Sense Extension Functions in Lexical Semantics

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Abstract

Representing polysemy in an economical way is an issue of major importance within lexical semantics. Polysemy is found both within single lexical entries, and systematically in some lexical classes with common semantic properties. Prepositions in various languages are generally considered highly polysemic in an unpredictable way. The latter participate in what can be called systematic polysemy. This work is highly inspired by work as different as Pustejovsky [Pus91], Copestake and Briscoe [CB95], and Lakoff [Lak94].

I will sketch a framework or the fundamentals of a formalism in which important polysemic properties can be described. The interpretational semantics is built as typed lambda-calculus. This choice is not essential to the formalism, which might be extended to situation-theoretical notation and interpretation. Currently, situation-theoretical issues are not discussed within the framework.

It is briefly outlined how the lexical semantics as construed in this paper can be implemented in a typed feature structure formalism compatible to HPSG [PS94]. Accounts of various aspects of prepositional semantics are given in this formalism, with special emphasis on the Danish preposition med.

1 Systematic polysemy

Certain phenomena are usually referred to as polysemy. One such example is the well-known example by Pustejovsky [Pus91]:

(1) a. Mary enjoys the movie

   b. Mary enjoys watching the movie

The sentences (1a) and (1b) are synonymous, and in order to maintain compositionality and avoid multiple lexical entries for the verb **enjoy**, the semantics is accounted for by claiming that **enjoy**'s semantics ENJOY is a two-place predicate taking an event as its second argument. The noun **movie** belongs to a class of complex lexical entries that enables it to act semantically both as an event involving some watching and as a simple object that can be watched. The two senses are related by a process called *type-raising*. Movie and similar nouns obviously form a class, which can be represented in a hierarchical lexicon as being marked for susceptibility to type-raising.

The phenomenon is referred to as *logical metonymy* because the relation between a movie and the event of watching a movie can be judged to be familiar with usual metonymic relations pictured in (2), where the underlined NP's can be said to be interpreted identically in certain contexts.

(2) a. <u>Denmark</u> voted against the treaty

b. The majority of the Danish voters voted against the treaty

By accounting for the phenomenon in semantic terms, one does not have to posit that the syntactic difference between **the movie** and **watching the movie** should trigger different lexical entries of **enjoy**. Furthermore, enjoying different sorts of events can still be described by the same verb entry:

(3) Franz enjoyed the sausage

By inserting the semantics for typical events involving sausages into the semantics for **sausage**, one can infer that the semantics for the clause (3) contains some eating event.

2 Extending the scope: Lexical metaphor

Within theoretical linguistics, polysemy, metonymy and metaphor are traditionally regarded as if not out of bounds, then at least as marginal phenomena not worth paying too much attention to when describing the language system as it is typically construed by linguists. In computational linguistics it is often thought that such topics should be treated in an AI fashion, without employing the known structures of the linguistic system. In my view, polysemy constitutes an at least empirically indistinguishable part of the language systems. It is the norm rather than the exception that words are used in different but related senses. It is a lexicological challenge to account for a system within which the senses of every lexeme are related instead of just listing the various senses of the individual lexemes, in much the same sense as it is a challenge for the phonologist to state and arrange the phonemes of a language in a system stating generalizations on properties across sounds instead of listing the individual sounds.

The most general system in which all senses of all lexemes can be represented is not interesting for my purpose: construed as a feature-structure system the number of primitive features would have the same magnitude as the number of lexemes.

What one needs is a limited system with a few dimensions along which the sense extensions take place. As it is the case for any kind of linguistic categorization, such dimensions or features must be empirically motivated. This restricts the domain of the functions in question to be a quite narrow one. The sense extensions must be testable either in the cognitive/physical system or as a means to underpin grammatical generalizations.

The set of sense extension functions that apply to the whole range of lexical items is believed to be a very small, general one. One such function is the meronymic PART-OF function, which is present in Ray Jackendoff's [Jac91] and several other authors' accounts. Other, more special functions apply to special domains. Lexemes whose semantics have an inherent spatial and/or temporal structure like activity verbs and prepositions can have spatial functions applied to them.

I shall restrict myself to treat lexical metaphor. It is not yet clear to me whether or how phrasal metaphor should be described as a linguistic process.

