

Restructuring restructuring

Simon Dobnik and Robin Cooper
Dept. of Philosophy, Linguistics and Theory of Science
University of Gothenburg
Box 200, 40 530 Göteborg, Sweden
simon.dobnik@gu.se, robin.cooper@ling.gu.se

June 2, 2016

1 Introduction

Not all infinitival constructions consisting of a matrix verb and a non-finite verb have the same syntactic and semantic properties. For example, modal verbs taking non-finite complements are operators that denote necessity or possibility of the event denoted by the non-finite complement, on the other hand verbs such as “forget” denote an event that is in some semantic relation to another event denoted by the complement non-finite verb. Studies show that there is a large number of verbs that are somewhere in between: in some cases they function as operators or modifiers of events denoted by their non-finite complement, in other cases they denote independent events. This is expressed syntactically by processes such as clustering of clitics, passive formation, scrambling, adverbial modification, and the scope of negation which in the former case operate in the domain of both verbs, but in the latter case are restricted to the domain of each verb. Historically, in order to account for such “long-distance processes” and to account for the variation where the same lexical item occurs in structures without the “long-distance processes”, it was proposed that some verbs or their syntactic projections undergo restructuring which can be either restructuring of their argument and event structure at the lexical level preceding syntactic projection or through structural changes to the syntactic configuration that these verbs are projected in.

Although there is no doubt that restructuring involves interfacing syntax with semantics it has been mostly seen as a syntactic phenomenon.¹ Dobnik (2003) argues along the lines mentioned above that different syntactic configurations also have distinct semantics which is otherwise also expected assuming that syntax drives semantic interpretation. He formalises analyses in a theory which intends to capture the interface between syntax and semantics (Ramchand, 2008) but which takes a syntactic perspective for its starting point. However, this still leaves some questions about semantics unanswered. In this paper we take a fresh look at restructuring within a semantic theory known as TTR or Type Theory with Records – Cooper, 2005a,b, 2012; Cooper and Ginzburg, 2015; Cooper, in prep. As semantic composition is driven by syntactic parsing this does not mean that we abandon or understate the contributions of syntax. Syntax plays the same role as before. The approach allows us to work with relatively simple syntactic representations that correspond to surface realisations of sentences and associate them with strict formal representations that capture their semantics.

¹But see for example Napoli (1981).

2 Restructuring in Slovenian

Let us first consider some examples of restructuring from Slovenian, a South Slavic language mainly spoken in Slovenia. (1) and (2) show examples of clustering of clitics which always cluster in the second clausal position known as the Wackernagel position (Wackernagel, 1892). In (1) the matrix verb is “nameravati” (intend) whereas in (2) the matrix verb is “načrtovati (plan). The examples in (1a, 2a) show a sentence with full lexical noun phrases, whereas (1b, 2b) and (1c, 2c) show sentences where these are replaced by pronoun clitics, once clustered in the domain of the complement non-finite verb *to buy* (non-restructuring, (1b, 2b)), and once clustered in the domain of the matrix verb (restructuring, (1c, 2c)). (1b, 1c) show that *intend* allows both options of clitic placement (non-restructuring and restructuring), but *plan* (2b, 2c) only allows clustering of clitics in the domain of the complement verb (non-restructuring) – (2c) is unacceptable. Note also that a modal verb like “morati” *must* would only allow a placement of clitics in the domain of the matrix verb (restructuring).

- (1) a. Janez je nameraval kupiti Mariji rože na tržnici.
John-NOM is intended to buy Mary-DAT flowers-ACC at market place
“John intended to buy Mary flowers at the market place.”
“John had a go at buying Mary flowers at the market place.”
- b. Janez je nameraval kupiti ji jih na tržnici.
John is intended to buy her them at market place
“John intended to buy them for her at the market place.”
- c. Janez ji jih je nameraval kupiti na tržnici.
John her them is intended to buy at market place
“John had a go at buying them for her at the market place.”
- (2) a. Janez je načrtoval kupiti Mariji rože na tržnici.
John-NOM is planned to buy Mary-DAT flowers-ACC at market place
“John planned to buy Mary flowers at the market place.”
#“John had a go at buying Mary flowers at the market place.”
- b. Janez je načrtoval kupiti ji jih na tržnici.
John is planned to buy her them at market place
“John planned to buy them for her at the market place.”
- c. #Janez ji jih je načrtoval kupiti na tržnici.
John her them is planned to buy at market place
#“John had a go at buying them for her at the market place.”

Here we would like to note that (1a), where the matrix verb is *intend*, is syntactically and semantically ambiguous, whereas (1b) and (1c) only allow one syntactic and semantic interpretation each. In (2a) on the other hand, where the matrix verb is *plan*, only the first reading is available which means that (2a) is also not syntactically ambiguous. Since only the second reading is available in (2c) and since *plan* does not allow this reading, we mark (2c) as semantically malformed. Traditionally, such examples would be marked as ungrammatical but we argue that the notion of ungrammaticality is not appropriate here. Structurally, there is nothing wrong with this sentence. In fact, its structure is identical to (1c). Furthermore, when we ask

for acceptability judgements of isolated examples of restructuring and non-restructuring sentences the answers appear to be dynamic.² Informants may occasionally change their intuitions for examples such as (2c) from initial unacceptable to acceptable. We argue that in this case they coerce the meaning of the verb such as *plan* into the interpretation that is licensed in this structural configuration. It appears then that *intend* lets itself coerce better than *plan* as it is acceptable in both structural configurations. The coercion of meaning given a particular structure supports our argument that it is structural configurations which compositionally determine the meaning of a sentence and that one needs to look at restructuring also from the semantic perspective.

In (1c) and (2c), restructuring configurations, we translate *intend* as “have a go at” but this is an over-simplification. The difference in semantics of restructuring and non-restructuring configurations is related to argument and event structure of verbs imposed by these configurations. We argue that with these two structural configurations we express fine-grained semantic distinctions that allow us to represent a particular view on situations we encounter. Therefore, in order to pin down their meaning, one needs to construct a wider situation and discourse context in which such sentences can be evaluated. Consider the following conversation:

- (3) A: Kaj pa rože? Kdo jih bo kupil?
 what PART flowers? who them will buy
 “What about flowers? Who is buying them?”
- B: Janez jih namerava kupiti jutri.
 John them intends to buy tomorrow
 “John intends to buy them tomorrow.”

