Semantic Theory

Lexical Semantics IV

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Event Semantics for Adjuncts

The gardener killed the baron at midnight in the park

$\Rightarrow \exists e[\ kill(e,g,b) \wedge time(e, m) \wedge location(e, p)\ ]$

$\lambda y \lambda x \lambda e.\ kill(e,x,y)$

A Related Problem?

The window broke
A rock broke the window
John broke the window with a rock

$break_3(x,y,z) \models break_2(z,y) \models break_1(y)$

The plane flew to Frankfurt
John flew the plane to Frankfurt
John flew Bill with the plane to Frankfurt

$fly_4(x,y,z,u) \models fly_3(z,y,u) \models fly_2(y,u)$

Verb alternations

- We call this phenomenon syntactic alternation, or (more traditionally) diathesis.
- Some more syntactic alternations:

  John sells the book.
  The book sells for 19.95€.

  Mary reads the book
  The book reads easy.

- Some syntactic alternations form regular grammatical patterns, e.g., passivization, dative shift.

Thematic Roles (Fillmore 1968)

- Thematic roles describe the conceptual participants in a situation in a generic way, independent from their grammatical realization.
- More technically speaking: Thematic roles provide a semantic characterisation of specific argument positions in a predicate-argument structure.
- A typical role inventory might contain :
  - Agent, Theme (Patient, Object),Recipient, Instrument, Source, Goal

Role Annotation Examples

- *[The window]$_{pat}$ broke*
- *[A rock]$_{inst}$ broke [the window]$_{pat}$*
- *[John]$_{ag}$ broke [the window]$_{pat}$ [with a rock]$_{inst}$*

Role linking

- The process that maps syntactic functions to semantic roles is called "role linking" or just "linking".
- An example:

break3: Subj → *Agent*
AccObj → *Patient*
PrepObj → *Instrument*

break2: Subj → *Instrument*
AccObj → *Patient*

break1: Subj → *Patient*

Linking: Grammar or Lexicon?

- Role information is part of the grammar: Role linking regularities can be systematically described. Example:
  - The agent takes the subject position.
  - In the absence of an agent, the instrument takes the subject position.
  - In the absence of agent and instrument, the theme takes the subject position.
- Role information is part of the lexicon: Role linking information is stated explicitly for each lemma.
- Providing grammatical theories for role linking has been a challenge for theoretical linguists. For practical purposes of correct wide-coverage grammar engineering the lexicon is the more useful alternative.

Integrating Roles into Logic

- Treat complements analogously to adjuncts in Davidsonian Semantics:
- Thematic roles are two-place relations between the event denoted by the verb, and an argument role filler.
- The event verb itself is just a one-place predicate taking an event as argument.
- Examples:

  John broke the window with a rock

  ⇒ ∃e [break(e) ∧ ag(e,j) ∧ pat(e,w) ∧ inst (e,r)]

  The gardener killed the baron at midnight in the park

  ⇒ ∃e [kill(e) ∧ ag(e,g) ∧ pat(e,b) ∧ time(e,m) ∧ location(e,p)]
- This analysis is called „Neo-Davidsonian“ or „radical Davidsonian“ event semantics.
- Semantic information can be partitioned into minimal pieces of information: One-place predicates and two-place relations.

Thematic Roles 2

- Thematic roles describe the conceptual participants in a situation in a generic way, independent from their grammatical realization.
- More technically speaking: Thematic roles provide a semantic characterisation of specific argument positions in a predicate-argument structure.

The role concept is more powerful:

- It allows to generalize over and relate different predicates that are used to describe a specific situation.

Thematic Roles 2

Mary gave Peter the book
Peter received the book from Mary

John sold the car to Bill for 3,000€
Bill bought the car from John for 3,000€

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Thematic Roles

- Capture syntactic verb alternations: equvalent uses with different realization of "the same" semantic argument positions.
- Allow to represent the semantic correspondence between (uses of) relational concepts in a systematic way – thereby supporting basic lexical-semantic inference.
- Support a systematic representation of the mapping between syntactic complements and semantic argument positions (role-linking).
- Support the systematic description of selectional preferences and constraints (e.g.: Agent is animate, Source and Goal are locations)
- Support the encoding and application of additional inference rules.

The Role Dilemma

- According to Filllmore (1968), thematic roles form a small, closed, and universally applicable inventory conceptual argument types.
- A typical role inventory might consist of the roles: Agent, Theme (Patient, Object),Recipient, Instrument, Source, Goal, Beneficiary, Experiencer.

But_

- A closed inventory of 8 or 12 or even 20 roles is not sufficient to describe the wealth of predicate-argument relations.

Options:

- Use role names in a more or less arbitrary way, or:
- Assume a much greater role inventory, e.g.: Use different roles for every verb (modulo Alternation)

Frame Semantics

- Structured schemata representing complex prototypical situations, events, and actions are the basic inventory for the conceptual modelling of the world. These are called frames.
- Frames are „evoked“ by NL expressions,typically content words (also called frame-evoking elements (FEEs) or target words).
- Thematic roles are neither universal nor lemma-specific: Role specifications have local validity for the target words of a frame (therefore also called frame elements/ FEs).

