Introducing a Lexicon of Verbal Polarity Shifters for English

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What are Polarity Shifters?
## Shifters vs Negation

| Example | Negation | Polarity Shifters |
|---------|----------|-------------------|
| He did \[\textit{not} \ \text{have} \ [\textit{hope}]^+\]. | He \[\textit{abandoned} \ [\textit{hope}]^+\]. |
Shifters vs Negation

| Example         | Negation            | Polarity Shifters       |
|-----------------|---------------------|-------------------------|
| He did [not have [hope]⁺]. | He [abandoned [hope]⁺]. |

| Word Type | Closed Class | Open Class |
|-----------|--------------|------------|
### Shifters vs Negation

|                      | Negation          | Polarity Shifters |
|----------------------|-------------------|-------------------|
| **Example**          | *He did [not have [hope]⁺]*. | *He [abandoned [hope]⁺]*. |
| **Word Type**        | Closed Class      | Open Class        |
| **Resource Creation**| Cheap             | Expensive         |
### Shifters vs Negation

|                  | Negation                        | Polarity Shifters                   |
|------------------|---------------------------------|------------------------------------|
| **Example**      | *He did [not have [hope]⁺].*    | *He [abandoned [hope]⁺].*           |
| **Word Type**    | Closed Class                    | Open Class                         |
| **Resource Creation** | Cheap                  | Expensive                          |

Existing polarity classifiers can process negation, but fail to detect polarity shifters due to a lack of resources.
Goal

Create a Lexicon of Verbal Polarity Shifters
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Create a Lexicon of Verbal Polarity Shifters

Main sentence predicate ⇒ far reaching scope
Overview

• Polarity Shifters
  • Related Work
  • Word Sense Ambiguity
  • Shifter Scope

• Lexicon
  • Annotation Process
  • Lexicon Example

• Conclusion
## Related Work

|                        | Supervised Bootstrapping (Schulder et al., 2017) | Complete Annotation (this work) |
|------------------------|-----------------------------------------------|---------------------------------|
| **Input Resource**     | WordNet                                       | WordNet                         |
| **Lexicon Size**       | 3,000 verbs                                   | 10,500 verbs                    |
| **Shifter Labels**     | Lemma                                         | Word Sense                      |
| **Additional Information** | -                                             | Shifter Scope                   |
Word Sense Ambiguity

- 50% of verbs are polysemous.
- 12% of verbs are shifters in at least one word sense.
- Among polysemous verbal shifters, only 23% are shifters in all their word senses.

**Mark down:** Reduce in price  
Shifter

The agency *[marked down [their assets]]*.

**Mark down:** Write down  
No Shifter

*She *[marked down [his confession of guilt]]*.*
Shifter Scope

When a phrase contains a polarity shifter, you need to know what part of the phrase it can affect. (Wiegand et al., 2017, GSCL)

\[[\textit{The villain}]^- \textbf{defeated} [\textit{the hero}]^+ .\]

\[[\textit{The villain}]^- \textbf{surrendered} [\textit{to the hero}]^+ .\]
Shifter Scope

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\[ \text{[The villain]}^- \text{surrendered} \ [\text{to the hero}]^+. \]
When a phrase contains a polarity shifter, you need to know what part of the phrase it can affect. (Wiegand et al., 2017, GSCL)

The villain - defeated [the hero]^+.  

[The villain]^- surrendered [to the hero]^+.  

The villain - surrendered to the hero^+.  

subj
Shifter Scope

When a phrase contains a polarity shifter, you need to know what part of the phrase it can affect. (Wiegand et al., 2017, GSCL)

[The villain] - **defeated** [the hero] +.

[The villain] - **surrendered** [to the hero] +.

Scope annotated for dependency relations. Assumes active sentence.
Verbal shifters affect not only direct objects.
Overview

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  • Related Work
  • Word Sense Ambiguity
  • Shifter Scope

• Lexicon
  • Annotation Process
  • Lexicon Example

• Conclusion
Annotation Workflow

Lemma 1

Lemma 2

Lemma 3
Annotation Workflow

Lemma 1

Lemma 2

Lemma 3
Annotation Workflow

Lemma 1 → Sense 1

Lemma 2 → Sense 1

Lemma 3 → Sense 2
Annotation Workflow

Lemma 1 → Sense 1 → Is Shifter?
Lemma 2
Lemma 3 → Sense 2
Annotation Workflow

Lemma 1

Sense 1

Is Shifter?

Sense Definition

Lexicon Examples

Lemma 2

Sense 2

Lemma 3
Annotation Workflow

Lemma 1 → Sense 1 → Is Shifter? → Sense Definition

Lemma 2 → Sense 2

Lemma 3

No :( → Lexicon Examples
Annotation Workflow

Lemma 1

Sense 1

Lemma 2

Sense 2

Lemma 3
Annotation Workflow

Lemma 1

Sense 1 ✗

Sense 2

Lemma 2

Lemma 3
Lemma 1

Sense 1 ×

Sense 2

Is Shifter?

