

Concord and Contribution Constraints in Lexical Semantics

or:

Redundancy in Semantic Role Marking

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Kutaisi 2011

Outline

1 Introduction

2 Selected PPs

- Type of selected PPs
- The status of Type AB prepositions
- Frames and selected prepositions

3 Lexical Resource Semantics (LRS)

- Background
- Concord and contribution in operator combinatorics
- Lexical semantics in LRS
- Comparison to frames

4 LRS Analysis of selected PPs

5 Summary and discussion: Integrating frames?

Topic

- *speak*-frame in FrameNet (framenet.icsi.berkeley.edu/):

<i>speak-on-topic</i>
SPEAKER
AUDIENCE
TOPIC

- Representation with “conjoined decompositional predicates”:
speak(*e*) \wedge **Speaker**(*e*, *x*) \wedge **Audience**(*e*, *y*) \wedge **Topic**(*e*, *z*)
- Syntactic realization of the **topic**:

- (1)
- a. They **talked** about/ of/ * \emptyset / *in this issue.
 - b. They **discussed** about/ *of/ \emptyset / *in this issue.
 - c. They are **interested** *about/ *of/ * \emptyset / in this issue.

Research questions

- Transparent and plausible semantics for head and dependent?
- How to combine the contribution of a dependent with that of the head?
- Role of frames and role of conjoined decompositional predicate representation?

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 - Background
 - Concord and contribution in operator combinatorics
 - Lexical semantics in LRS
 - Comparison to frames
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Outline

1 Introduction

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- Type of selected PPs
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- Background
- Concord and contribution in operator combinatorics
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- Comparison to frames

4 LRS Analysis of selected PPs

5 Summary and discussion: Integrating frames?

Outline

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 - Type of selected PPs
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 - Frames and selected prepositions
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Three types of selected PPs

Tseng (2000): *The Representation and Selection of Prepositions*, Ph.D. thesis. University of Edinburgh.

- Type A: preposition makes independent contribution to the meaning; preposition is relatively free.
 - Type B: preposition makes no contribution to the meaning; preposition is fixed.
 - Type AB: prepositions makes contribution to the meaning; preposition is fixed.
- (2)
- a. Type A: Alex **put** the book **on/ under** the table.
 - b. Type B: Everyone **picked on/ *under** the new student.
 - c. Type AB: Pat **knocked at/ *by** the door.

The status of topic prepositions

- *of*: Type B

(3) We talked **of** this incident last night.

a. free predicative use: * This book is **of** Georgia.

b. passive: This incident was talked **of** a lot last year.

systematically marks complement PPs, but doesn't specify a semantic role.

- *about*: Type AB

(4) We talked **about** this incident last night.

a. free predicative use: This book is **about** Georgia.

b. passive: This incident was talked **about** a lot last year.

systematically marks complement PPs and specifies a topic-role.

- *talk*:
 - ▶ syntactic selection: $NP_x, PP[of|about]_y$
 - ▶ semantic contribution: $\mathbf{talk}(e) \wedge \mathbf{Speaker}(e, x) \wedge \mathbf{Topic}(e, y)$
- PP[*of*]: *y*
Type B preposition; no redundancy
- PP[*about*]: $\dots \wedge \mathbf{Topic}(e, y)$
Type AB preposition; redundant marking of the Topic role

Other predicates with topic role

discuss:

- *discuss*:
 - ▶ syntactic selection: $NP_x, NP_y | PP[about]_y$
 - ▶ semantic contribution: $\mathbf{discuss}(e) \wedge \mathbf{Speaker}(e, x) \wedge \mathbf{Topic}(e, y)$
- $NP_y: y$
no redundancy
- $PP[about]_y: \dots \wedge \mathbf{Topic}(e, y)$
Type AB preposition; redundant encoding

be interested in:

- *interested*:
 - ▶ syntactic selection: $NP_x, PP[in]_y$
 - ▶ semantic contribution:
 $\mathbf{interest}(e) \wedge \mathbf{Experiencer}(e, x) \wedge \mathbf{Topic}(e, y)$
- $PP[in]_y: y$
Type B preposition; no redundancy

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The semantics of Type AB prepositions

- Type AB prepositions always make redundant semantic contributions.
- Arguments for this
 - ▶ *be-* verbs in German
 - ▶ Selected PPs in Esperanto
 - ▶ *durch* PPs in German