According to [Lak94], one must distinguish between metaphor and metaphor *use*. Metaphor is here construed as a function between structured sense domains. Metaphor use is a pair containing a metaphor and a source sense. The metaphor is a mapping from source senses to target senses. Both source and target senses are linked to the same lexeme, i.e., they are expressible with the same phonology. Some target senses seem to recur more often than others; a linguist might judge some recurrent senses as *lexicalized metaphorical uses*, because they can be conventional and have achieved unpredictable connotations, use of the latter can be characterized as *creative metaphorical uses*. I emphasize that I can state nothing about the

psychological status of the senses nor whether the sense extension functions mirror how any senses come about in the mind of the language user. Just like phrase-structure rules in formal grammar are often understood as acceptability constraints on syntax, sense extension functions should be conceived of as formal relations between interpretations.

The lexicalized uses are parts of the language system according to which computational linguists might consider it worth to enable the computer to parse as well as generate.

The creative uses are highly relevant for parsing, but probably of minor importance with respect to computational generation, because computer users do not expect any kind of nonconventional creative behaviour from computers.

The important point is that both lexicalized and creative uses arguably can be described with the same set of functions, and only statistical methods can distinguish between the two.

The cognitivist approach states some metaphors in a quite elaborate hierarchical system [Lak94]. This system is highly interesting, certainly not because the cognitivist positions reflect the observations of vagueness that many linguists strive to account for, but simply because it forms an informal version of a strong hypothesis about interesting parts of the language system.

One well-known metaphor is TIME IS SPACE. I conceive of this metaphor as a sense extension function which is no less formally describable than what is usually the case within formal linguistics. Furthermore, it fulfills the testability requirement. The function is an instance of a general sense extension function that connects two partially isomorphic domains. In this case, the time domain is mapped onto one of the dimensions in the spatial domain. Actually, the time domain can be construed as a particular instance of a one-dimensional subdomain of the general three-dimensional spatial domain. With this construal, TIME IS SPACE is a reflexive metaphorical function, i.e., a function from a domain to the domain itself or a subdomain thereof.

Because the function is reflexive, the inverse metaphor SPACE IS TIME is automatically present. In other words, it is possible to view time as a trajectory in space, and thus communicate about time in spatial terms. Vice versa, one can communicate about space in temporal terms. You can express a distance by referring to the time it conventionally takes to travel it.

Because of the reflexive nature of the sense extension function, it is not very well argued that either time or space is the basic domain of the relevant prepositions. One could as well postulate that the basic domain is a one-dimensional ordered space, and apply trivial sense extension functions to evoke the attested uses. With the sketched method it is not possible to devise one basic sense. In this case, the choice of basic sense is arbitrary.

When applying sense-extension function to prepositional arguments, one can account for basic senses of prepositions in the following examples.

(4) a. Jeg bor 10 minutter fra universitetet
       'I live 10 minutes from the university'

    b. Toget standsede 8 minutter efter Helsinki
       'The train stopped 8 minutes after Helsinki'

    c. Vandet varede 10 kilometer
       'The water lasted 10 kilometres'

All the uses in (4) — which I cannot determine as lexicalized or creative — can be accounted for using the functions in (4').

(4′) a. PERIOD(x) → DISTANCE$(\varphi_a(x))$

 b. LOCATION(x) → MOMENT$(\varphi_b(x))$

 c. DISTANCE(x) → PERIOD$(\varphi_c(x))$

The first of these functions simply states that a sense of the type PERIOD is mapped to a derived sense of type DISTANCE. The argument x is the period, and the function φ_a is a physically dermined function that maps a certain period of time to the distance usually covered in that periode of time. The other functions can be described in a parallel way.

Polysemy is possible according to the TIME IS SPACE metaphor. (5) is ambiguous in the context of a train voyage that Peter performs every day. The PP '10 minutter efter Køge' can refer to (a) a location at which the train is usually located 10 minutes after leaving the station of Køge, and to (b) the time 10 minutes after the train leaves Køge, regardless of how far the train has actually gone.[1]

(5) Peter spiser altid sin madpakke 10 minutter efter Køge
 'Peter always eats his lunch 10 minutes after Køge'

The lexeme **fra** ('from') is stated to have the sense

(6) $([\lambda(a : \text{distance}).\lambda(b : \text{location}).(c : \text{location})| \textit{distance}(b,c) = a] : \text{sense})$

The lexeme **efter** ('after') is stated to have the sense

(7) $([\lambda(a : \text{period}).\lambda(b : \text{moment}).(c : \text{moment})| \textit{period}(b,c) = a] : \text{sense})$

The **til** ('to') and **før** ('before') senses are stated parallel to that.

