Who evoked that frame?
Some thoughts on context effects and event types

Katrin Erk
Joint work with Gerhard Kremer, Sebastian Padó, Stefan Thater

Frame Semantics
in Natural Language Processing
A Workshop in Honor of
Chuck Fillmore (1929–2014)
How I first met FrameNet

• SALSA project: The Saarbrücken Lexical Semantics Annotation and Analysis Project (Erk et al., ACL 2003, Burchardt et al., 2009)

• Manual annotation of a German corpus with Frame-semantic information (Fillmore et al, 2003)
  • 1.5 million words of syntactically annotated German newspaper text (TIGER Corpus)
  • Focus on verb annotation

• People: Manfred Pinkal, Anette Frank, Aljoscha Burchardt, Katrin Erk, Andrea Kowalski, Sebastian Padó

• Funded by Leibniz Program of DFG (German Science Foundation)
A SALSA annotation example

(They didn't want to pay the move back because the employee had quit.)

• Annotating all verbs in the corpus
• Annotation on top of existing syntactic trees
• Using FrameNet as-is, as far as possible (almost always possible)
Inter-annotator agreement

<table>
<thead>
<tr>
<th></th>
<th>Agreement (Frames)</th>
<th>Agreement (FEs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inter-Annotator</td>
<td>84.9%</td>
<td>85.7%</td>
</tr>
<tr>
<td>Inter-Adjudicator</td>
<td>97.0%</td>
<td>96.2%</td>
</tr>
</tbody>
</table>

- Reasonable inter-annotator agreement
- Frames somewhat more coarse-grained than WordNet synsets
- Still, interesting issues with frame assignment
  - Some instances with continuing disagreement
  - Some instances where two frames seem to fit at the same time
Word meaning in context: It’s complicated

- Ambiguity – polysemy – contextual modulation may be a gradient, not clearly distinct categories (Tuggy 1993, Cruse 1995)

- Sense boundaries to some extent arbitrary (Kilgarriff 1997: “I don’t believe in word senses”)

- Manual word sense annotation remains a difficult task. Factors that influence difficulty (Passonneau et al., 2010):
  - Sense concreteness
  - Specificity of the sentence context
  - Similarity between senses
A U-semantic exercise

• Fillmore 1985: U-semantics, semantics of understanding:
  • “uncover the nature of the relationship between linguistic texts and the interpreter’s full understanding of the texts in their contexts”
  • Contrast: T-semantics, semantics of truth

• Finding the interpretive frames necessary for understanding a sentence
  • Corpus-based, bottom-up approach

• Today:
  • Corpus-based, bottom-up analysis of word meaning in context
  • Using one-word paraphrases (substitutes) given by human readers: a probe into perceived frames?
Lexical substitution

- Annotation framework for describing word meaning in context
  - Alternative to using dictionary senses
- McCarthy andNavigli 2007, 2009
- Describe instance by collection of contextually appropriate lexical substitutes (one-word paraphrases)
Lexical substitution: an example

<table>
<thead>
<tr>
<th>sentence with target</th>
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<tr>
<td>If science finds a <strong>way</strong> to safely free the subjects of Emil's art, perhaps the I who reads this file will know that my decision is wise.</td>
<td>means, process, practice, technique, solution, plan, avenue, method, procedure</td>
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</table>

- Annotators see a target word in context
- They provide one or more one-word substitutes
- Multiple annotators per instance: yields paraset (paraphrase set) for the instance
Properties of lexical substitution annotation

- Annotators can be non-experts
- No sense inventory required
- Provides more graded meaning description through the collection of substitutes in the paraset
- Substitutes can be viewed as weighted: How many annotators proposed this substitute?
CoInCo: A recent all-words lexical substitution corpus

- CoInCo (Kremer et al., EACL 2014)
  - Large, all-words lexical substitution corpus
  - Constructed using Amazon Mechanical Turk

- All content words annotated
  - Target sentence, plus one sentence context either side
  - 6 annotators per target

- Part of MASC (Ide et al. 2008, 2010): selected news and fiction documents
  - 30k words of running text, 15.4k annotated words

- [http://www.ims.uni-stuttgart.de/forschung/ressourcen/korpora/coinco.html](http://www.ims.uni-stuttgart.de/forschung/ressourcen/korpora/coinco.html)
Analyzing the lexical substitution data