The dialogue could be taken from some long-term event planning, e.g. a wedding. There has been a meeting previously where everyone was assigned a task, e.g. Janez to buy flowers. The dialogue takes place at some later time, at another meeting, where A is checking on the progress of the tasks that have been agreed upon and everyone should be engaged with. Janez is not present this time, otherwise he could have answered the question himself. B’s response indicates that Janez has committed to the event of flower-buying and to a certain degree he might have been engaged with the event – for example he might have already phoned several florists to check their offers – but the event of flower-buying will complete tomorrow when he will go to one of the florists, pay for the flowers and take them home. In contrast, a non-clitic climbing, non-restructuring version

- (4) B: Janez namerava kupiti jih jutri na tržnici.
 John intends to buy them tomorrow at market place
 “John is intending to buy them tomorrow at the market place.”

does not contain an implication that Janez has been engaged with buying flowers: intending and buying are distinct events. He might have said yesterday:

- (5) B: Flowers? Well, there’s still plenty of time. I can probably get them tomorrow at the market place.

The relation between the intending event and the buying event are vague. Such configurations are always interpreted with non-obligatory control as shown in (Dobnik, 2003, p.41–46). It is even possible that Janez has not yet committed to the flower-buying in which case he might have said something as the following:

²In addition to the author, the judgements of the examples in this paper have been confirmed by at least one other native speaker of Slovenian. Speakers come from or around Slovenj Gradec.

- (6) B: Flowers? ... Should I buy flowers? ... At the market place? ... Tomorrow?

It appears to be difficult to truth-conditionally pin down the difference between (3) and (4), for example with tests for entailment. This is because events are conceptual categories (or types, we will argue) and hence the same reality may be conceptualised by speakers as any number of events. Hence, there is a mereological problem of what part of reality constitutes an event. Events allow speakers to express different takes on reality, a view that is also represented by Smith (1991). When does the flower-buying start and when does it complete? When someone contemplates buying flowers, commits to buy flowers, googles for florists, walks to the market place, talks to a sales person, chooses a particular bunch of flowers from the sales person, receives the flowers, pays for them and walks home? Even if one chooses a particular extension for an event, one can later revise it: an event may be re-conceptualised as any number of sub-events or reversely any number of events may be re-conceptualised as a single event. According to the intuition of the author who is a native speaker, the event of flower-buying in (3) can start as early as the point in time when Janez committed to buy flowers. However, equally the same time-point may be included in the conceptualisation of a separate event from flower-buying which would make (4) true.

In isolated judgements native speakers prefer restructuring uses of *intend* (3) over non-restructuring ones (4). This can be attributed to a pragmatic fact. In (3) it is communicatively more relevant to report that Janez is engaged with the event of buying flowers than reporting that he is contemplating how he might carry out the event of flower-buying. Reporting about the state of events rather than cognitive states of individuals may be generally more common and hence a preference for (3).

In addition to clitic climbing, restructuring and non-restructuring configuration also differ in how mediopassive is formed. In mediopassive accusative case is assigned to the clitic pronoun *se* (“self”) which in this case does not have a reflexive interpretation to subject but instead that something acts onto subject. For this reason we prefer the term progressive passive. In restructuring configurations (7a and 8a), the direct object of the embedded non-finite complement becomes the subject of the matrix verb which does not assign its own argument (cf. 8a). The matrix verb now agrees in gender and number with the argument of the non-finite complement. The passivisation thus affects both verbs simultaneously, providing strong evidence that they belong to the same clausal domain. Restructuring (a) and non-restructuring (b) configurations exhibit the same semantic differences as previously discussed.

- (7) a. Rože *so se* morale kupiti.
 flowers-FEM,NOM are self-ACC must-PART,FEM to buy
 Lit. “The flowers had to buy themselves.”
 “They had to buy the flowers”
 “They must have bought the flowers.”
- b. Moralo *se* *je* kupiti rože.
 must-NEU,3P,SG self-ACC is to buy flowers-FEM,ACC
 “It was necessary the case that they bought the flowers.”
 “It must be the case that they bought the flowers.”
- (8) a. Rože *so se* nameravale kupiti.
 flowers-FEM,NOM are self-ACC intended-FEM to buy
 Lit. “The flowers intended to buy themselves.”
 “They had a go at buying flowers.”

- b. Nameravalo *se* *je* kupiti rože.
 intended-NEU,3P,SG self-ACC is to buy flowers-FEM,ACC
 “It was intended to buy flowers.”
 “They intended to buy flowers.”

Verbs such as *intend* also form the *se* passive independently of the embedded non-finite complement (8a). In this case the argument of the embedded verb receives accusative case demonstrating that the embedded verb is not affected by passivisation of the matrix verb. The matrix verb is lacking an agent argument and hence the subject of the matrix clause is realised as an anticipatory pronoun which is morphologically marked on the participle as a third person singular neuter, Slovenian being a *pro*-drop language. If we replace the verb *intend* with *plan* then only this construction is acceptable.

- (9) a. #Rože *so se* načrtovale kupiti.
 flowers-FEM,NOM are SE planned-FEM to buy
 Lit. “The flowers planned to buy themselves.”
 “#They had a go at buying flowers.”
- b. Načrtovalo *se je* kupiti rože.
 planned-NEU,3P,SG SE is to buy flowers-FEM,ACC
 “It was planned to buy flowers.”
 “They planned to buy flowers.”

Several other tests point to these differences between the usage of verbs like *intend* and *plan* in restructuring and non-restructuring configurations. These include non-focus scrambling, modification by temporal adverbs and the scope of negation. For examples and discussion of these the reader is referred to Dobnik (2003).

