Introducing a Lexicon of Verbal Polarity Shifters for English

Marc Schulder
Michael Wiegand
Stephanie Köser
Spoken Language Systems
Saarland University, Germany

Josef Ruppenhofer
Institute for German Language
Mannheim, Germany
What are Polarity Shifters?
## Shifters vs Negation

<table>
<thead>
<tr>
<th>Example</th>
<th>Negation</th>
<th>Polarity Shifters</th>
</tr>
</thead>
<tbody>
<tr>
<td>He did [<em>not have [hope]⁺</em>].</td>
<td>He [<em>abandoned [hope]⁺</em>].</td>
<td></td>
</tr>
</tbody>
</table>
## Shifters vs Negation

<table>
<thead>
<tr>
<th></th>
<th>Negation</th>
<th>Polarity Shifters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example</strong></td>
<td><em>He did [not have [hope]^+].</em></td>
<td><em>He [abandoned [hope]^+].</em></td>
</tr>
<tr>
<td><strong>Word Type</strong></td>
<td>Closed Class</td>
<td>Open Class</td>
</tr>
</tbody>
</table>
### Shifters vs Negation

<table>
<thead>
<tr>
<th>Example</th>
<th>Negation</th>
<th>Polarity Shifters</th>
</tr>
</thead>
<tbody>
<tr>
<td>He did <em>not</em> have [hope]+.</td>
<td></td>
<td>He <em>abandoned</em> [hope]+.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Word Type</th>
<th>Closed Class</th>
<th>Open Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Creation</td>
<td>Cheap</td>
<td>Expensive</td>
</tr>
</tbody>
</table>
# Shifters vs Negation

<table>
<thead>
<tr>
<th></th>
<th>Negation</th>
<th>Polarity Shifters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example</strong></td>
<td>He did [not have [hope]⁺].</td>
<td>He [abandoned [hope]⁺].</td>
</tr>
<tr>
<td><strong>Word Type</strong></td>
<td>Closed Class</td>
<td>Open Class</td>
</tr>
<tr>
<td><strong>Resource Creation</strong></td>
<td>Cheap</td>
<td>Expensive</td>
</tr>
</tbody>
</table>

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
Goal

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

<table>
<thead>
<tr>
<th></th>
<th>Supervised Bootstrapping (Schulder et al., 2017)</th>
<th>Complete Annotation (this work)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Resource</strong></td>
<td>WordNet</td>
<td>WordNet</td>
</tr>
<tr>
<td><strong>Lexicon Size</strong></td>
<td>3,000 verbs</td>
<td>10,500 verbs</td>
</tr>
<tr>
<td><strong>Shifter Labels</strong></td>
<td>Lemma</td>
<td>Word Sense</td>
</tr>
<tr>
<td><strong>Additional Information</strong></td>
<td>-</td>
<td>Shifter Scope</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Mark down: Reduce in price</th>
<th>Shifter</th>
</tr>
</thead>
<tbody>
<tr>
<td>The agency [<em>marked down</em> [<em>their assets</em>]⁺⁻].</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mark down: Write down</th>
<th>No Shifter</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>She</em> [<em>marked down</em> [<em>his confession of guilt</em>]⁻⁻].</td>
<td></td>
</tr>
</tbody>
</table>
When a phrase contains a polarity shifter, you need to know what part of the phrase it can affect. (Wiegand et al., 2017, GSCL)

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

\[ \text{The villain}^{-} \text{ surrendered } \text{to the hero}^{+} \].
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)

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

\[ [\text{The villain}]^- \text{surrendered} [\text{to the hero}]^+. \]
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)

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

\[ [\text{The villain}]^{-}\text{surrendered} [\text{to the hero}]^{+}. \]
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)

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

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

Scope annotated for dependency relations. Assumes active sentence.
Shifter Scope

- Direct Object: 71%
- Prepositional Object: 10%
- Subject: 18%
- Clausal Complement: 1%
Verbal shifters affect not only direct objects.

