A COMPOSITIONAL SEMANTICS FOR LOCATIVES

CÉCILE MEIER

Frankfurt University
C.Meier@lingua.uni-frankfurt.de

Spatial expressions are usually interpreted as relations between two individuals (see e.g. Bierwisch 1996). I am going to argue that a smoother picture of the semantics of locatives arises if we assume that locative prepositional phrases refer to places. This move necessitates the introduction of variables for places into the formal language. I am going to show in detail that an analogous linguistic system underlies the reference to places and the reference to times. Locative modifiers may play the role of frame-setters restricting the reference place. They may set the place of the utterance or the place of an event, state or individual (in analogy to the so-called event time and speech time). Furthermore, expressions like **everywhere** and **nowhere** act as locative quantifiers. In my view, the overall architecture of locative semantics mirrors the properties of other quantificational domains and this view fits nicely into the program of *ontological symmetry* that Schlenker Schlenker 2005 has recently argued for.

1. Introduction

The compositionality of spatial expressions has not received too much attention in previous linguistic work. Most papers on locatives concentrate on the conceptual contribution of these expressions (see e.g. Tenbrink 2005 for a valuable survey). And, if they discuss the compositionality of locatives, the authors either only develop a semantics for the predicative use (see e.g. Winter and Zwarts 2000) or only for the modifier use (see e.g. Maienborn 2001) but there is no unified account for all types of grammatical functions, i.e. an account that includes the attributive use and the use as plain arguments.

Maienborn concludes on the basis of empirical data that there are three types of locative modifiers: so-called internal (or V-) and external (or VP-)modifiers and frame setters (or CP-modifiers). Syncategorematically, she introduces three rules of interpretation (named combinatorial templates). And she employs an idiosyncratic variant of variable assignment in order to derive the desired interpretations. Her account is problematic in several respects. In general, all three types of Maienborn's locative modifiers are introduced by the same prepositions in many languages. I know of no language that expresses the combinatorial templates explicitly. By usual

linguistic standards there is a generalization missing here. Why do we need the different interpretation mechanisms? A unified mechanism is preferable.

Life-time effects: It seems that so-called existence-dependent predicates localize an argument of the construction whereas existence independent predicates don't (see Musan 1997 for the notion of existence dependence with respect to temporal properties of individuals). In (1-a) Krause has to be in Spain at the time of his unhappiness in the past. In (1-b) Krause doesn't even have to be alive at the time of his fame in Spain (Examples from Klein 1991).

(1) a. Krause was unhappy in Spain.
b. Krause was popular in Spain.

Maienborn's account fails to explain this life-time effect, familiar from temporal semantics. I will argue that it depends on the semantics of the predicate and not the modifier and conceptual reasoning whether the subjects are localized in the domain of the spatial expression.

Event localization vs. individual localization: In example (2-a) the event of singing is localized in the bathtub, in (2-b) it is only the dog that is there.

(2) a. Jim sang the song in the bathtub.
b. Jim kept the dog in the bathtub.

In order to account for the effect that local adjuncts may have access to participants of a situation, Maienborn introduces a free variable in the logical form of the sentence that rather miraculously ends up having the correct assignment. In my account the correct refernce is part of the semantics of the predicate. (2-a), I am going to interpret as existence dependence of the subject and (2-b) as existence dependence of the object.

Localizing Object Parts: Moreover, some predicates introduce existential quantification over parts of their arguments. (3) is an example for this case. (3) means that there is a part of Jim's face that was red. My account is related to Musan's account of individual time slices but expresses the same information without enriching the ontology with partial individuals.

(3) Jim was red in the face.

Quantification: In Maienborn's account quantification over locations is not an issue. I am going to show that spatial quantificational expressions are best analyzed as relations between two predicates of places. Locative adverbs either restrict the nucleus of such tripartite structures or the restriction, dependent on the information structure of the sentence.

2. The Analysis

Ontology: I assume an ontology with individuals, times, worlds and spaces. Whereas times are the real numbers, spaces are triples of real numbers in the so-called three dimensional Euclidean space. Individuals might be located in this absolute space. I am following the tradition in linguistics by introducing an empirical function π that assigns an object its space with respect to a world and a time. Herweg and Wunderlich 1991 call this space (i.e. a set of spatial points) the *Eigenspace* occupied by the object in a world at a time; see also Kracht 2004 for a recent mathematically founded version of this concept. Individuals may continuously move over time. With Kracht, I call the space occupied by the object during the time interval the moving takes place its *region*. Regions are subsets of the set of triples of reals, as well. The role of the preposition is conceived as a function that assigns regions to regions (of objects). The preposition **in**, e.g., relates the Eigenspace of an object to the convex closure of the Eigenspace and returns the convex closure minus the Eigenspace of the object; see Kracht 2004. In other words, prepositions assign neighbourhoods to Eigenspaces of objects. They are conceived here as so-called neighbourhood functions; see Herweg and Wunderlich 1991 and Winter and Zwarts 2000 for the concept. Since it is not entirely clear up to now how to formalize the exact contribution to the meaning of the preposition I confine myself to the use of meta language representations for the prepositions.