3 A syntactic approach

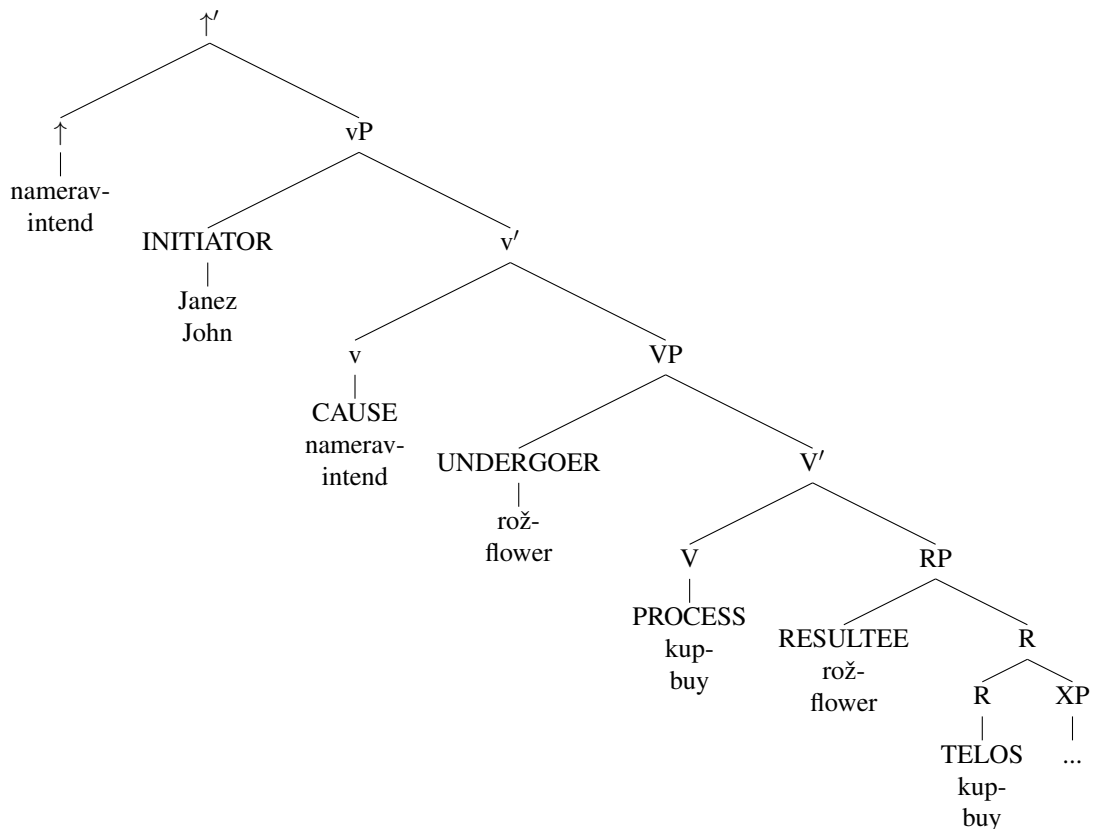
Rizzi (1976, 1978, 1982) and Aissen and Perlmutter (1976, 1983) propose that all matrix verbs with non-finite complements project the same initial structure consisting of two non-transparent domains, which in some cases can become *restructured* Rizzi (1976) or *reduced* Aissen and Perlmutter (1976) into a single domain. As a result, a clause union is achieved. Both proposals claim that syntactic restructuring affects the argument structure of both verbs. Subsequent analyses propose that clause union is derived through movement. Evers (1975a,b) proposes an adjunction of the complement verb to the matrix verb, and Kayne (1989, 1991) proposes that clauses are reduced by raising and merging of the non-finite complement inflectional head I to the matrix I. Roberts (1997, 1994) proposes that restructuring involves a morpho-syntactic process known as *incorporation* of the complement verb into the matrix verb, an idea similar to Evers (1975a) and Rizzi (1976).

An alternative to syntactic processes that involve changing of structure or movement is to assume that restructuring structures are syntactic domains from the start and are not derived. This approach requires us to postulate that certain non-finite verbs project in at least two different kinds of structural templates corresponding to restructuring and non-restructuring configurations. The selection preferences of verbs are explained by their lexical complementation properties. For example, DiSciullo and Williams (1987) argue that restructuring verbs and their non-finite complements are morphological compounds of type VV, yet such a view is problematic as such complexes may be interrupted by adverbs and only the matrix verb is inflected. Cinque (2006) proposes that ‘restructuring verbs’ semantically and syntactically correspond to

functional heads and thus require no arguments. Rosen (1990) argues that restructuring verbs are *light verbs* which take simple VP complements. Light verbs are similar to modal verbs and auxiliaries in a sense they do not license argument and event structure. They are different from them in the sense that they share the argument and event structure with the non-finite verb forming a complex predicate. According to Rosen the argument structure formation is a lexical and not a syntactic process. It is a dynamic process which tries to account for why we get light and non-light lexical variants of the same verb. Wurmbrand (2001) argues that one should distinguish at least two kinds of restructuring – *lexical* and *functional* restructuring configurations – and thus combines the ideas of Cinque (2006) and Rosen (1990). Functional restructuring configurations are those containing modal, aspectual, causative and motion matrix verbs that do not take any thematic arguments in addition to the complement non-finite phrase. On the other hand, lexical restructuring verbs take also a subject.

The preceding approaches say very little about the semantics of restructuring configurations and treat them more or less identically to non-restructuring ones. Dobnik (2003) demonstrates that restructuring configurations have a different argument and event structure than non-restructuring and therefore also different meanings. It follows that restructuring is a phenomenon that cannot be described sufficiently in syntactic theory alone but also requires an application of lexical morphology and semantics. Dobnik (2003) formulates analyses in the extension of the Minimalist syntactic theory (Chomsky, 1995) known as *First-Phase Syntax* (Ramchand, 2008) which tries to account for the derivation of semantic and morphological properties of verbal predicates through syntactic rules. For example, in (10) is the analysis we propose for a restructuring use of *intend*. The analysis states that the semantics of the arguments like *John* and *flowers* in this construction is determined in virtue of its being projected in particular structural positions such as INITIATOR, UNDERGOER and RESULTEE. A certain argument may be associated with several semantic roles and therefore projected in several positions. Following the principles of the Minimalist Program it is assumed that only one of these positions is realised in the surface form. The same holds for a verbal head *intend*. Its semantics are composed of a lexical semantics part, a CAUSE part and a functional part which adds intentionality (with an s) to the causative event in the sense that its success is undetermined. The example also shows that structural nodes also have a morphological character.

(10)



There are several problems with this analysis. For example, while attempting to encode semantics we have to insert into structural representations nodes that are not overtly observable, some of which are reduplications. As a result we need to postulate additional assumptions concerning how such structures are turned into surface forms. Secondly, we are forced to introduce abstract heads such as \uparrow , INITIATOR, CAUSE, UNDERGOER, PROCESS, RESULTEE and TELOS which correspond to universal concepts that make up verbal predicates. However, as argued by Pulman (2005) it is unclear what the semantics of such representations are. Furthermore, although such representations are a part of a tree structure, the structure itself does not fully explain how the semantics of the nodes are combined compositionally in a way done in Montague semantics (Montague, 1974; Dowty *et al.*, 1981). We believe that these questions can be answered by TTR to which we turn in the following section.