- What relations do we find between targets and substitutes? Synonymy? Hypernymy?
- Are paraset similar to word senses?
- How fine-grained are they?
- Basis: WordNet
Analyzing the lexical substitution data

- What relations hold between targets and substitutes?
  - Lookup in WordNet

<table>
<thead>
<tr>
<th>Relation</th>
<th>Syn</th>
<th>Hyper</th>
<th>Hypo</th>
<th>Other</th>
<th>Not in WN</th>
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<tr>
<td>% substitutes</td>
<td>9.4</td>
<td>9.8</td>
<td>10.5</td>
<td>68.9</td>
<td>2.1</td>
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- Virtually all substitutes are in WordNet
- But majority does not instantiate a classical relation to the target
Analyzing the lexical substitution data

- What relations hold between targets and substitutes?
  - Lookup in WordNet

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- Manual analysis of “Other” cases:
  - Some errors (not that many)
  - Some cases of missing WordNet links
  - Many cases of contextual modulation
Context-specific substitutes

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<tbody>
<tr>
<td>When I think of Julia Child I think of the television episode where she's <strong>showing</strong> you how to make a turkey dinner and the turkey fell on the floor.</td>
<td>exhibit, demonstrate, present, display, tell, <strong>explain</strong>, instruct, teach</td>
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“Other” substitutes (italics):

give very specific description of the situation

Neither WordNet nor FrameNet has any connections between “show” and “teach”
## Context-specific substitutes

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<td>Mama <strong>kept</strong> her mink jacket, a family hand-me-down, safe from time in a stopbox, and lent the capturador to my uncle for his stamp collection.</td>
<td>preserve, protect, save, store, <strong>guard, secure, stow</strong></td>
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Also no FrameNet connection between “keep” and “guard/secure/stow”
Comparing three instances of “move”

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<td>Reuters Holdings PLC said Michael Reupke resigned as general manager to pursue</td>
<td>decision, change, maneuver, action, act, step, measure,</td>
</tr>
<tr>
<td>unspecified interests, a <strong>move</strong> the news organization termed an &quot;amicable</td>
<td><em>development, transfer, departure, switch</em></td>
</tr>
<tr>
<td>separation.”</td>
<td></td>
</tr>
<tr>
<td>Ochoa's new teammates were generally pleased with the <strong>move</strong>, even if it wasn't a</td>
<td>decision, change, shift, <em>deal, trade, swap, situation</em></td>
</tr>
<tr>
<td>blockbuster.</td>
<td></td>
</tr>
<tr>
<td>Also spurring the <strong>move</strong> to cloth: diaper covers with Velcro fastenlers that</td>
<td>change, shift, drive, <em>switch, transfer, transition</em></td>
</tr>
<tr>
<td>eliminate the need for safety pins.</td>
<td></td>
</tr>
</tbody>
</table>
Comparing four instances of “leave”

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<tbody>
<tr>
<td>leave for early retirement</td>
<td>depart, exit, go, resign, opt, withdraw, deter</td>
</tr>
<tr>
<td>leave the bar</td>
<td>depart, exit, desert</td>
</tr>
<tr>
<td>leave the U.S.</td>
<td>depart, exit, disembark, emigrate</td>
</tr>
<tr>
<td>leave university training</td>
<td>Depart, abandon, quit, finish, stop, discontinue, flee</td>
</tr>
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Sometimes substitutes are really not paraphrases

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<td>Come on, I have something to show you</td>
<td>present, give, bestow, offer, amuse</td>
</tr>
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Substitutes do not even fit the same syntactic structure, but are contextually plausible.
Wide context plays a role

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<td>I mean, where do the dryads fit in a place like this?</td>
<td>spot, residence, occupation, location, habitat, society, world</td>
</tr>
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“world” is not a synonym of “place”, but if we are speaking of dryads, we are most likely in a Fantasy context.

