such that the tagger got 20 correct and 20 incorrect predictions on them. (The tagger’s real performance is closer to 85%.) Each row in this table represents instances grouped by whether the tagger correctly predicted the target’s gold tag and whether the target’s gold tag was present among the 5 neighbors, yielding four possibilities. (For example, the second row covers the instances where the tagger incorrectly predicted the supersense tag, but the target’s gold tag was present among the neighbors.) The “None” column indicates how many times “None” was chosen by the crowd.

selection task, we have a frequency distribution over the substitutes. These distributions can then be used to train classifiers to predict supersenses.

In pilot studies, we carry out both subtasks for five common prepositions: *for*, *with*, *to*, *from*, and *in*. Annotators were shown the instances and asked to write a single substitution per instance. Although our dataset was too small, we qualitatively evaluate our pilot data and find that we could expect a classifier to achieve good results with a larger quantity of similar data – see Figure 2.

**Task 2: Neighbor Selection** This design consists of a single task and requires a labeled corpus  $\mathcal{L}$ , an unlabeled input corpus  $\mathcal{U}$ , and some similarity function  $\text{sim}(x, y)$  that can compare two unlabeled instances  $\langle s_1, t_1 \rangle, \langle s_2, t_2 \rangle$  represent how similar the usages of  $t_1$  and  $t_2$  are as a real number.

An unlabeled instance  $\langle s, t \rangle \in \mathcal{U}$  is selected, the *target* instance.  $\text{sim}$  is used to compare it to every instance in  $\mathcal{L}$ , and the top  $k$  most similar instances in  $\mathcal{L}$  are retrieved with their labels,  $\langle s_1, t_1, \ell_1 \rangle, \dots, \langle s_k, t_k, \ell_k \rangle$ . We call these retrieved instances the target’s *neighbors*. Neighbors may optionally be filtered, e.g. to ensure that no label  $\ell$  is represented more than once among  $\ell_1, \dots, \ell_k$ .

The target sentence  $s$  is presented to crowdworkers along with  $s_1, \dots, s_k$  from the neighbors, and crowdworkers are asked to select any neighbors for which the usage of the preposition  $t_i$  in  $s_i$  most resembles the usage of  $t$  in  $s$ . For example, if the target sentence were “I was booked **at** the hotel”, “There was no cabbage **at** the store” would be a good neighbor to choose, while “My technician arrived **at** 11 pm” would not be good to choose. The predicted supersense tag is taken from the neighbor sentence selected most often by crowdworkers.

In our pilot studies, we use the same five prepositions from before and implement our *sim* function as cosine similarity between supersense tag class probability vectors from the system of Liu et al. (2020). We find that using this methodology, human workers are able to outperform the supersense tagger: in easy cases, the humans agree with the tagger; when the tagger makes a mistake but still succeeds in retrieving a neighbor with the correct supersense, humans usually select the correct neighbor; when no good option is available, humans tend to select “None”. See Table 1.

**Conclusion** We have presented two designs for deriving prepositional supersense tags from crowdsourced tasks, and we have investigated their efficacy through pilot studies, finding both promising for producing high-quality annotations. We have made idealizations throughout this work: all data was homogeneous with respect to genre, and crowdworkers had some knowledge of the prepositional supersense annotation guidelines which likely made them better than real-world crowdworkers. Moreover, we studied only 5 common prepositions covering 20 or so supersenses out of SNACS’s 50. In future work, we will implement these designs on crowdsourcing platforms to further investigate these designs’ efficacy and the extent to which these idealizations affect our results.

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