Sense Definition

Lexicon Examples

Lemma 2

Lemma 3
Annotation Workflow

- Lemma 1
  - Sense 1 ✗
  - Sense 2 ✓

- Lemma 2
- Lemma 3

- Is Shifter?
  - Yes!

- Sense Definition
- Lexicon Examples
Annotation Workflow

Lemma 1
- Sense 1 ✖
  - Sense 2 ✔

Is Shifter?

What Scope?

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Annotation Workflow

Lemma 1

Sense 1 ✗

Sense 2 ✓

Is Shifter?

Lemma 2

Lexicon Examples

Lemma 3

What Scope?
Annotation Workflow

Lemma 1 -> Sense 1 ✗

Lemma 2

Sense 2 ✔ Subj

Lemma 3
Annotation Workflow

Lemma 1 → Sense 1 ✗

 Lemma 2

Sense 2 ✔  Subj

Lemma 3
Annotation Workflow

Lemma 1 → Sense 1 ✗
Lemma 2
Lemma 3 → Sense 2 ✔ Subj

Sense = Lemma-Synset pair
Observation: Sense annotation considerably faster than lemma annotation

Sense = Lemma-Synset pair
Annotators

Expert Annotator:
Experience in linguistics and annotation work

Inter-annotator Agreement:
2nd annotator labelled 400 word senses
Cohen's $\kappa = 0.73$
$\Rightarrow$ Substantial agreement

Both annotators are authors of this paper.
## Lexicon Example

| Blow out | Synset 00436247 | SUBJ | Shifter |
|----------|----------------|------|---------|
| **melt, break, or become otherwise unusable** |

| Blow out | Synset 02767855 | DOBJ | Shifter |
|----------|----------------|------|---------|
| **put out, as of fires, flames, or lights** |

| Blow out | Synset 02766970 |  -  | No Shifter |
|----------|----------------|-----|------------|
| **erupt in an uncontrolled manner** |
Conclusion

Summary
We introduced a lexicon of English verbal shifters:
  • Covers all verbs in WordNet
  • Annotations for each word sense
  • Shifter labels
  • Shifter scope labels

Data
  • https://github.com/uds-lsv/lrec2018

Future Work
  • Nouns, adjectives
  • Other languages
Thank You
References

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Future Work
• Nouns, adjectives
• Other languages
Real World Distribution

How frequent are shifters in actual corpora?

**Corpus:** Amazon Product Reviews (Jindal and Liu, 2008)
- 5.8 million reviews
- Popular sentiment analysis domain

**Heuristic:**
1. List all lemmas that have at least one shifter sense
2. Count occurrences of shifter lemmas
3. Normalize over shifter sense ratio of lemma

**Example:**
*blow out:* 2290 occur. *⅔* shifter senses = 1527 shifter occur.
Real World Distribution

Verbal Shifters

Vocabulary: 1163 words
   (95% of shifters in lexicon)

Raw count: 34 million
Corrected count: 13 million
   (5% of verbs in corpus)

Negation

Vocabulary: 15 words (Wilson et al., 2005)
Count: 13 million
Fun Facts

1. Annotating per word sense is faster than per lemma.

2. Corpus frequency tests show that verbal shifters are as frequent as negations
Subject (subj):

\[ [[\text{The villain}]_{subj} \text{surrendered}]^+ \text{ [to the hero]}^+ \].

Direct Object (dobj):

\[ \text{The storm } [\text{ruined } [\text{their party}]^+_\text{dobj} ]^- \].

Prepositional Object (pobj):

\[ \text{The wall } [\text{shielded } \text{them } [\text{from the explosion}]^-_{\text{pobj}} ]^+ \].

Clausal Complement (comp):

\[ \text{He } [\text{failed } [\text{to pass the exam}]^+_\text{comp} ]^- \].
Shifter Scope: Prepositions

- **from**: 57%
- **of**: 20%
- **for**: 6%
- **on**: 4%
- **at**: 4%
- **other**: 10%
The Trouble with Synsets

Synsets do not model syntactic information

He \textbf{[discarded [the evidence]^+]}^-.
⇒ direct object

He \textbf{[disposed [of the evidence]^+]}^-.
⇒ prepositional object
The Trouble with Synsets

Synsets do not model syntactic information

WordNet

S: (v) discard, dispose, [...]  
(throw or cast away)

"Put away your worries"

He [discarded [the evidence]+]-.  
⇒ direct object

He [disposed [of the evidence]+]-.  
⇒ prepositional object
Annotation Granularity

Lemma
- Lemma 1 + Sense 1
- Lemma 1 + Sense 2
- Lemma 1 + Sense 3

Synset
- Lemma 1 + Sense 1
- Lemma 2 + Sense 1
- Lemma 3 + Sense 1

Lemma-Sense Pair
- Lemma 1
- Sense 1