Shifter Scope

- Direct Object: 71%
- Subject: 18%
- Prepositional Object: 10%
- Clausal Complement: 1%
Overview

• Polarity Shifters
  • 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
   ↓
Lemma 3

Lemma 2 → Sense 2
Annotation Workflow

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

Lemma 1 → Sense 1 → Is Shifter? → Sense Definition
Lemma 2
Lemma 3
Sense 1 → Sense 2
Lexicon Examples
Annotation Workflow

Lemma 1

Sense 1

Is Shifter?

Sense Definition

Lexicon Examples

Lemma 2

Sense 2

No :(

Lemma 3
Annotation Workflow

- Lemma 1
  - Sense 1
    - Sense 2

- Lemma 2
- Lemma 3
Annotation Workflow

**Lemma 1**

- Sense 1 ✗
- Sense 2 ✔

**Is Shifter?**

- Yes!

**Sense Definition**

**Lexicon Examples**
Annotation Workflow

Lemma 1

Sense 1 ✗

Sense 2 ✔

Is Shifter?

What Scope?

Lemma 2

Lemma 3
Annotation Workflow

Lemma 1 ➔ Sense 1 ✗ ➔ Is Shifter?

Lemma 2 ➔ Sense 2 ✔ ➔ What Scope?

Lemma 3 ➔ Lexicon Examples
Annotation Workflow

Lemma 1

Sense 1

Sense 2 ✔ Subj

Lemma 2

Lemma 3

Sense 2 ✔ Subj
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

Sense = Lemma-Synset pair
Annotation Workflow

Observation:
Sense annotation considerably faster than lemma annotation

Sense = Lemma-Synset pair

Lemma 1

Sense 1 ✗

Sense 2 ✔

Subj

Lemma 2

Lemma 3
Annotators

Expert Annotator:
Experience in linguistics and annotation work

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

⇒ Substantial agreement

Both annotators are authors of this paper.
<table>
<thead>
<tr>
<th>Blow out</th>
<th>Synset 00436247</th>
<th>SUBJ</th>
<th>Shifter</th>
</tr>
</thead>
<tbody>
<tr>
<td>melt, break, or become otherwise unusable</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blow out</th>
<th>Synset 02767855</th>
<th>DOBJ</th>
<th>Shifter</th>
</tr>
</thead>
<tbody>
<tr>
<td>put out, as of fires, flames, or lights</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blow out</th>
<th>Synset 02766970</th>
<th>-</th>
<th>No Shifter</th>
</tr>
</thead>
<tbody>
<tr>
<td>erupt in an uncontrolled manner</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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

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

N. Jindal and B. Liu. 2008. **Opinion Spam and Analysis.** In *Proceedings of WSDM.*

S. Kiritchenko and S.M. Mohammad. 2016. **The Effect of Negators, Modals, and Degree Adverbs on Sentiment Composition.** In *Proceedings of WASSA@NAACL/HLT.*


J. Ruppenhofer, and J. Brandes. 2015. **Extending effect annotation with lexical decomposition.** In *Proceedings of WASSA@EMNLP.*

N. Schneider, D. Hovy, A. Johannsen, and M. Carpuat. 2016. **SemEval-2016 Task 10: Detecting Minimal Semantic Units and their Meanings (DiMSUM).** In *Proceedings of SemEval@NAACL-HLT.*


M. Wiegand, A. Balahur, B. Roth, D. Klakow, and A. Montoyo. 2010. **A Survey on the Role of Negation in Sentiment Analysis.** In *Proceedings of NeSp-NLP.*

M. Wiegand, M. Wolf, and J. Ruppenhofer. 2017. **Negation Modeling for German Polarity Classification.** In *Proceedings of GSCL.*

**Conclusion**

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

**Data**

**Future Work**
- Nouns, adjectives
- Other languages
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
Shifter Scope

Subject (subj):

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

Direct Object (dobj):

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

Prepositional Object (pobj):

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

Clausal Complement (comp):

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

Synsets do not model syntactic information

<table>
<thead>
<tr>
<th>WordNet</th>
</tr>
</thead>
<tbody>
<tr>
<td>S: (v) discard, dispose, [...]</td>
</tr>
<tr>
<td>(throw or cast away)</td>
</tr>
<tr>
<td>&quot;Put away your worries&quot;</td>
</tr>
</tbody>
</table>

*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