

Abstract Meaning Representation of Constructions: The More We Include, the Better the Representation



Claire Bonial (Army Research Lab),
Bianca Badarau (SDL), Kira Griffitt (Linguistic Data Consortium),
Ulf Hermjakob, Kevin Knight (USC Information Sciences Institute)
Tim O’Gorman, Martha Palmer (University of Colorado Boulder)
Nathan Schneider (Georgetown University)

LREC

10 May 2018

Introduction

Where does meaning come from?

- Individual words **compose** meaning

**Lexical
Predicate**

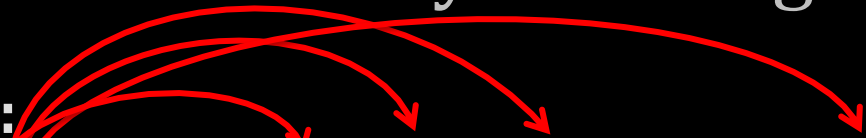
She moved the foam off her cappuccino
NP. Agent NP. Theme PP. Path



- Flexible templates (compatible with certain words) can also carry meaning

**Construction:
Caused-Motion**

She moved the foam off her cappuccino
NP. Agent Verb NP. Theme PP. Path



Introduction

Where does meaning come from?

Why does this matter?

NLP Impact:

- What do we store in a computational lexicon?
- Semantic Role Labeling / Syntactic Parsing:
What do we assume are predicates and arguments of those predicates?

Introduction

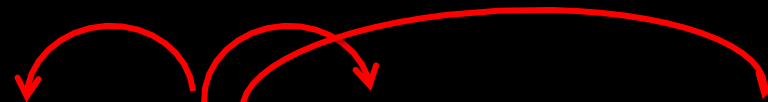
What do we store in a computational lexicon?

What do I consider predicates and their args?

- Individual words

**Lexical
Predicate**

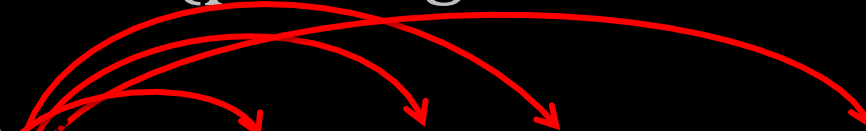
She moved the foam off her cappuccino
NP. Agent NP. Theme PP. Path



- Constructions (pairing of form + meaning)

**Construction:
Caused-Motion**

She moved the foam off her cappuccino
NP. Agent Verb NP. Theme PP. Path



Introduction

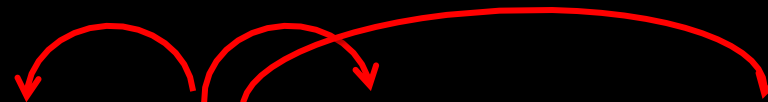
What do we store in a computational lexicon?

What do I consider predicates and their args?

- Individual words

**Lexical
Predicate**

She moved the foam off her cappuccino
NP. Agent NP. Theme PP. Path



- Constructions (pairing of form + meaning)

**Construction:
Caused-Motion**

She sneezed the foam off her cappuccino
NP. Agent Verb NP. Theme PP. Path



Background: Constructions

She sneezed the foam off her cappuccino.

- Sneeze.01 (typically intransitive)
 - Arg0: sneezer
- Caused Motion Construction
 - Mover, moved, path

Argument Structure Constructions:
productive patterns, licensing verb
and arguments



Argument Structure Constructions: Goldberg, 1995

Research Problem

How can we extend the Abstract Meaning Representation (AMR) to account for meaning stemming from constructions?

Background: AMR

- Goals:
 - creating large-scale semantics bank
 - simple structures, like Penn Treebank
- Supporting research in:
 - semantic parsing
 - natural language generation
 - machine translation
- *70 plus research papers use AMR!*

Background: AMR

*AMR **assigns** semantic roles of individual lexical predicates.*

- Assign.01 from PropBank “Rolesets”
 - ARG0 (assigner): *AMR*
 - ARG1 (assigned) : *semantic roles*
 - ARG2 (assigned-to): *individual lexical predicates*

PropBank: Palmer et al., 2005; <http://propank.github.io>

Background: AMR

AMR assigns semantic roles...