Formal Language: the semantics uses the types e, t, w, i and p for entities, truth values, worlds, times and spaces. In addition to variables for entities, worlds and time, I introduce variables for spaces into the language. The interpretation function $[\![\ldots]\!]^c$ assigns denotations relative to a context of discourse c. In order to interpret complex configurations, I will use functional application, λ-abstraction and some sort of existential closure.

Locative denotations: Consider in a first step constructions with one-place predicates. In order to account for the life-time effect, I assume that some predicates trigger a presupposition regarding the existence of their argument. **Unhappy** for example depends on the existence of its argument.

(4) $[\![\textbf{unhappy}]\!]^c = \lambda < w, l, t > .\lambda a : a$ exists in w at t in l. x is unhappy in w at t in l.

Consider the sentence in (5-a). With the semantics for **unhappy** we want to make sure that Krause existed at the time in the past in question and that he was in Spain then and that he was unhappy. Intuitively the evaluation location (the location of Krauses unhappyness) is included in the reference location (the IN-location of Spain). (5-b) states these intuitive truth conditions where @ refers to the actual world.

(5) a. Krause was unhappy in Spain.
b. $\exists t^*[t^* \subseteq \text{PAST1} \;\&\; \exists l[l \subseteq \text{IN+}(\pi(\text{SPAIN}, t^*, @))$
$\&\; \text{UNHAPPY}(@, t^*, l)(\text{KRAUSE})]]$

Tense and aspect are interpreted as definites and semantic relations between properties of time and two times; see von Stechow 2002, for example.

(6) $[\![\text{PAST}_j]\!]^{g,c}$ = is defined if $g(j)$ precedes the speech time t_c. If defined, $[\![\text{PAST}_j]\!]^{g,c} = g(j)$.

(7) $[\![\text{PERFECTIVE}]\!]^c = \lambda P.\lambda t.\exists t'[t' \subseteq t \;\&\; P(t')]$

These elements occupy the Tense Phrase and the Aspect Phrase at the level of logical form. In analogy to the temporal domain, I am going to introduce semantic "aspectual" relations between locations and extra syntactic levels in the derivational tree: the ConP (Containment Phrase) and the LocP (Locative Phrase). The head of the first phrase hosts a predicate that I call SUP. This element introduces the containment relation between the location of the predicate (evaluation location) and the reference location and the location of the utterance respectively. They stand in the superset relation.

(8) $[\![\textbf{SUP}]\!]^c = \lambda l.\lambda l'[l' \subseteq l]$

Locative PPs denote reference locations and are definite. These locatives are situated in LocP that dominates ConP, as represented in (9).

(9) $[_{TP}$ PAST1 $[_{AspP}$ PFV $[_{LocP}$ in Spain $[_{ConP}$ SUP $[_{IP}$ Krause [unhappy]]]]]]

The denotation of the locative makes use of the neighbourhood function and the localization function.

(10) $[\![\textbf{in Spain}]\!]^c$ = the IN+-space of Spain in w at t
(= IN+$(\pi([\![\textbf{Spain}]\!], t, w))$)

The reading in (5-b) is derived by means of the lexical definitions and existential closure at the level of the Locative Phrase (LocP) and at the level of the Tense Phrase (TP). The denotation of the preposition is constructed by abstracting over the individual, the world and time variable.[1]

Universal quantification is defined as in (11). It relates two locative predicates.

(11) $[\![\textbf{everywhere}]\!]$(L)(P) = 1 gdw. $\forall l[L(l) \;\Rightarrow\; P(l)]$

(12) Krause was unhappy everywhere.

a. $[_{TP}$ PAST1 $[_{AspP}$ PFV [LocP everywhere $[_{LocP}$ C $[_{ConP}$ SUP $[_{IP}$ Krause [unhappy]]]]]]]

b. $\exists t$[PAST1 $\subseteq t \;\&\; \forall l[g(C) \supseteq l \;\Rightarrow\; \text{UNHAPPY}(@, t^*, l)(\text{KRAUSE})]]$

Constructions with predicates that do *not* show the life-time effect are defined as total and not as partial functions.[2]

[1] If the locative remains unarticulated the locative reference must be supplied by a free variable C.
[2] Predicates with different orientation trigger different presuppositions on their arguments.

(13) $[\![\textbf{popular}]\!]^c = \lambda < w, l, t > .\lambda a.\ x$ is popular in w at t in l.

Let us now turn to predicates of "zero arity" modified with a locative as exemplified in the sentence in (14).