German *sprechen* ('speak/talk')

- (5) Wir **sprachen** *(über) das Thema.
we talked about the topic

● Analysis 1:

- ▶ *sprechen*:
syntactic selection: $NP_x, PP[über]_y$
semantic contribution: **talk**(e) \wedge **Speaker**(e, x)
- ▶ $PP[über]$: Type A preposition?
non-redundant meaning contribution

● Analysis 2:

- ▶ *sprechen*:
syntactic selection: $NP_x, PP[über]_y$
semantic contribution: **talk**(e) \wedge **Speaker**(e, x) \wedge **Topic**(e, y)
- ▶ $PP[über]$: Type AB preposition
redundant meaning contribution

German *sprechen* ('speak/talk')

- (6) a. Wir **sprachen** *(über) das Thema.
we talked about the topic
- b. Wir **be-sprachen** (*über) das Thema.
we be-talked (about) the topic

- *be*-V (Günther, 1986; Wunderlich, 1987)
- Pattern: $NP_x PP_y V \mapsto NP_x NP_y be\text{-}V$
- Type of PP: Type AB: see (6)

(7) Type B:

- a. Sie **wachten** über die Stadt.
they kept watch over the city
- b. Sie **be-wachten** die Stadt.

- *be*- does not change the semantic contribution, only the syntactic selection frame.
- Analysis 1 is to be preferred.

Remark: *be-* with Type A prepositions

- Different syntactic pattern:

$NP_x NP_y PP_z V \mapsto NP_x NP_z PP[mit]_y be-V$

(8) Type A preposition with transitive verb:

a. Alex *legte* Bücher *auf das Sofa*.

Alex put (in laying position) books on the sofa

b. Alex *belegte das Sofa* mit Büchern.

Alex be-put the sofa with books

(9) Type A preposition with intransitive verb:

a. Alex *lag* *auf dem Sofa*.

Alex was laying on the sofa

b. *Alex *be-lag das Sofa*.

Selected PPs in Esperanto

- English: typically Type A or Type B
Esperanto (Zamenhof, 1905): mainly Type A or Type AB
- All selected PPs that express topic take *pri* ('about'):
diskuti (pri) ('discuss'), *paroli (pri)* ('speak'), *interesiĝi (pri)* ('be interested'), *plendi (pri)* ('complain'), ...
- Only Type B preposition: *je*

(10) Ili **atendis je/** *por/ *al/ *pri la buso.
they waited *je/* for/ to/ about the bus

- Sometimes: variation between Type AB preposition and *je*:

(11) Ili **kulpigis min je/ pri/ pro** sabotaĝo.
they accused me *je/* about/ because of sabotage

- Clear distinction between Type AB and Type B preposition would be obscured if we assumed an empty

Solstad (2007): German *durch* ('through')

- (12) a. Ein Polizist wurde **durch** einen Schuss **getötet**.
a policemen was through a shot killed
- b. Ohnesorg **starb durch** einen gezielten Schuss.
Ohnesorg died through an accurate shot

- *durch* can express a cause.
- Redundant marking of causation with predicates like *kill*.
- Non-redundant marking of causation with predicates like *die*.

Summary: Redundant marking with selected prepositions

- Type AB prepositions:
 - ▶ Optionally redundant marking: *discuss* (\emptyset /*about*), *talk* (*of/about*)
 - ▶ Obligatorily redundant marking: *sprechen* (*über*)
- Type B prepositions/ NP arguments:
 - ▶ Obligatory non-marking at the dependent:
besprechen, *interested* (*in*)
- Type A prepositions:
 - ▶ Obligatory non-marking at the head:
lay (*somewhere*), *put* (*s.th. somewhere*)

Type AB prepositions always involve redundant marking.
Can we ignore their semantics?

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Frames for the predicates

- All possible arguments, properties of a concept are present in the frame.
- Frames capture the common semantic properties of predicates, independently of their concrete realization.
- Hierarchical organization (*talk* is a subframe of *communicate*, . . .)
- Syntactic arguments are linked to semantic roles. Semantic roles are a subset of the frame elements.
- PP type is largely not predictable from the underlying frame.