Example Frames

- Frame: REQUEST

  Frame Elements: SPEAKER, ADDRESSEE, MESSAGE, MEDIUM, ...

  Lexical Units: *appeal.n, ask.v, beg.v, beseech.v, call.v, command.n, command.v, demand.n, demand.v, entreat.v, entreaty.n, implore.v, invite.v, order.n, order.v, petition.n, plea.n, plead.v, request.n, request.v, suggestion.n, summon.v, tell.v, urge.v*

- Frame: COMMERCE

  Frame Elements: BUYER, SELLER, GOODS, ...

  Lexical Units: *auction.v, retail.v, retailer.n, sale.n, sell.v, vend.v, vendor.n*

An Example

- Airbus sells five A380 planes to China Southern for 220 million Euro
- China Southern buys five A380 planes from Airbus for 220 million Euro
- Airbus arranged with China Southern for the sale of five A380 planes at a price of 220 million Euro
- Five A380 planes will go for 220 million Euro to China Southern

An Example

Common frame-semantic Analysis:

Frame: COMMERCIAL_TRANSACTION
SELLER: Airbus
BUYER: China Southern
GOODS: five A380 planes
PRICE: 220 million Euro

Event-Semantic representation

$\exists e$ [COMMERCIAL_TRANSACTION(e) $\wedge$
seller(e, Airbus) $\wedge$ buyer(e,C.S.) $\wedge$
goods (e, 5_A380) $\wedge$ price (e,220m€)]

The Berkeley FrameNet Database

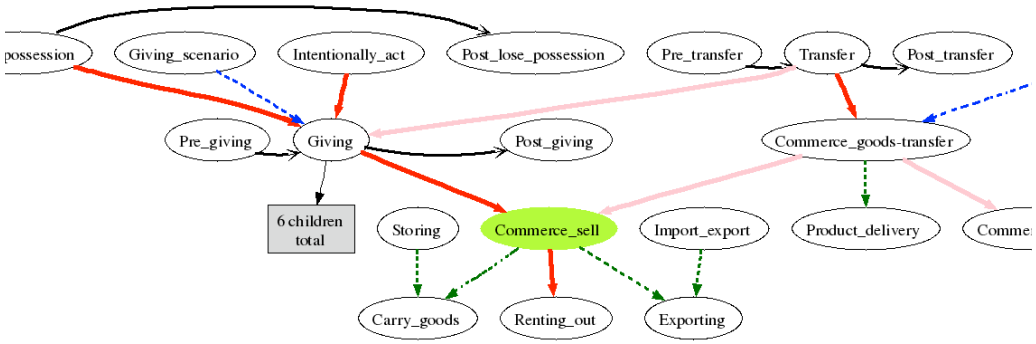
The FrameNet database consists of:

- A data-base of frames with
  - Descriptions of frames with inventory of Roles/Frame elements and associated lemmas
  - Frame-to-Frame Relations
- A lexicon with
  - Frame information
  - Grammatical realisation patterns (role linking information)
  - Annotations of example sentences (from BNC) for all use variants of words

The Berkeley FrameNet Database

- Current release: 700 frames, about 10,000 lexical units (mostly verbs)
- Planned: A total of 15000 verb descriptions
- http://framenet.icsi.berkeley.edu/

Frame-to-Frame Relations



Levin's Verb Classes

Margaret cut the bread
Janet broke the vase
Terry touched the cat
Carla hit the door

middle alternation
The bread cuts easily
Crystal vases break easily
*Cats touch easily
*Doors hit easily

conative alternation
Margaret cut at the bread
*Janet broke at the vase
*Terry touched at the cat
Carla hit at the door

body-part possessor ascension alternation
Margaret cut Bill on the arm
*Janet broke Bill on the finger
Terry touched Bill on the shoulder
Carla hit Bill on the back

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PropBank

- PropBank: Annotation of Penn TreeBank with predicate-argument structure. Verbs come with individual roles.
- Generalisation over alternation patterns of single verbs (the *break* case).
- No generalisation across lexeme boundaries (the *give/receive* case).
- Efficient annotation process, high inter-annotator agreement

PropBank Example: expect

Roles:

Arg0: expecter
Arg1: thing expected

Example: Transitive, active:

Portfolio managers expect further declines in interest rates.

Arg0:	Portfolio managers
REL:	expect
Arg1:	further declines in interest rates

(Slides taken over from Baker/Hajic/Palmer/Pinkal, ACL 2004)

PropBank example: *give*

Roles:

Arg0: giver
Arg1: thing given
Arg2: entity given to

Example: double object

The executives gave the chefs a standing ovation.

Arg0:	*The executives*
REL:	*gave*
Arg2:	*the chefs*
Arg1:	*a standing ovation*

PropBank: Comments

- Role assignment is to some part motivated by syntactic structure.
- No cross-lexical generalisations
- Cross-lingual generalisation is difficult
- This is illustrated by the following “Trends in argment numbering“, taken from annotators guidelines
  - Arg0 = agent
  - Arg1 = direct object / theme / patient
  - Arg2 = indirect object / benefactive / instrument / attribute / end state
  - Arg3 = start point / benefactive / instrument / attribute
  - Arg4 = end point