(6) is nothing more than a typed lambda-expression stating that the mapping from pairs of lengths of paths and locations to locations with a certain cognitive or physical relation between them is a sense. The physical relation here is the one of *distance*.

Senses of spatio-temporal prepositions used without measures can be derived from the above senses.

2.1 Representing semantics and metaphor

Compositional rules combining syntax and semantics serve to fill in the proper arguments. Unfortunately, this paper leaves no space to describe the details concerning the syntax. However, I shall give a brief outline of the metaphor representation system implemented in a feature-structure calculus compatible with HPSG[2]

The tricky part is to give a formally operational definition of the notion of domains. I shall just sketch how the domains work in this paper.

Domains are not parts of semantics, but structured concepts to which the lexical semantics must adhere. Domains contain conditions that domain members must fulfill, and mappings between linguistically stated relations between items belonging to the domain and real-world relations. Domains are arranged in multiple inheritance hierarchies. This calls for an example.

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[1] (4b) suffers from the same structural ambiguity. Since the event only occurred once, it is not decidable whether one thinks of the time or the place of the event.

[2] The semantics is slightly deviant from the HPSG standard. For simplicity, it is assumed that a suitable representation of the interpretable semantics is a string of λ-expressions to be evaluated by a grammar-external device. The semantics of a phrase is built by concatenating the semantics of its constituents.

$$(8) \quad \overset{\text{1-dimension}}{\begin{bmatrix} \text{ORDER} & \top \\ \text{INTERVAL} & \top \end{bmatrix}}$$

$$\overset{\text{1-dim-space}}{\begin{bmatrix} \text{ORDER} & \lambda ab.a <_{spatial} b \\ \text{INTERVAL} & \lambda abc.|a -_{spatial} b| = c \end{bmatrix}} \qquad \overset{\text{time}}{\begin{bmatrix} \text{ORDER} & \lambda ab.a <_{temporal} b \\ \text{INTERVAL} & \lambda abc.|a -_{temporal} b| = c \end{bmatrix}}$$

Domains are represented as typed feature structures. The above definition (8) ensures — due to a general wellformedness criterion on typed feature structures — that all subdomains of *1-dimension* have the features ORDER and INTERVAL. The values of these features are interpretation functions relevant to the individual domains. The actual interpretation functions are here represented as λ-abstractions of logical expressions with domain-specific operators and real-world arguments. These arguments are projections of locations and times on domain-specific scales. The example is simplified, the interpretation functions should be typed λ-expressions.

The isomorphy crucial to the metaphorical sense extensions is represented in the wellformedness criterium to which the typed feature structures must conform. That is, metaphors exploiting 1-dimensional structure are functions between subdomains of the *1-dimension* domain.

The lexical entry of **før** is stated in (9). The DOMAIN feature constrains the semantic content of **før** to a function relevant to a particular domain. I have (arbitrarily) stated that the relational content of the lexical entry must adhere to the domain *time*. Structure-sharing (by the index [1]) implies that the value of the CONTENT feature is $\lambda abc.a <_{temporal} b$.

ARG1 and ARG2 contain the semantics of the subject and object of the preposition, respectively. We shall presently look away from the inconsistency regarding that subjects of temporal prepositions usually denote events, and the proposed representation is some representation of a moment.

The metaphor is represented as an HPSG-style *lexical rule* in (10). (10) applied to (9) yields the derived lexical entry (11), which contains the semantics of the spatial metaphorical use of **før**.

$$(9) \quad \begin{bmatrix} \text{PHON} & \text{før} \\ \text{SEM} & \begin{bmatrix} \text{DOMAIN} & \overset{time}{\begin{bmatrix} \text{ORDER} & [1] \end{bmatrix}} \\ \text{CONTENT} & [1]\,[2]\,[3] \\ \text{ARG1} & [2] \\ \text{ARG2} & [3] \end{bmatrix} \end{bmatrix}$$

$$(10) \quad \begin{bmatrix} \text{SEM} \mid \text{DOMAIN} & \textit{1-dimension} \end{bmatrix} \Rightarrow \begin{bmatrix} \text{SEM} \mid \text{DOMAIN} & \textit{1-dim-space} \end{bmatrix}$$

$$(11) \quad \begin{bmatrix} \text{PHON} & \text{før} \\ \text{SEM} & \begin{bmatrix} \text{DOMAIN} & \overset{\textit{1-dim-space}}{\begin{bmatrix} \text{ORDER} & [1]\lambda ab.a <_{spatial} b \end{bmatrix}} \\ \text{CONTENT} & [1]\,[2]\,[3] \\ \text{ARG1} & [2] \\ \text{ARG2} & [3] \end{bmatrix} \end{bmatrix}$$

The use of the type system ensures a parsimonious description, because the features values specific to every subdomain and common to various subdomains are stated only once, and because the domains and subdomains are common to several lexical entries.