4 An approach using TTR

TTR is a *rich* type theory which has as its starting point ideas taken from Martin-Löf type theory (Martin-Löf, 1984; Nordström *et al.*, 1990). By “rich” we mean that this type theory does not just have types for basic ontological categories that are used in Montague semantics such as entities, truth values and all the possible function types that can be built up out of these types. Types in a rich type theory include types of objects like the type *Tree*, that is, a type to which any object that is a tree would belong. In addition there are types of events (situations)³ following a suggestion within type theory by Ranta (1994). Thus in TTR there will be a type of situation where, for example, a person buys a bunch of flowers.

Types in TTR have two important properties:

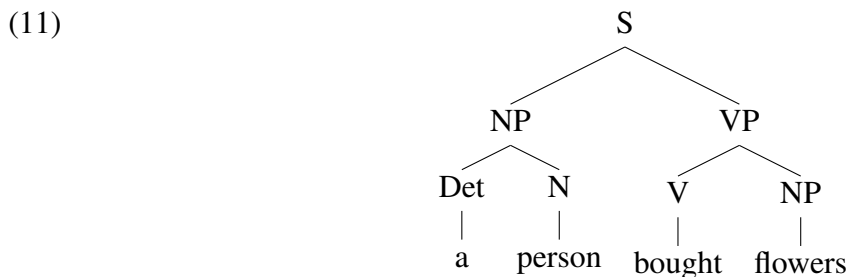
³We often take *event* and *situation* to be synonyms, although in a more careful terminology one can think of events as a particular kind of situation where a change takes place. Thus situations include both states and events. In this sense situations correspond to Bach’s (1986) eventualities.

1. They are considered as objects in their own right. They are not considered as sets of objects or sets of situations. Rather, objects or situations which “belong” to a type are considered as standing in a certain relation to the type, not as constituents or part of the type. An object or situation of a type is a *witness* for the type. Crucially this means that types are *intensional* in that two distinct types can have the same witnesses.
2. Types can be structured objects, that is, they can be constructed from other types, and also some other kinds of objects. Thus, for example, a type of situations where a person buys a bunch of flowers, will be a complex type constructed from among other things the types for person, flower and buying situations. The fact that we can construct types from other types means that it is possible to make sure that there is a type corresponding to each declarative expression in a natural language, for example, and that types can play the role of propositions in other theories — “true” if there is a witness for the type, “false” otherwise.⁴

These aspects of types in TTR make them good candidates for relating them to cognitive structures. An agent that is able to distinguish trees from other objects or that is able to distinguish situations in which a person buys a bunch of flowers from other situations must have something implemented in the brain which allows her to make these distinctions.

The TTR approach to grammar builds on this conception of types. Grammar involves relating types of utterance situations to types of situations which are described by utterances. (In the case of sub-sentential constituents or non-declarative sentences, it is not a type of situation but normally some kind of function which given appropriate arguments will return such a type.) This goes back to the idea of sign in de Saussure (1916) which has been exploited in modern linguistics in, for example, Head Driven Phrase Structure Grammar (Sag *et al.*, 2003; Boas and Sag, 2012). The idea of relating speech situations to situations described by an utterance comes from early work on situation semantics (Barwise and Perry, 1983; Barwise, 1989).

The notion of syntax in terms of types of utterance situations is spelled out in Cooper (2014); Cooper and Ginzburg (2015); Cooper (in prep) and we will not do it in detail here. We think of a tree like (11) as representing a type of utterance situation.



It is a type of event categorized as a sentence which is constituted by a string of two events, the first categorized as a noun phrase and the second as a verb phrase. Similarly the noun phrase event is constituted of a determiner event followed by a noun event and similarly for the verb phrase. The idea here is that we think of syntactic trees as representing types of speech events rather than as abstract linguistic objects. For example, we can think of the phonetic transcription of a word as representing a type of event where the word is uttered, a speech event which has a particular phonological type. As our subject here is not phonology we will use standard orthographic representations enclosed in inverted commas to represent phonological types. Thus,

⁴This is known in type theory under the slogan “propositions as types”. See Ranta (1994) for discussion in relation to linguistics.

for (11), the relevant phonological types are “a”, “person”, “bought” and “flowers”. By using record types in the manner in which feature structures are used in feature-based grammar theories we can associate categories with these phonological types. Thus (12a) represents the type of an utterance of *a* as a determiner and (b12) the type of an utterance of *person* as a noun. These correspond to the trees in (12c-d).

(12) a. $\left[\begin{array}{l} \text{phon} : \text{“a”} \\ \text{cat} : \textit{Det} \end{array} \right]$

b. $\left[\begin{array}{l} \text{phon} : \text{“person”} \\ \text{cat} : \textit{N} \end{array} \right]$

c. $\begin{array}{c} \textit{Det} \\ | \\ \text{a} \end{array}$

d. $\begin{array}{c} \textit{N} \\ | \\ \text{person} \end{array}$

We can express constituent structure by using a ‘daughters’-field similar to the daughters-attribute used in HPSG combined with string types. Thus the type $T_1 \hat{\ } T_2$ is the type of a string of two events, the first of which is of type T_1 and the second of type T_2 . Thus the type of a speech event which is the utterance of the noun-phrase *a person* could be the type (13a) corresponding to the tree (13b).

(13) a. $\left[\begin{array}{l} \text{phon} : \text{“a”}\hat{\ }\text{“person”} \\ \text{cat} : \textit{NP} \\ \text{daughters} : \left[\begin{array}{l} \text{phon} : \text{“a”} \\ \text{cat} : \textit{Det} \end{array} \right] \hat{\ } \left[\begin{array}{l} \text{phon} : \text{“person”} \\ \text{cat} : \textit{N} \end{array} \right] \end{array} \right]$

b. $\begin{array}{c} \textit{NP} \\ \swarrow \quad \searrow \\ \textit{Det} \quad \textit{N} \\ | \quad | \\ \text{a} \quad \text{person} \end{array}$