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- Background
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- Comparison to frames

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Outline

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- Frames and selected prepositions

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Head-Driven Phrase Structure Grammar (HPSG)

- Pollard and Sag (1994)
- Formalism:
 - ▶ model-theoretic grammar
 - ▶ feature structures as modelling objects: sorted, directed graph with labeled edges and possible re-entrancies (including cyclicity)
 - ▶ grammar: set of constraints on feature structures
- Sign-based:

[PHON	<i>phonological representation</i>]
	[CATEGORY <i>syntactic category, valence, ...</i>	
SYNSEM	CONTENT <i>semantic representation</i>	
	CONTEXT <i>pragmatics</i>	
DAUGHTERS	<i>constituent structure</i>	

Underspecified Combinatorial Semantics

- Underspecified semantics (Reyle, 1993; Pinkal, 1996; Egg, 2002; Kallmeyer and Romero, 2008)
 - ▶ scope relations are left underspecified
 - ▶ meaning contribution: lists of partially specified expressions of a semantic representation language
- In HPSG: Frank and Reyle (1995); Egg (1998); Copestake et al. (1995, 2005)
- *Lexical Resource Semantics* (LRS) Richter and Sailer (2004)
 - ▶ readings: semantic representations that contain exactly the meaning contributions of the elements in the sentence.
 - ▶ constraints restrict possible readings

Combinatorial Semantics of LRS

- Use of a standard semantic representation language
- Different words may contribute identical parts to the overall reading.
- Identity of operators: question, negation, tense (see Frank's talk!)
- Example: Negation in German and Afrikaans

(13) **Niemand** hat **nichts** gesehen. (German, double negation)
nobody has nothing seen
 $\neg\exists x(\mathbf{person}(x) \wedge \neg\exists y(\mathbf{thing}(y) \wedge \exists e(\mathbf{see}(e, x, y))))$

(14) **Niemand** het **niks** gesien nie. (Afrikaans, single negation)
nobody has nothing seen not
 $\neg\exists x(\mathbf{person}(x) \wedge \exists y(\mathbf{thing}(y) \wedge \exists e(\mathbf{see}(e, x, y))))$

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Negation contribution and redundancy

- N-words contribute negation:

- (15) a. Wer hat angerufen? Niemand. (German)
 who has called? nobody
 b. Wie het gebel? Niemand. (Afrikaans)

- n-words: nobody, niemand, nikto, personne, af exad, ... :

- ▶ Intuitively: $\neg(\dots \exists x(\mathbf{person}(x) \wedge \dots)) \dots$
- ▶ Semantic parts: $\langle \neg\alpha, \exists x\beta, x, (\gamma \wedge \delta), \mathbf{person}(x), \mathbf{person} \rangle$
- ▶ Subexpression constraints ($\phi \triangleleft \psi$: ϕ is a subexpression of ψ):
 $\beta \triangleleft \alpha, (\gamma \wedge \delta) \triangleleft \beta, \mathbf{person}(x) \triangleleft \gamma$

Deriving the negation readings

- n-words: nobody, niemand, nikto, personne, af exad, . . . :
 - ▶ Semantic parts: $\langle \neg\alpha, \exists x\beta, x, (\gamma \wedge \delta), \mathbf{person}(x), \mathbf{person} \rangle$
 - ▶ Subexpression constraints:
 $\beta \triangleleft \alpha, (\gamma \wedge \delta) \triangleleft \beta, \mathbf{person}(x) \triangleleft \gamma$
- nothing, nichts, niks, nic, rien, klum, . . . :
 - ▶ Semantic parts: $\langle \neg\alpha', \exists y\beta', y, (\gamma' \wedge \delta'), \mathbf{thing}(y), \mathbf{thing} \rangle$
 - ▶ Subexpression constraints:
 $\beta' \triangleleft \alpha', (\gamma' \wedge \delta') \triangleleft \beta', \mathbf{thing}(y) \triangleleft \gamma'$
- Verb: see, sehen, sien, . . . :
 - ▶ Intuitively: $\exists e(\dots \mathbf{see}(e, x, y) \dots)$
 - ▶ Semantic parts: $\langle \exists e\phi, e, \mathbf{see}(e, x, y), \mathbf{see} \rangle$
 - ▶ Subexpression constraints: $\mathbf{see}(e, x, y) \triangleleft \phi$

Deriving the negation readings

- Semantic parts in the sentence:

$\left\langle \begin{array}{l} \neg\alpha, \exists x\beta, x, (\gamma \wedge \delta), \mathbf{person}(x), \mathbf{person}, \\ \neg\alpha', \exists y\beta', y, (\gamma' \wedge \delta'), \mathbf{thing}(y), \mathbf{thing}, \\ \exists e\phi, e, \mathbf{see}(e, x, y), \mathbf{see} \end{array} \right\rangle$

- Double negation reading:

$\neg\exists x(\mathbf{person}(x) \wedge \neg\exists y(\mathbf{thing}(y) \wedge \exists e(\mathbf{see}(e, x, y))))$

$\alpha = \exists x\beta,$ $\beta = (\gamma \wedge \delta),$ $\gamma = \mathbf{person}(x),$ $\delta = \neg\alpha',$
 $\alpha' = \exists y\beta',$ $\beta' = (\gamma' \wedge \delta'),$ $\gamma' = \mathbf{thing}(y),$ $\delta' = \exists e\phi,$
 $\phi = \mathbf{see}(e, x, y)$

Deriving the negation readings

- Semantic parts in the sentence:

$$\left\langle \begin{array}{l} \neg\alpha, \exists x\beta, x, (\gamma \wedge \delta), \mathbf{person}(x), \mathbf{person}, \\ \neg\alpha', \exists y\beta', y, (\gamma' \wedge \delta'), \mathbf{thing}(y), \mathbf{thing}, \\ \exists e\phi, e, \mathbf{see}(e, x, y), \mathbf{see} \end{array} \right\rangle$$

- Single negation reading:

$$\neg\exists x(\mathbf{person}(x) \wedge \exists y(\mathbf{thing}(y) \wedge \exists e(\mathbf{see}(e, x, y))))$$
$$\begin{array}{llll} \alpha = \alpha' = \exists x\beta, & \beta = (\gamma \wedge \delta), & \gamma = \mathbf{person}(x), & \delta = \exists y\beta', \\ & \beta' = (\gamma' \wedge \delta'), & \gamma' = \mathbf{thing}(y), & \delta' = \exists e\phi, \\ \phi = \mathbf{see}(e, x, y) & & & \end{array}$$

Typological differences

Richter and Sailer (2006)

- *Negation Faithfulness Constraint* (German):
No two signs may contribute the same negation.
⇒ No redundancy; strict double negation language
- *Negation Complexity Constraint* (Afrikaans, Polish):
There may not be more than one negation that takes scope over the semantic contribution of the main verb.
⇒ Redundancy: strict negative concord language
- Unmarked case (French): none of the constraints.
⇒ Optional redundancy: optional negative concord language

LRS: The possibility of redundant marking is a core property of natural language semantic combinatorics.

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 - Background
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 - **Lexical semantics in LRS**
 - Comparison to frames
- 4 LRS Analysis of selected PPs
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Outline

1 Introduction

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- Type of selected PPs
- The status of Type AB prepositions
- Frames and selected prepositions

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Frames

- Similar formal foundations as feature structures (Petersen, 2007)
- Frames represent concepts.
- Representation of lexical semantic content with attributes and values rather than in with “conjoined decompositional predicates”
- LRS lexical semantics:
 - ▶ emphasis on the syntax-semantics interface
 - ▶ extend mechanisms from operator semantics to lexical semantics
- Frames:
 - ▶ emphasis on the semantic-conceptual interface
 - ▶ extend lexical semantic mechanisms to the clausal level

Outline

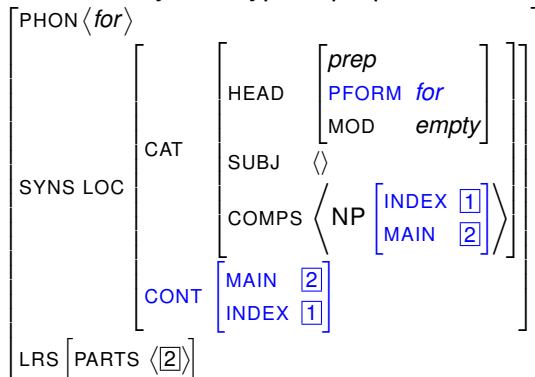
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- 2 Selected PPs
 - Type of selected PPs
 - The status of Type AB prepositions
 - Frames and selected prepositions
- 3 Lexical Resource Semantics (LRS)
 - Background
 - Concord and contribution in operator combinatorics
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 - Comparison to frames
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LRS Analysis of selected PPs