The definition of the domain type system is in fact a cognitive theory itself, because it has to reflect the semantic features to which metaphor is judged to apply.

It stands as a link between the pure linguistic semantics and the truth-conditional interpretation functions by which the language describes the world.

As a first approximation of a theory of lexical metaphor, all lexical metaphors must be represented as instances of the lexical rule (12). The condition ensures that the domains α and β have one or more features in common, to secure isomorphy.

(12) $\left[\text{SEM} \mid \text{DOMAIN} \quad \alpha\right] \Rightarrow \left[\text{SEM} \mid \text{DOMAIN} \quad \beta\right], \; features(\alpha) \cap features\beta \neq \emptyset.$

The use of HPSG-like lexical rules in computer implementations is not unproblematic for known reasons, but such issues are outside the scope of the current treatment.

The arbitrary choice of basic sense of **før** has no ramifications for the account. If one chooses the abstract *l-dimension* as the basic domain for **før**, metaphors derived from (12) do the job of deriving the specific spatial and temporal senses. I am currently ignorant of how a theory should respond to these questions.

3   Sense extension in grammar

The highly polysemic Danish preposition **med** — largely translatable as English 'with' — is used in several syntactic contexts with different senses attached to it. The semantics is traditionally accounted for by positing either homonymy or combining very different semantic content with each syntactic construction. The latter approach is motivated by the fact that one typical sense of **med** resembles the IN-STRUMENTAL sense of the instrumental case in e.g. Slavonic languages. Often, if one sense is grammaticalized in one influential language, the scientific community will soon regard that sense as primitive in the semantic description of a number of other languages, whether or not that particular sense plays a role in the individual grammar. Instrumentality is not attested as a semantic element in Danish morphology. One cannot derive the other senses of **med** from the instrumental sense, so if the lexeme has one basic sense, it cannot be the instrumental sense.

Introspectively and by examining parts of a Danish written language corpus [Ber],I state the following senses.

<table>
<tr><td rowspan="10">(13)</td><td>a</td><td>Han slog hende med en hammer
'He hit her with a hammer'</td><td>Instrumental</td></tr>
<tr><td>b</td><td>Han læssede vognene med ost
'He loaded the trucks with cheese'</td><td>Incremental theme</td></tr>
<tr><td>c</td><td>Han vendte tilbage med succes
'He returned with success'</td><td>Circumstantial subjective predicate</td></tr>
<tr><td>d</td><td>Han øvede med sangerne[3]
'He had the singers practice'
(lit. 'He practiced with the singers')</td><td>Causative</td></tr>
<tr><td>e</td><td>Han gik til bal med sine venner
'He went to a ball with his friends'</td><td>Coagentive</td></tr>
<tr><td>f</td><td>konen med æggene
'The woman with the eggs'</td><td>Control, Proximity</td></tr>
<tr><td>g</td><td>pigen med det lyse hår
'The girl with the blond hair'</td><td>Part/Whole</td></tr>
<tr><td>h</td><td>Dansen med den slemme pige
'The dance with the naughty girl'</td><td>(Deverbal) Coagentive</td></tr>
<tr><td>i</td><td>Ulykken med den væltede tankvogn
'The accident with the overturned tanker'</td><td>Unspecified participation</td></tr>
</table>

The upper block (13a-e) shows use of **med** in prepositional phrases in verb-modifying positions, typically in the final part of clauses. The lower block shows (13f-i) prepositional phrases modifying a noun, i.e., contributing to a noun phrase.

The clausal uses of **med** often serve to express the state of a secondary agent to be related to the expressed action. This is quite contrary to the use of **med** in noun phrases, where control or contiguity between things is expressed.

But, the exceptions show that the interpretive choice between the event-participative and the noun-modifying sense is semantic rather than syntactic. In (13c) the object of the preposition clearly modifies the subject of the phrase, although it can also be said to describe the circumstances of the event. The fact that 'success' cannot really be counted as a participant triggers the adnominal sense.