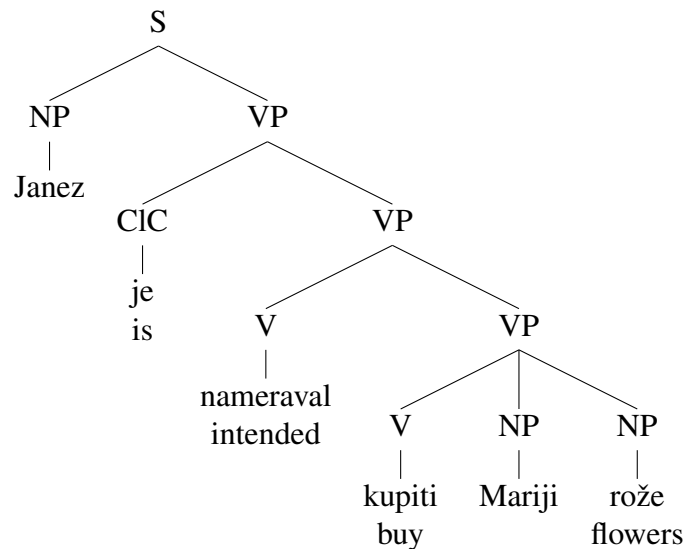
The notion of some events as being constituted of strings of smaller events comes from important work by Fernando (2004, 2006, 2008, 2009, 2011, 2015). We use the string types of TTR in order to capture this. Thus, for example, if *NP* is the type of noun phrase utterances and *VP* is the type of verb phrase utterances, then $NP \hat{\ } VP$ is the type of strings of two events, the first of which is of type *NP* and the second of which is of type *VP*. We can say that such a string is also of type *S*. In terms of the kind of reasoning involved in parsing we can say that if you have heard an event of type *NP* followed by an event of type *VP* then you can reason that that event string actually constitutes an event of type *S*.

This may sound like a somewhat baroque reconstruction of what we have always known as phrase structure and a syntactician may perhaps wonder what the point is of reconstructing syntax in terms of event types. There is, however, an important restriction that this event oriented view of syntax puts on us. It means that syntax deals with the categorization by types of observable utterance events. If we take the view that syntactic trees are compact representations of such utterance types then the kind of trees that we were discussing in Section 3 are not syntactic representations in this sense. They are mixing together two distinct kinds of information

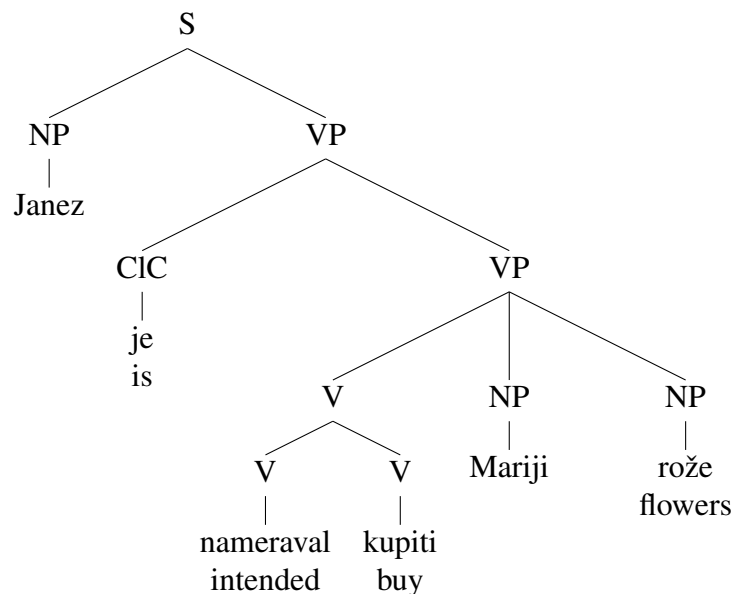
– one kind of information concerning the utterance events and another concerning the interpretation of such utterance events. This seems to do a disservice both to syntax and to semantics: to syntax, because it is not clearly represented what the observable syntactic events are and to semantics because phrase structure simply does not give us the kinds of notions, for example, concerning inference, that are required for an adequate account of semantic interpretation. Thus this view of syntax as event-based leads us to the kind of concrete view of syntax and its relation to semantic interpretation which has been argued for by, among many others, Cooper (1982) and the authors in the collection Barker and Jacobson (2007).

Given this view of syntax we would like to propose something like the two structures in (14) for the example *Janez je nameraval kupiti Mariji rože* “Janez intended to buy flowers for Marija” discussed in Section 2. (14b) is our alternative analysis to (10) from Section 3.

(14) a.

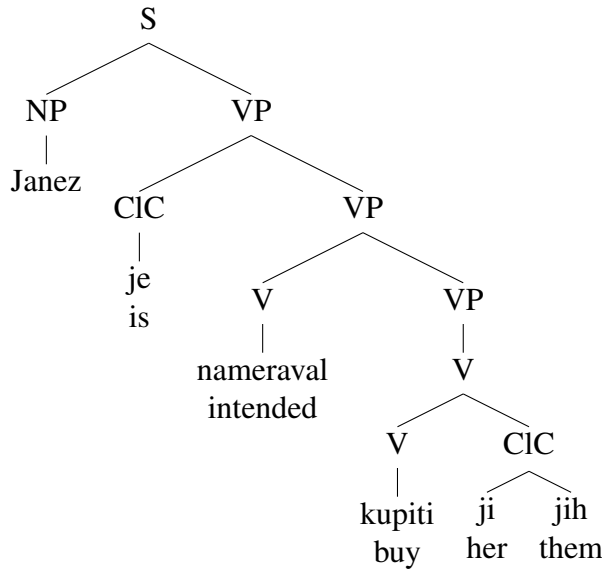


b.

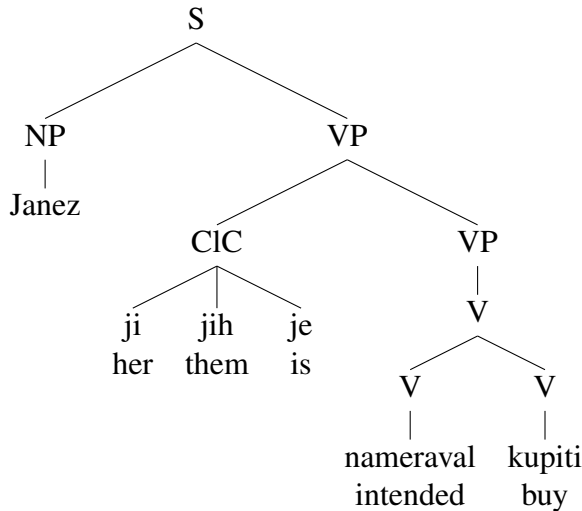


The analysis in (14) presents the sentence as syntactically ambiguous. In the cases where the objects are represented by the pronominal clitics the position of the clitics will disambiguate the two syntactic analyses. In the case of the infinitive in (14a) the clitics will be attached in the clitic position following the infinitive and in the case of the complex verb in (14b) which is no longer an infinitive the clitics will be attached to the clitic cluster associated with the tense. This is shown in (15a and b) respectively.