*AMR **assignment** of semantic roles of individual lexical predicates...*

should represent concepts and relations consistently, despite syntactic differences.

- Assignment → Assign.01
 - ARG0 (assigner): *AMR*
 - ARG1 (assigned) : *semantic roles*
 - ARG2 (assigned-to): *individual lexical predicates*

AMR Approach to Constructions

The more we include, the better the representation.

- Include.01, representation → represent.01, better → good.02
- Gap in representation: Correlation

Annotating constructions required a novel approach...

AMR Approach to Constructions

1. Exploiting lexical predicate rolesets in combination with modifier roles (e.g., Source, Destination), addition of implicit predicates (e.g., Cause-01, Move-01)
 - Where existing AMR machinery provides adequate coverage of constructional meaning
2. Adding constructional rolesets
 - Where existing AMR machinery does not adequately capture semantics, and/or
 - We can add a single construction roleset in lieu of many individual lexical rolesets

Exploiting Lexical Rolesets

- Intransitive Motion Construction:

Rumble-01

Arg0: entity rumbling
Arg1: sound/utterance
Arg2: hearer

2. The troops rumbled along the main road.

```
(r / rumble-01
  :ARG0 (t / troop)
  :path (e / along
        :op1 (r2 / road
              :mod (m / main))))
```

- Caused-Motion Construction:

Blink-01

Arg0: blinker
Arg1: eyes (usually unstated)

3. He blinked the snow off his eyelashes.

```
(b / blink-01
  :ARG0 (h/ he))
  :ARG0-of (c5 / cause-01
    :ARG1 (m2 / move-01
      :ARG1 (s / snow)
      :source (e / eyelash
        :part-of h))))
```

i.e. *He blinked, the blinking caused the snow to move from his eyelashes.*

Adding Constructional Rolesets

- Degree-Related Constructions – Have-Degree-91:
 - Comparison
 - Superlative
 - Degree-consequence
- Quantity-Related Constructions – Have-Quant-91:
 - Comparison
 - Superlative
 - Quantity-consequence
- The X-er, The Y-er – Correlate-91
- Comparing Resemblance – Have-Degree-of-Resemblance-91

Degree-Related Constructions

Have-Degree-91

Arg1: domain, entity characterized by attribute

Arg2: attribute (e.g. tall)

Arg3: degree itself (e.g. more/most, less/least, equal)

Arg4: compared-to

Arg5: superlative: reference to superset

Arg6: consequence, result of degree

Comparative:

4. The girl is taller than the boy.

(h / have-degree-91

:ARG1 (g / girl)

:ARG2 (t / tall)

:ARG3 (m / more)

:ARG4 (b / boy))

i.e. *The girl is more tall compared to the boy.*

Superlative:

5. She is the tallest girl on the team.

(h / have-degree-91

:ARG1 (s / she)

:ARG2 (t / tall)

:ARG3 (m / most)

:ARG5 (g / girl

:ARG0-of (h2 / have-org-role-91

:ARG1 (t2 / team))))

i.e. *She is the most tall of the girls on the team.*

Degree-Related Constructions

Have-Degree-91

Arg1: domain, entity characterized by attribute

Arg2: attribute (e.g. tall)

Arg3: degree itself (e.g. more/most, less/least, equal)

Arg4: compared-to

Arg5: superlative: reference to superset

Arg6: consequence, result of degree

Degree-Consequence:
*The watch is too wide;
therefore, it does not
fit my wrist.*

*I was too tired to
drive.*

```
6. The watch is too wide for my wrist.  
  (h / have-degree-91  
    :ARG1 (w / watch)  
    :ARG2 (w2 / wide-02  
      :ARG1 w)  
    :ARG3 (t / too)  
    :ARG6 (f / fit-06  
      :ARG1 w  
      :ARG2 (w3 / wrist  
        :part-of (i / i))))
```


The X-er, The Y-er

Correlate-91

Arg1: X, degree/quant word modifying first item changing in relation to Arg2

Arg2: Y, degree/quant word modifying second item changing in relation to Arg1

10. The longer he is around, the more miserable I will be.

(c / correlate-91

:ARG1 (m2 / more

:ARG3-of (h2 / have-degree-91

:ARG1 (b / be-located-at-91

:ARG1 (h / he)

:ARG2 (a / around))

:ARG2 (l2 / long-03

:ARG1 b)))

:ARG2 (m3 / more

:ARG3-of (h3 / have-degree-91

:ARG1 (i / i)

:ARG2 (m / miserable))))

i.e. An increase in how long he is around correlates with an increase in how miserable I am.