Error here: “occupation”
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<tr>
<td>Now, how can I help the elegantly mannered friend of my Nepthys and his surprising</td>
<td>dependent, person,</td>
</tr>
<tr>
<td>young charge?</td>
<td><em>task, lass, protégé, effort, companion</em></td>
</tr>
<tr>
<td>The distinctive whuffle of pleasure rippled through the betas on the bridge, and</td>
<td>dependent, command,</td>
</tr>
<tr>
<td>Rakal let loose a small growl, as if to caution his charges against false hope.</td>
<td><em>accusation,</em> <em>private, companion, follower,</em> <em>subordinate, prisoner,</em></td>
</tr>
<tr>
<td></td>
<td><em>teammate,</em> <em>ward, junior, underling,</em> <em>enemy,</em> <em>group,</em> <em>crew,</em> <em>squad,</em></td>
</tr>
<tr>
<td></td>
<td><em>troop,</em> <em>team,</em> <em>kid</em></td>
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Note context effect: *protégé* versus *underling*
A dramatic sentence with dramatic context effects

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<tr>
<td>My fear is that she would live, and I would learn that I had lost her long before Emil Malaquez translated her into a thing that can be kept, admired, and loved.</td>
<td>preserve, retain, hold, fix, store, own, possess, enshrine, stage</td>
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“Other” substitutes: more fine-grained characterization of the situation than WordNet-related substitutes

In FrameNet, Retaining (with “keep”) does inherit from Possession (with “own”, “possess”).
More than one word sense activated

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<td>I clapped her shoulder to show I was not laughing at her.</td>
<td>demonstrate, express, establish, indicate, prove, convey, imply, display, disclose, clarify</td>
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- WordNet show.2: prove, demonstrate
  - FrameNet: Evidence, Reasoning
- WordNet show.6: express
More than one word sense activated

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<td>He jumped at my arm while I was still off-balance, and I felt the surge of adrenaline that comes right when your body realizes that it’s too late to save itself.</td>
<td>feel, experience, sense, perceive, notice, detect, realize</td>
</tr>
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- FrameNet Perception_experience: feel, detect, experience, perceive
- FrameNet Becoming_aware: detect, perceive, notice
Further analysis of lexical substitution data

- Are parasets different, or just more fine-grained?
- Evaluate like a word clustering problem
  - WordNet (extended) synsets: Gold standard clusters
  - Parasets: “Predicted” clusters
  - Evaluation: Average cluster purity
    - Accuracy of each cluster compared to its best-match gold class

```
synsets
w1
w2
w3
w4
w5

parasets
w2
w3
w4

purity: 1/1 = 1.0
purity: 2/3 = 0.66
```
Paraset purity with respect to WordNet synsets

- Cluster purity is 75.1% for verbs, 81.2% for nouns
  - Surprisingly high
- Parasets make the same “major sense distinctions” as synsets
  - but describe more fine-grained meaning modulation
How similar are parasets that map to the same sense?

• Purity analysis maps parasets to best WordNet sense
• How similar are parasets that map to the same sense?
• Common core: intersection of parasets with same sense
  • Mostly non-empty (86% of cases)
  • May go beyond the synset
  • About quarter to third of substitutes shared among same-sense parasets
• Non-shared substitutes:
  • Contextual modulation
  • Small-sample effects
Some questions

• **How specific should frames be?**

• …if we want to find the interpretive frames necessary for understanding a sentence?

• Does “keep” need a “person as precious thing to be owned” frame with “possess” and “enshrine” as other LUs?

• Not possible for FrameNet as a resource

• But what does a listener need to know to understand the sentence?
Some questions

- Sense boundary issues
- All those closely related uses of “leave”
- Instances with more than one sense being prominent

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<td>prove, express, …</td>
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- Fillmore 1982, “climb”
- Parasets with partial overlap
Sense boundary issues

- Senses/frames as
  - prototypes with fuzzy boundaries
  - local maxima in a instance landscape (Kawamoto 1988, Murphy 2002)

- Modeling this:
  This is where distributional models come in

- Studying this: Lexical substitutes
Some questions

- Who evoked that frame?

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<td>…where do the dryads fit in a <strong>place</strong> like this?</td>
<td>world, …</td>
</tr>
<tr>
<td>…translated her into a thing that can be <strong>kept</strong>…</td>
<td>own, possess, enshrine, stage, …</td>
</tr>
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- How best to describe why a frame is relevant for sentence: Is it just the LU that introduces the frame?
  - Context can effect large change in perceived sense
Who evoked that frame?

- McRae and Matsuki 2009: “People use their knowledge of common events to understand language, and do so as quickly as possible”
- Effect of general event knowledge on expected words and constructions
- “thing to be kept” example: Integration of frame introduced by situation, and frame introduced by “keep”? 
Some questions

- Lexical substitution is a useful annotation paradigm:
  - Non-expert annotators
  - Fine-grained meaning annotation
  - Parasets that can be further analyzed automatically

- Can this be used to aid frame creation?