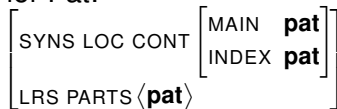
- Syntax based on Tseng (2000)
- Example analysis of *wait for* (Type B)
- Example analysis of *talk about* (Type AB)

Type B: preposition

- Lexical entry of a Type B preposition:

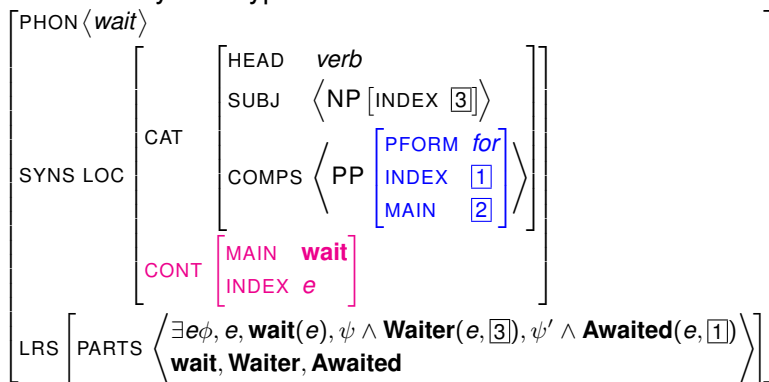


- for Pat:



Type B: selecting predicate

- Lexical entry of a Type B selector:



- wait for Pat



Type AB: preposition

- Lexical entry of a Type AB preposition:

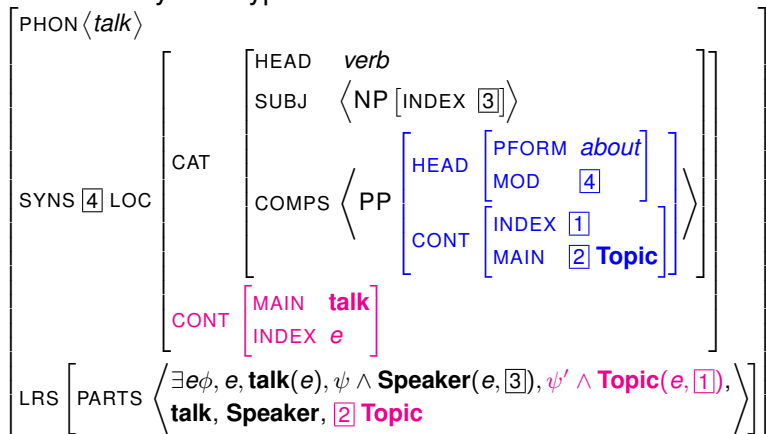
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LRS	\langle PARTS \langle $\alpha \wedge$ Topic ([2], [1]), Topic ([2], [1]), Topic \rangle \rangle																	

- about Pat:

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LRS PARTS	\langle $\alpha \wedge$ Topic ([2], pat), Topic ([2], pat), Topic , pat \rangle							

Type AB: selecting predicate

- Lexical entry of a Type AB selector:



Type AB: preposition

- talked about Pat

$$\left[\text{LRS} \left[\text{PARTS} \left\langle \begin{array}{l} \exists e \phi, e, \text{talk}(e), \psi \wedge \text{Speaker}(e, \text{pat}), \psi' \wedge \text{Topic}(e, \text{pat}), \\ \text{talk, Speaker, } \boxed{2} \text{Topic,} \\ \alpha \wedge \text{Topic}(e, \text{pat}), \boxed{2} \text{Topic, pat} \end{array} \right\rangle \right] \right]$$

- Alex talked about Pat

$$\left[\text{LRS} \left[\text{PARTS} \left\langle \begin{array}{l} \exists e \phi, e, \text{talk}(e), \psi \wedge \text{Speaker}(e, \text{alex}), \psi' \wedge \text{Topic}(e, \text{pat}), \\ \text{talk, Speaker, } \boxed{2} \text{Topic,} \\ \alpha \wedge \text{Topic}(e, \text{pat}), \boxed{2} \text{Topic, pat} \\ \text{alex} \end{array} \right\rangle \right] \right]$$

- Reading: $\exists e(\text{talk}(e) \wedge \text{Speaker}(e, \text{alex}) \wedge \text{Topic}(e, \text{pat}))$

- Redundancy: $(\alpha \wedge \text{Topic}(e, \text{pat})) = (\phi' \wedge \text{Topic}(e, \text{pat}))$

- Uniqueness of Thematic Roles Principle:*

For each referential variable x and each thematic role predicate Θ :
There may be at most one occurrence of $\Theta(x, \dots)$ in the logical form of an utterance.