(14) It is warm here.

The locative indexical **here** is conceived as the space that the speaker is talking about in the discourse; see Kratzer 1978 for the different uses of **here**, for example.

(15) $[\![\textbf{here}]\!]^c$ = the space that the speaker has in mind at the speech time t_c in the world of utterance w_c.

The zero arity predicate is a function that relates a triple of a world, time and space to a truth value.

(16) $[\![\textbf{warm}]\!]^c$(w,t,l) = 1 iff it is warm in w at t in l.

Present tense and imperfective aspect are defined as follows.

(17) $[\![\textbf{NOW}]\!]^c$ = the speech time t_c conceived as a point.

(18) $[\![\textbf{IMPERFECTIVE}]\!]^c = \lambda P.\lambda t.\lambda t'[t \subseteq t'\ \&\ P(t')]$

Intuitively, the sentence expresses the truth conditions in (19). The containment relation seems reversed (compared to constructions with one-place arguments). The location that counts as "here" in the discourse falls within the warm region.

(19) $\exists t[\text{NOW} \subseteq t\ \&\ \exists l[\text{HERE} \subseteq l\ \&\ \text{WARM}(@, l, t)]]$

In order to account for this, I propose the LF representation in (20) for the sentence in (14) with a predicate CAP as in (21) introducing the locational semantic relations.

(20) [$_{TP}$ NOW [$_{AspP}$ IPFV [$_{LocP}$ here [$_{ConP}$ CAP [$_{AP}$ warm]]]]]

(21) $[\![\textbf{CAP}]\!]^c = \lambda l.\lambda l'[l \cap l' \neq \emptyset]$

I have to admit at this point that I do not know what exactly governs the choice of SUP or CAP. But, I believe that it is a question of conceptual knowledge about space. If a locative designates an indivisible space, there is no difference between overlap and inclusion and the reading in (19) could be derived. In temporal semantics a similar fact is usually attributed to the aspectual class of the predicate. In eventives the evaluation time is included in the reference time and in statives it is the other way around. Some constructions (in particular predicative constructions in the present tense) allow for aspectual containment relations in both directions. In these cases, Kamp and Reyle 1993 attribute the differences to the semantic characteristics of the temporal adverb. Some adverbs refer to time spans that are conceived as indivisible (or punctual) and others are conceived to be divisible. In analogy we would have to

classify locations with respect to their divisibility. Whether more fine grained locational structures are available probably depends on experience and conceptualization and the goal of the discourse.

For location independent predicates, I assume that they attribute properties to spatial parts of the arguments.

(22) $[\![\textbf{red}]\!]^c = \lambda < w, t, l > .\lambda a.$There is a part x of a such that $\pi(x, t, w) \subseteq \pi(a, t, w)$ and x is red in w at t in l.

Acknowledgements

I am grateful for discussions with A. Brasevanu, M. Schwager, A. von Stechow, E. Zimmermann, and the participants of the Semantic Reading Group at Frankfurt University. All shortcomings are nevertheless mine.

Bibliography

Bierwisch, M.: 1996, How much space gets into language, in P. B. et.al. (ed.), *Language and Space*, pp 31–76, MIT Press, Cambridge

Herweg, M. and Wunderlich, D.: 1991, Lokale und direktionale, in *Ein internationales Handbuch zeitgenössischer Forschung*, pp 758–785, deGruyter, Berlin

Kamp, H. and Reyle, U.: 1993, *From Discourse to Logic*, Kluwer Academic Publishers, Dordrecht

Klein, W.: 1991, Raumausdrücke, *Linguistische Berichte* 132, 77–144

Kracht, M.: 2004, *Language and Space*, ms, UCLA, Los Angeles

Kratzer, A.: 1978, *Semantik der Rede. Kontexttheorie, Modalwrter, KonditionalsŁtze*, Scriptor, Kronberg

Maienborn, C.: 2001, On the position and interpretation of locative modifiers, *Natural Language Semantics* 9, 191–240

Musan, R.: 1997, Tense predicates and liefe time effects, *Natural Language Semantics* 5, 273–301

Schlenker, P.: 2005, *Ontological Symmetrie in Language: A breif Manifesto*, ms, 2005. To appear in Mind and Langague

Tenbrink, T.: 2005, *Semantics and Application of Spatial Dimensional Terms in Englsih and German*, Technical report, SFB/TR 8 Report No. 004-03/2005, UniversitŁt Bremen

von Stechow, A.: 2002, Temporal prepositional phrases with quantifiers: Some additions to pratt and francez (2001), *Linguistics and Philosophy* 25, 755–800

Winter, Y. and Zwarts, J.: 2000, Vector space semantics: A model theoretic analysis of locative prepositions, *Journal of Logic, Language and Information 9:171-213* 9, 171–213