(15) a.



b.



From the point of view of the kind of syntactic theory we discussed in Section 3, these structures might be regarded as simplified-minded or naive in that they do not give any indication of the difference in meaning associated with the two structures. It is the job of the semantics associated with these structures to make this distinction. This will enable us to deploy semantic tools that are capable of making explicit differences in meaning that are hard to describe exactly in terms of syntactic structure.

We give a simplified sketch of how the compositional semantics will work on the two structures in (15). The verb *buy* corresponds to a three place predicate of individuals, ‘buy’. (In this presentation we will ignore problem arising from the plural *flowers*.) In TTR what we mean by predicate is something that can be combined with arguments to construct an elementary type of situation, known as a *p*type (the ‘p’ is for “predicate”). All three arguments to ‘buy’ must be of type *Ind*, that is, the type of individuals. Thus we can construct the type in (16), assuming that ‘janez’, ‘marija’ and ‘flowers’ are individuals.

(16) buy(janez, marija, flowers)

This is the type of situations in which Janez buys flowers for Marija. In general, situation types can be constructed from several *p*types and we use *record types* in order to be able to collect *p*types together. An example is the type in (17) which is a type of situations in which a man buys some flowers for a woman.

$$(17) \left[\begin{array}{l} x : Ind \\ c_1 : man(x) \\ y : Ind \\ c_2 : woman(y) \\ z : Ind \\ c_3 : flowers(z) \\ e : buy(x, y, z) \end{array} \right]$$

Here, ‘man’, ‘woman’ and ‘flowers’ are unary predicates of individuals, each of which are used to construct ptypes which depend on individuals in other fields in the record type. A field in a record type is a pair consisting of a label such as ‘x’ or ‘c₁’ and a type such as *Ind* or ‘man(x)’. (17) is, then, a type of situation in which there is an individual who is a man, an individual who is a woman and an individual which is flowers and the man buys flowers for the woman. There is a very obvious way in which this type corresponds to the expression of first order logic given in (18).

$$(18) \exists x[man(x) \wedge \exists y[woman(y) \wedge \exists z[flowers(z) \wedge buy(x, y, z)]]]$$

Some important differences between (17) and (18) are:

1. (17) represents a type of situations in a type theoretic universe whereas (18) is an expression in an artificial language whose denotation in a model or possible world is ‘True’ or ‘False’.
2. The labels in (17) (such as ‘x’ and ‘e’) can be used as pointers to components in a situation of this type. They do not become “invisible” and “interchangeable” as bound variables do in a logic.
3. Record types like (17) introduce an important notion of subtyping. For example, any situation of type (17) is also of the type

$$\left[\begin{array}{l} x : Ind \\ c_1 : man(x) \end{array} \right]$$

That is, any situation in which a man buys flowers for a woman is also a situation in which there is a man. In the logical expression (18) we have an entailment to

$$\exists x[man(x)]$$

but this is not situation specific in the way that the subtyping is.

Given this discussion, let us revise (16) to (19), the type of situations where there are some flowers which Janez buys for Marija.

$$(19) \left[\begin{array}{l} z : Ind \\ c : flowers(z) \\ e : buy(janez, marija, z) \end{array} \right]$$

(19) is a good type to represent the content of *Janez bought Marija flowers* but it will not do of course to represent the content of the VP *buy Marija flowers*. For this we need a property which abstracts over the first argument of *buy*. In TTR we make properties be functions from records (situations) which contain an individual labelled by ‘x’ to a type constructed from the individual. The relevant type of records which fall under the domain of the property is (20a). To say that a record, *r*, is of this type we use the notation in (20b) and we represent the property of buying Marija flowers as (20c), where *r.x* is used to represent the object in the ‘x’-field in *r*.

- (20) a. [$x : Ind$]
 b. $r : [x : Ind]$
 c. $\lambda r : [x:Ind] . \left[\begin{array}{l} z : Ind \\ c : flowers(z) \\ e : buy(r.x, marija, z) \end{array} \right]$

The property in (20c) is a function which maps a record, r , (modelling a situation) with a field labelled ‘ x ’ containing an individual to a record (situation) type where there are some flowers which the individual labelled by ‘ x ’ in r buys for Marija.

We treat *intend* as corresponding to a predicate which takes an individual and a property to create a ptype. Thus we propose (21) as the content for (14a).

$$(21) \left[e : intend(janez, \lambda r : [x:Ind] . \left[\begin{array}{l} z : Ind \\ c : flowers(z) \\ e : buy(r.x, marija, z) \end{array} \right]) \right]$$

Thus the content of (14a) is a type of situation where Janez stands in the intend-relation to the property of buying Maria some flowers. Note that this type is constructed from various objects in the type theoretic universe and has a structure quite close to the syntactic structure (14a) and thus facilitates compositional interpretation of a syntactic structure that directly reflects the observable speech events.

Some attentive readers may now wish to say that this is all very well, but there is no representation here in either the syntax or the semantics that *intend* is a control verb, that is, that it is Janez who is supposed to buy the flowers. In order to account for this we need to relate the predicate ‘intend’ (representing a relation between individuals and properties) to another predicate ‘intend[†]’, representing a relation between individuals and types. The relationship between the two is represented in (22).

$$(22) \text{ For any event, } e, \text{ individual, } a, \text{ and property, } P, \\ e : intend(a, P) \text{ iff } e : intend^{\dagger}(a, P([x=a]))$$

That is, if an event, e , is one where a intends to P , then e is also an event where a intends that $P([x=a])$, that is the type that results from applying the property P to the record $[x=a]$. (Note that since $a:Ind$, the record $[x=a]$, using the ‘=’-sign in the field to represent a record, is of the record type $[x:Ind]$, using the ‘:’-sign in the field to represent a record type. This constraint represents an adaptation to TTR of a standard analysis of control from the earliest phase of Montague semantics.⁵ An advantage of this kind of analysis is that it gives us a simple way to represent different kinds of control, for example non-obligatory control, without having to represent this in the syntax. For example, what occurs as the argument of the property P in (22) need not be a , but can be a set which contains a or something involving existential quantification over individuals and we can account for ambiguity between such different conditions by allowing for alternative conditions on what follows from the intend-relation holding between an individual and a property. We will not go into this detail as it is not the main point of the paper. For a discussion of obligatory and non-obligatory control in restructuring and non-restructuring configurations see (Dobnik, 2003, p.41–46).