In (13i), on the other hand, a tanker can only metaphorically be said to be 'a part of' an accident. The tanker is rather interpreted as participating in an unspecified role of the event of an accident. I cannot say whether the tanker caused the accident or its turning over was caused by it.

Med with deverbal nouns clearly can function as controlling the original prepositional object as in (13h). The particular sense is the same as if the preposition had been controlled by the original verb.

The instrumental sense is special, because the 'instrument' is often both participating (non-voluntarily) in an event and a part of the agent. That is the case when the agent uses a part of his body as instrument, as in (14).

(14) Hun sparkede professoren med sin højre fod
     'She kicked the professor with her right foot'

But what is expressed as new information is not that the foot is a part of the person, but that the foot is that part of the person which is utilized to perform the action. Thus, the controlling sense is the most important one.

Basically, the senses of **med** fall into two groups: Participating in events and describing physical objects.

Thus, superficially **med** is a preposition very different from the well-studied spatial ones, which keep their spatial sense in the adnominal use as well as in the adverbial and verbal-complementary uses.

3.1 Participative and adnominal senses

Interestingly, the predicative senses of **med** can be singled out by substituting [... A ... med B] with [B har A] — in English: [B 'has' A].

The rest of the senses are participative in the sense that they relate a *secondary participant* to the expressed action, which I will describe with semantic roles of a 'chain of action' as in [Cro93] and others.

The question is, of course, what has the 'have' relation got in common with the relation of a secondary participant.

The link between the senses becomes more obvious if one employs the notion of *accompaniment*. I shall shortly list some important circumstances of the participating senses.

Coagentivity Secondary participants often occur together with agents, which either control them or perform the action in company with them. Thus, the secondary participant can be part of the 'agentivity side' in the activity. When the secondary participant is coagentive with the agent (which is expressed as subject or object), the secondary participant is undergraded only for pragmatic reasons.

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[3] This construction also has the Coagentive sense.

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The expressed agent has no control of the secondary participant, and the agent and secondary participant are interchangeable.

The accompaniment relation between agent and secondary participant is clearly a meronymic relation between groups of individuals, and as such a subcase of a general PART-OF relation.

Instrumentality and incremental themes When the secondary participant is controlled by the agent and cannot be ascribed intentionality, it is harder to employ the notion of being part of the active side. The control part is more important than contiguity. Being an instrument also involves that employing the instrument for the intended purpose actually forms a part of the action. Thus, 'He hit her with a hammer' and 'The man with the hammer hit her' differ exactly on this point. The instrument interpretation is triggered by the fact that the preposional phrase is grammatically linked to a verb which is lexically specified for taking instruments of the relevant kind. '?He read the paper with a hammer' is not that reasonable.

The semantic role of *incremental theme* is mentioned in [Dow91]. Traditionally, separate accounts have been made of instrumentality and incremental themes, though it is very difficult to single out the differences between them. The verbal semantics decide whether a secondary participant is an instrument or an incremental theme. They have the same primitive semantic properties with respect to the agent, i.e., they are controlled by the agent and often propelled by the agent. This position is supported by the ambiguity of 'They loaded the trucks with shovels'.

The distinction between instrumentality and incremental thematicity is a lexical matter of the controlling verb, and I have not yet fulfilled the major lexical-semantic task of partitioning the verbs according to this distinction.

3.2 Causativity

The causative **med** constitutes a special problem. [Han71] states an extreme example:

(15) Jensen er nede i postkassen med et brev
     litt. 'Jensen is down in the mailbox with a letter'
     meaning 'Jensen performs an action making the letter go into the mailbox'

The secondary participant is simply undergoing the trajectory described in the predicate, leaving the agent with the only function of causing the event, if one does not consider the unlikely interpretation where the agent physically ends up in the mailbox.

The secondary participant overtakes the part of the agentive role from the agent, which the agent cannot possibly fulfill. This is a very special subcase of coagentivity, but it is governed by principles not related to the lexical semantics of **med**.

3.3 Adnominal senses

The important features in adnominal modification are contiguity, part/whole and control.

Typically the prepositional subject cognitively controls the prepositional object, as in (13f). Otherwise physical contiguity or attachment is present, as in (13g). In such cases the prepositional object is often part of the prepositional subject.

In cases when no control is involved, subject and object can be interchanged. This is a very fundamental issue that applies also to the coagentive cases. The

use of **med** in this case is simply pragmatically determined, and has the effect of undergrading the entity chosen as the prepositional object.