Evaluation, Implementation

- New guidelines, rolesets piloted on ‘Challenge Set’
 - 50 sentences from AMR 2.0
 - Selected using keyword searches, manual analysis
 - Represents variety of degree/quantity related constructions
 - Includes tricky cases with clear inconsistencies in past annotation
- Double annotated: 1 CU annotator, 1 SDL annotator
- Agreement: 88.6% (‘smatch’ score (Cai and Knight, 2013))
- Manual retrofitting of approximately 4700 annotations

Conclusions, Future Work

- AMR 3.0 release 2018
 - 59783 total AMRs
 - 6112 instances of degree/quantity-based constructions
- Coverage of constructional semantics: a layer of meaning critical for translation, natural language understanding
 - 4 construction entries added to the AMR lexicon
 - 5 distinct constructions
- Deepening AMR...
 - More constructions?
 - Aspect, Modality

Use Case	Roleset/Relation	Count
Downtoners, intensifiers	Degree	4547
Comparison, superlative, degree-consequence	Have-Degree-91	4943
Comparison, superlative, quantity-consequence, quantity reification	Have-Quant-91	1122
Comparing resemblances	Have-Degree-of-Resemblance-91	9
The X-er, The Y-er	Correlate-91	38

Multi-sentence

thank you

Collaborators



Bianca Badarau



Kira Griffitt



Ulf Hermjakob



Kevin Knight



University of Colorado **Boulder**



Martha Palmer



Tim O'Gorman



Nathan Schneider

Background: Constructions

Alternative: Additional senses of lexical predicates (e.g., caused-motion sense of *sneeze*)

The child pulled her foot out of the boot.

Gary talked me into a corner.

They booed the clown off the stage.

She blinked the snow off her eyelashes.

Caused Motion: *She sneezed the foam off her cappuccino*

Syntax: NP V NP PP

Semantics: Agent V Theme Initial Location

Research Problem

Where does meaning come from?

Lexical Semantics

pull

*They **pulled** the clown off the stage.*

motion boo

*They **booed** the clown off the stage.*

motion blink

*He **blinked** the snow off his eyelashes.*

tall, modifier

*She is as **tall** as her brother.*

adverbial, sell

*The lower the price, the more you'll **sell**.*

Constructional Semantics

Caused-Motion

Caused-Motion

Caused-Motion

Comparison

Correlation

- To be comprehensive, Abstract Meaning Representation must include both lexical, constructional semantics

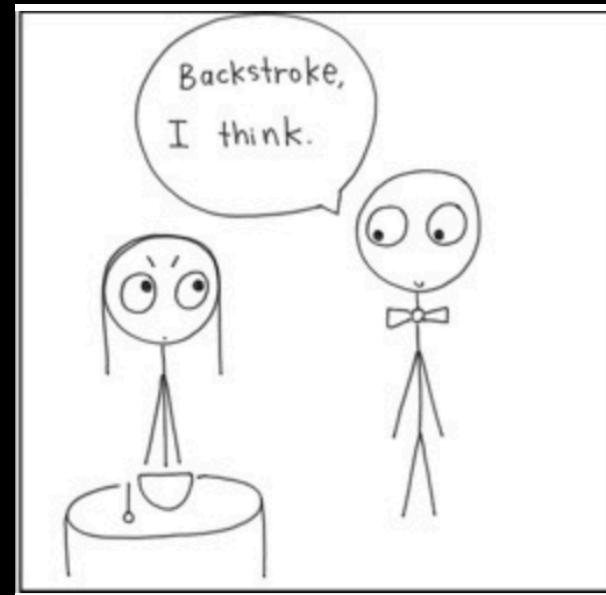
Background: Constructions

Constructions: prefabricated parts, templates; pairing of form and meaning arising out of individual discourse experience.



Compositional:
WH-Question

Constructional:
Surprise,
Disapproval



Construction Grammar: Hopper, 1998; MacWhinney, 2001; Bybee and McClelland, 2005; Fillmore et al., 1988; Kay and Fillmore, 1999; Michaelis and Lambrecht, 1996.