⁵This is an adaptation of a standard analysis of subject control in early Montague Grammar taking off from Montague’s (1973) proposal that subject control verbs correspond to relations between individuals and properties. For classic early treatments of various control structures in Montague Grammar see Thomason (1976) and Bennett (1976).

We now turn our attention to the second structure (14b). Here in the syntax we have the complex verb cluster *intend buy* and we interpret this by using a complex predicate in the semantics. The content corresponding to this structure is (23).

$$(23) \left[\begin{array}{l} z : \text{Ind} \\ c : \text{flowers}(z) \\ e : \text{intend_buy}(\text{janez}, \text{marija}, z) \end{array} \right]$$

Note that whereas in (21) we had two event roles labelled ‘e’, one for the intending and one for the buying, now we only have one. The “intend buying” is treated as a single elementary event type. Of course, we now need to say something about how the predicate ‘intend_buy’ is related to the predicates ‘intend’ and ‘buy’. This we do in (24).

(24) if p is a predicate whose arguments are required to be of the types T_1, \dots, T_n , $a_1 : T_1, \dots, a_n : T_n$ and the string type Σ is such that any string of type Σ is of type $p(a_1, \dots, a_n)$ (that is, Σ is a subtype of $p(a_1, \dots, a_n)$), then intend_p is a predicate whose arguments are required to be of the types T_1, \dots, T_n such that for any event, e , $e : \text{intend}_p(a_1, \dots, a_n)$ iff

1. there is some e' such that $e' : \text{intend}^\dagger(a_1, p(a_1, \dots, a_n))$
2. for some Σ' which is a proper initial substring type of Σ , $e : \Sigma'$

(24) allows us to take any predicate p and construct a new predicate ‘intend $_p$ ’ which takes the same types of arguments as p . We are allowed to do this provided that for appropriate arguments a_1, \dots, a_n there are strings of events that could constitute an event of type $p(a_1, \dots, a_n)$. For example, if p is ‘buy’ and the event type is that of buying flowers for Marija, this could involve a string of events like going to the stall in the market, choosing the flowers, paying the flower seller, and receiving the flowers and, of course, many other variants of this. When is an event of the type constructed with ‘intend $_p$ ’? There are two conditions mentioned in (24). The first relates ‘intend $_p$ ’ to ‘intend † ’ and at the same time gives us the (obligatory) control information, a_1 has to intend that a_1 stands in the relation p to the rest of the arguments. In the case of restructured predicates the control is required to be of this nature and the kind of variation in the type of control we discussed with respect to (22) is not available. The second condition requires that e constitutes an initial proper substring of a string of events that could constitute the ‘p’-event, that is a_1 has started in on a ‘p’-event but not completed it. This gives the restructured predicate something like the flavour of a progressive tense. The agent is in the middle of an event with the intention to complete it. However, we cannot infer that the event will be completed. This means that in the past tense we are likely to get the implicature that the event was not completed, that the agent failed to buy the flowers, for example (if it had been completed we would have said so). This implicature will not be present in the present and future since we cannot tell yet whether the event will be completed in the future.

5 Conclusion

We have sketched a way of doing compositional semantics for restructured predicates in Slovenian using tools from TTR enforcing a restricted view of syntax limited to types of observable speech events. This allows us both a concrete view of syntax and the use of semantic tools for the analysis of meanings which are hard or impossible to represent in terms of syntactic tree structures. While we favour the TTR approach as an overall theory of types suitable for both syntactic and semantic analysis, much of the semantic machinery we use is adapted from

the classical approach to formal semantics given to us by Richard Montague and subsequent developments in Montague semantics.

References

- Aissen, Judith L. and David M. Perlmutter (1976) Clause reduction in Spanish, in H. Thompson, K. Whistler, V. Edge, J. Jaeger, R. Javkin, M. Petruck, C. Smeall and R. D. Van Valin Jr. (eds.), *Proceedings of the Second Annual Meeting of the Berkeley Linguistic Society (BLS 2)*, pp. 1–30, Berkeley, CA: Berkeley Linguistic Society.
- Aissen, Judith L. and David M. Perlmutter (1983) Clause reduction in Spanish, in D. M. Perlmutter (ed.), *Studies in Relational Grammar 1*, pp. 360–403, Chicago: The University of Chicago Press.
- Bach, Emmon (1986) The Algebra of Events, *Linguistics and Philosophy*, Vol. 9, pp. 5–16.
- Barker, Chris and Pauline Jacobson (2007) *Direct Compositionality*, Oxford University Press.
- Barwise, Jon (1989) *The Situation in Logic*, CSLI Publications, Stanford.
- Barwise, Jon and John Perry (1983) *Situations and Attitudes*, Bradford Books, MIT Press, Cambridge, Mass.
- Bennett, Michael Ruisdael (1976) A Variation and Extension of a Montague Fragment of English, in Partee (1976), pp. 119–164.
- Boas, Hans C. and Ivan A. Sag (2012) *Sign-Based Construction Grammar*, CSLI Publications.
- Chomsky, Noam (1995) *The Minimalist Program*, Cambridge, Mass.: MIT Press.
- Cinque, Guglielmo (2006) *Restructuring and Functional Heads*, Oxford Studies in Comparative Syntax: The Cartography of Syntactic Structures 4, Oxford University Press.
- Cooper, Robin (1982) Binding in wholewheat* syntax (*unenriched with inaudibilia), in P. Jacobson and G. K. Pullum (eds.), *The Nature of Syntactic Representation (Synthese Language Library 15)*, Reidel Publishing Company.
- Cooper, Robin (2005a) Austinian truth, attitudes and type theory, *Research on Language and Computation*, Vol. 3, No. 2, pp. 333–362.
- Cooper, Robin (2005b) Records and Record Types in Semantic Theory, *Journal of Logic and Computation*, Vol. 15, No. 2, pp. 99–112.
- Cooper, Robin (2012) Type Theory and Semantics in Flux, in R. Kempson, N. Asher and T. Fernando (eds.), *Handbook of the Philosophy of Science*, Vol. 14: Philosophy of Linguistics, pp. 271–323, Elsevier BV. General editors: Dov M. Gabbay, Paul Thagard and John Woods.
- Cooper, Robin (2014) Phrase structure rules as dialogue update rules, in V. Rieser and P. Muller (eds.), *Proceedings of The 18th Workshop on the Semantics and Pragmatics of Dialogue*, pp. 26–34.
- Cooper, Robin (in prep) Type theory and language: from perception to linguistic communication. Draft of book chapters available from <https://sites.google.com/site/typetheorywithrecords/drafts>.
- Cooper, Robin and Jonathan Ginzburg (2015) Type Theory with Records for Natural Language Semantics, in Lappin and Fox (2015), pp. 375–407.
- DiSciullo, Anna Maria and Edwin Williams (1987) *On the definition of word*, Cambridge, Mass.: MIT Press.
- Dobnik, Simon (2003) Restructuring in Slovene as First-Phase Syntax. Draft of an article available from http://dobnik.net/simon/documents/dobnik_restructuring.pdf.
- Dowty, David, Robert Wall and Stanley Peters (1981) *Introduction to Montague Semantics*, Reidel (Springer).