Summary of the LRS treatment

- Syntactic analysis based on Tseng (2000)
- Type B preposition:
 - ▶ PFORM value
 - ▶ inherits its entire content from its NP complement
- Type AB preposition:
 - ▶ PFORM value
 - ▶ inherits its index from its NP complement
 - ▶ has its own main content
 - ▶ redundancy enforced by the selector
- Type A preposition:
 - ▶ no special PFORM value
 - ▶ inherits its index from its MOD value
 - ▶ has its own main content
 - ▶ modifies its selector
- *Uniqueness of Thematic Roles Principle* enforces identities.
- Redundancy follows from the LRS mechanism.

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Double role of frames

- Concept to lexical semantics (“underlying frame”)
 - ▶ Attributes in frames are the conceptual basis for semantic roles
 - ▶ Formalism: only HPSG-compatible part of the formalism needed.
- Overt dependents to conceptual interpretation:
 - ▶ Frames provide the information for the interpretation of conceptual shifts, vaguenesses, polysemy, meronymy, ...

(16) Gamerschlag and Petersen (2010)

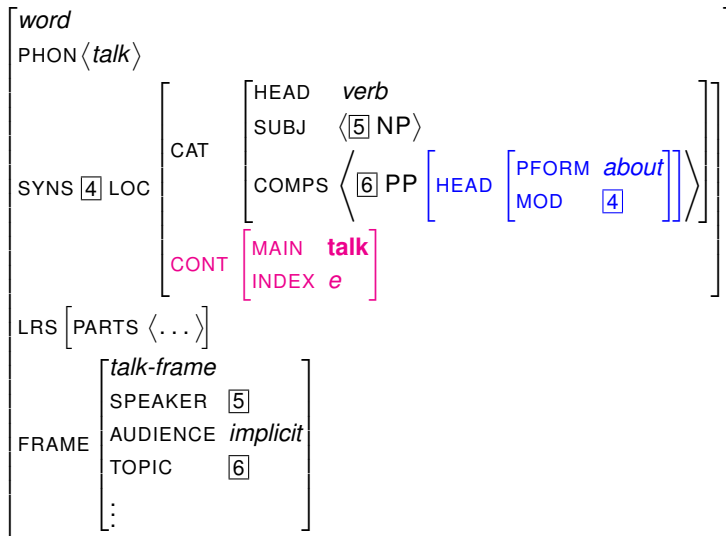
- a. Die Melone klingt dumpf.
the melon sounds muffled
- b. Die Melone klingt reif.
the melon sounds ripe

- ▶ Formalism: relies on properties beyond the HPSG-compatible

Integrating “underlying frames”

- Integrate FrameNet (Fillmore et al., 2003) or other approach
- Attribute FRAME defined on lexical items (no need for percolation)
- Sort hierarchy for frames
(*talk-frame* is a subsort of *communication-frame*)
- Attributes for all possible *frame elements*
- Values for these attributes:
 - ▶ obligatoriness:
implicit: non-overt;
synsem: to be overtly realized
...
 - ▶ selectional restrictions?
...
- “Underlying frame” contributes conceptual knowledge but does not contribute directly to the truth-conditional interpretation.
Needed to allow for differences between “underlying frame” and actual interpretation.

Sketch for *talk*



Summary

- Redundancy is a standard option in natural language semantic combinatorics, attested in both operator semantics (negation) and in semantic role marking.
- Redundancy can be enforced or forbidden by lexical specifications or well-formedness conditions on semantic representations.
- LRS can handle redundancies and non-redundancies in a natural way.
- Contrastive considerations of a frame semantic system
- Speculation: Possible way to integrate a frame approach into HPSG and to link it to an LRS combinatorics
- Open question: “second role” of frames and grammar?

Thank you for your attention!

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