I am working on a more detailed account of these issues.

3.4   The lexical entry of med

I state the basic lexical sense of **med** as follows:

(16) $([\lambda(a : \text{entity}).\lambda(b : \text{entity}).a \text{ } controls \text{ } b \vee contiguous(a, b)] : \text{sense})$

The sense of **med** is the disjunction of a cognitive relation of *control* and a physical relation of *contiguity*. It is yet to be determined how control is to be accounted for. As for contiguity, a formal treatment of contiguity is stated in [Aur91].

The sense in (16) is capable of encompassing events, when the subject argument (the event) is type-raised in the style of Pustejovsky. The event must simply be type-raised to yield the agent of the event.

3.5   Representing med in a typed feature structure system

I shall give an overview of the implementation of **med** in a system like the one sketched in section 2.1.

To maintain a unified account of the semantics of adjuncts to clauses and nouns compatible to HPSG [PS94], let us assume that the basic template for preposition semantics is as in (17). The compositional semantics of the adjunction is the conjunction of the semantics of the head (②) (or subject) and the semantics of the adjunct. Let us furthermore assume that the basic lexical entry of **med** is as (18), which is a particular instance of (17). The somewhat clumsy λ-expression owes its disgrace to the general adjunction account. The entry in (18) is the one that accounts for adjunction to nouns. This very simple treatment does not account for more subtle differences between senses of **med**. It does not rely on any metaphorical description. Thus, the domain stated in (18) is just an all-purpose domain containing typical relations among animate and inanimate physical objects. Again, all typing in the interpretational λ-calculus is abstracted from. We shall not deal further with the actual interpretation functions. The variables ν_1, ν_2 are purely symbolic devices which feed the arguments with indices ② and ③ into both interpretation functions ⒈ₐ and ⒈♭.

$$
(17) \quad \left[\text{SEM} \begin{bmatrix} \text{CONT} & ② \wedge ① ② ③ \\ \text{ARG1} & ② \\ \text{ARG2} & ③ \end{bmatrix} \right]
$$

$$
(18) \quad \begin{bmatrix} \text{PHON} & \textbf{med} \\ \\ \text{SEM} & \begin{bmatrix} \text{DOMAIN} & \begin{bmatrix} \text{ACCOMPANIMENT} & \boxed{1a} \\ \text{CONTROL} & \boxed{1b} \end{bmatrix} \\ \quad phys\text{-}obj \\ \text{CONT} & ② \wedge \lambda\nu_1\nu_2.(\boxed{1a}\nu_1\nu_2 \vee \boxed{1b}\nu_1\nu_2) \, ② \, ③ \\ \text{ARG1} & ② \\ \text{ARG2} & ③ \end{bmatrix} \end{bmatrix}
$$

When **med-phrases** describe events, a metonymic sense extension function must be applied to raise the agent semantics up from the semantics of the subject clause. Such a sense extension function can be represented as in (19).

$$(19) \quad \left[\text{SEM} \left[\begin{array}{ll} \text{CONT} & \boxed{2} \wedge \boxed{1} \boxed{2} \boxed{3} \\ \text{ARG1} & \boxed{2}\left[\text{AGT } \boxed{4}\right] \end{array} \right] \right] \Rightarrow \left[\text{SEM} \mid \text{CONT} \quad \boxed{2} \wedge \boxed{1} \boxed{4} \boxed{3}\right]$$

This metonymic function seems applicable with other prepositions. One can imagine other metonymic functions. To account for the ambiguity of (20) related to the Danish preposition i, one needs a function which assumes e.g. a recipient role, and type-raises its semantics.

(20) Han sendte hende et brev i Stockholm
    'He sent her a letter in Stockholm'

4 Conclusion

The treatment of some lexical semantic properties as a very restricted part of metaphoric and metonymic theory accounts for some obvious problems in the current state of lexical semantics. This can to a large extent be done with Pustejovsky-style type-raising functions. Making the cognitivist assumptions more precise opens the possibility of covering much larger aspects of posited language systems than are usually done in computational linguistics.

Accounting for metaphors as a part of a NLP system seems to be valuable mainly in the parsing realm. Devices of the sketched kind will probably be judged as highly over-generating. This is due to the current public expectations to the language use in computer systems. Most creative metaphorical language is highly stilistically marked, and it is hard to imagine any commercial need for a system generating metaphorical language.

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