- Evers, Arnold (1975a) The Guillotine principle, in A. Kraak (ed.), *Linguistics in the Netherlands 1972-1973*, p. 147, Amsterdam: Von Gorcu.
- Evers, Arnold (1975b) *The transformatonal cycle of Dutch and German*, PhD dissertation, University of Utrecht. The Netherlands.
- Fernando, Tim (2004) A finite-state approach to events in natural language semantics, *Journal of Logic and Computation*, Vol. 14, No. 1, pp. 79–92.
- Fernando, Tim (2006) Situations as Strings, *Electronic Notes in Theoretical Computer Science*, Vol. 165, pp. 23–36.
- Fernando, Tim (2008) Finite-state descriptions for temporal semantics, in H. Bunt and R. Muskens (eds.), *Computing Meaning, Volume 3 (Studies in Linguistics and Philosophy 83)*, pp. 347–368, Springer.
- Fernando, Tim (2009) Situations in LTL as strings, *Information and Computation*, Vol. 207, No. 10, pp. 980–999.
- Fernando, Tim (2011) Constructing Situations and Time, *Journal of Philosophical Logic*, Vol. 40, pp. 371–396.
- Fernando, Tim (2015) The Semantics of Tense and Aspect: A Finite-State Perspective, in Lappin and Fox (2015).
- Kayne, Richard S. (1989) Null subjects and clitic climbing, in O. Jaeggli and K. Safir (eds.), *The null subject parameter*, pp. 239–261, Dordrecht: Kluwer Academic Publishers.
- Kayne, Richard S. (1991) Romance clitics, verb movement, and PRO, *Linguistic Inquiry*, Vol. 22, pp. 647–686.
- Lappin, Shalom and Chris Fox (2015) *The Handbook of Contemporary Semantic Theory*, second edition, Wiley-Blackwell.
- Martin-Löf, Per (1984) *Intuitionistic Type Theory*, Bibliopolis, Naples.
- Montague, Richard (1973) The Proper Treatment of Quantification in Ordinary English, in J. Hintikka, J. Moravcsik and P. Suppes (eds.), *Approaches to Natural Language: Proceedings of the 1970 Stanford Workshop on Grammar and Semantics*, pp. 247–270, D. Reidel Publishing Company, Dordrecht.
- Montague, Richard (1974) *Formal Philosophy: Selected Papers of Richard Montague*, Yale University Press, New Haven, ed. and with an introduction by Richmond H. Thomason.
- Napoli, Donna Jo (1981) Semantic interpretation vs. lexical governance: clitic climbing in Italian, *Language*, Vol. 57:4, pp. 841–887.
- Nordström, Bengt, Kent Petersson and Jan M. Smith (1990) *Programming in Martin-Löf's Type Theory (International Series of Monographs on Computer Science 7)*, Clarendon Press, Oxford.
- Partee, Barbara H., ed. (1976) *Montague Grammar*, Academic Press.
- Pulman, Stephen G. (2005) Lexical Decomposition: For and Against, in J. I. Tait (ed.), *Charting a New Course: Natural Language Processing and Information Retrieval (The Kluwer International Series on Information Retrieval 16)*, pp. 155–173, Springer Netherlands.
- Ramchand, Gillian (2008) *Verb meaning and the lexicon: a first-phase syntax*, Vol. 116, Cambridge University Press, Cambridge, UK.
- Ranta, Aarne (1994) *Type-Theoretical Grammar*, Clarendon Press, Oxford.
- Rizzi, Luigi (1976) 'Ristrutturazione', *Rivista di Grammatica Generativa*, Vol. 1, pp. 1–54.
- Rizzi, Luigi (1978) A restructuring rule in Italian syntax, in S. J. Keyser (ed.), *Recent transformational studies in European languages*, pp. 113–158, Cambridge, Mass.: MIT Press.
- Rizzi, Luigi (1982) *Issues in Italian syntax*, Chapt. 'A restructuring rule', pp. 1–48. Dordrecht: Foris.
- Roberts, Ian (1994) Two types of head movement in Romance, in D. Lightfoot and N. Hornstein

- (eds.), *Verb movement*, pp. 207–242, Cambridge, UK: Cambridge University Press.
- Roberts, Ian (1997) Restructuring, head movement, and locality, *Linguistic Inquiry*, Vol. 28, pp. 423–460.
- Rosen, Sara Thomas (1990) Restructuring verbs are light verbs, in A. Halpern (ed.), *Proceedings of the 9th West Coast Conference on Formal Linguistics (WCCFL9)*, pp. 477–491, Stanford, CA: CSLI Publications.
- Sag, Ivan A., Thomas Wasow and Emily M. Bender (2003) *Syntactic Theory: A Formal Introduction*, 2nd edition, CSLI Publications, Stanford.
- de Saussure, Ferdinand (1916) *Cours de linguistique générale*, Payot, Lausanne and Paris, edited by Charles Bally and Albert Séchehaye.
- Smith, Carlota S (1991) *The parameter of aspect*, Vol. 43, Kluwer Academic Publishers, Dordrecht.
- Thomason, Richmond H. (1976) Some Extensions of Montague Grammar, in Partee (1976), pp. 77–118.
- Wackernagel, Jacob (1892) Über ein Gesetz der indogermanischen Wortstellung, *Indogermanische Forschungen*, Vol. 1, pp. 333–436.
- Wurmbrand, Susanne (2001) *Infinitives: Restructuring and clause structure*, Studies in Generative Grammar 55, Mouton de Gruyter.