Chapter 1

A novel representation of focus structure and non-constituent focus

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In this paper, we introduce the first proposal within the theory of Role and Reference Grammar towards a formal grammar with a modular architecture and a designated place for information structure. Our emphasis is on a formal representation of the focus structure that can uniformly capture "non-constituent focus" domains. In our account, the primary role of focusing is a pragmatic structuring, and we argue that the related notion of focus structure should be part of the grammatical system. In this proposal, we seek for a formal representation of the focus structure of the sentence without a syntactic F(ocus)-marking and, in general, without a primary determining role of syntax.

1 Introduction

Various focus structures where the elements within the focus domain do not form a syntactic constituent are problematic for traditional compositional approaches that capture the focus structure of the sentence using a syntactic F(ocus)-marking (see Krifka 1992, Büring 2016). Within the context of the preceding *wh*-question, the answer in (1a) has a focus structure where the subject and the verb form the focus domain, while, in the answer in (1b), the focus domain contains the verb and the indirect object. None of these form a constituent within the syntactic structure (in terms of traditional syntax).

(1) a. What happened to the book? *Pete sold* the book.
b. What did Pete do with the book? Pete *gave* the book *to Kate*.

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It is generally accepted that focusing leads to a division of the sentence, which has a direct effect on the interpretation. Following Chomsky's (1971) focus vs. presupposition distinction, Jackendoff (1972: 240) introduced a focus marker in syntax (i.e., F-marker), which gets interpreted at phonological form (PF) and logical form (LF). Languages reflect F-marking in various ways. In English, prosody (i.e., accent placement) is the main reflection of F-marking. To capture the prosody-information structure interface, take, for example, Selkirk's (1995) "focus projection" rules, that derive the focus domains based on the prosodic pattern and the syntactic structure. In a nutshell, the basic F-marking rule states that an element that bears the nuclear pitch accent is F-marked, and the additional F-projection rules determine in which ways F-marking is licensed on larger units. Using Büring's (2006) terminology, focus projection can be vertical (i.e., when F-marking of the head percolates up to larger constituents), or horizontal (i.e., when F-marking of an internal argument licenses the F-marking of the head). Based on F-marking, the *focus* (FOC) of the sentence is determined as the highest F-marked constituent.

Based on the F-marking in the syntactic structure, formal semantic approaches derive the contribution of focusing, either by introducing alternatives (see Rooth 1992) or by structuring the sentence meaning (see von Stechow 1991, Krifka 2001). The strength of such traditional compositional approaches is that the semantics of the constituents is directly calculated at the given nodes, hence an F-marked constituent has direct access to its corresponding semantic content. Despite the numerous phenomena analyzed and explained, all F-marking analyses have problems with broad focus domains that do not correspond to a constituent in the syntactic structure (1). Nevertheless such constructions occur frequently. The problem is essentially related to the grammar architecture and the determining role of syntax, as focus structure and the corresponding interpretation are read off from the syntactic structure. In the answer in (1a), the focus domain consists of the subject noun phrase plus the predicate, which do not form a constituent in traditional syntax. Similarly, the focus domain of the answer in (1b) is not a constituent, a VP without the object NP. The core problem in both constructions is that there is no node corresponding to these focus domains that could carry (the highest) F-marking, and as a result, the focus interpretation cannot be derived.[1]

In our proposal, we seek for a formal representation of the focus structure of the sentence without any syntactic F-marking. Information structure (IS), and

[1]Note that not all F-marking approaches require that the focus corresponds to a continuous domain. For example, Roothian alternatives can be derived using separate F-markers (on subject and verb, for example); however, this analysis lacks the representation of the focus structure and the distinction between broad focus and multiple focus structures.

hence focus structure, is orthogonal to syntax and semantics, and as Van Valin (2005), Latrouite & Van Valin (2023) and Bentley (2023) argue, it plays an important role in the linking between these levels. We propose a formal grammatical model that has a designated place for IS in its architecture, including a representation of the focus structure, which reflects the notion of *pragmatic focus*, i.e., focus in answers and correction. Building upon the theory of Role and Reference Grammar (RRG; Van Valin & LaPolla 1997, Van Valin 2005, 2023b), and its formal specification in terms of Tree-Wrapping Grammar (TWG; Kallmeyer et al. 2013, Kallmeyer 2016), we propose a modular grammar architecture, where IS is a separate module that must be linked to syntax, semantics and prosody. The way focus structure is represented should be uniform across languages, while the details linking the various grammatical modules capture the language-specific aspects of the expression and interpretation of focus, thus accounting for cross-linguistic variation. In this spirit, the representation of IS should be captured without syntactic F-marking and, in general, without a primary determining role of syntax.

The problems of syntactic F-marking in the interpretation of discontinuous focus are explicitly pointed out by Büring (2016), who also proposes a solution for them. Büring's approach to focusing is essentially Roothian in that it builds upon the fundamental idea that the core semantic contribution of focusing is the introduction of *alternatives*, which play a central role in focus pragmatics (relation to questions, contrast and so on). Büring (2006) already shows that F-marking is, in fact, unnecessary for explaining the relation of accent placement (prosody) and focus structure/semantics, previously captured in terms of focus projection rules (Selkirk 1995). Büring (2006) argues that the restrictions of vertical projection (i.e., F-marking percolating upwards) are empirically inadequate, and that the main effect of horizontal projection (i.e., integration) can be derived by *default prominence*. Therefore, focus projection is not necessary. Instead, he proposes a new theory and replaces the F-interpretation rules by *prominence interpretation* (Büring 2006: 343). This implies that syntactic F-marking is needless. As for deriving the set of alternatives without F-marking in the syntax, he introduces "Unalternative Semantics" (UAS; Büring 2015, 2016, 2019), and proposes a system where alternatives are calculated directly from the prosodic structure. In English, we get the alternatives from the metrical structure of the sentence. This is a crucial improvement. Next to other advantages, this system eliminates the primary source of the problem with discontinuous focus. The core idea behind Büring's approach is that focusing does not evoke, but rather restricts the alternatives at each node by determining the corresponding set of *unalternatives*, i.e., the meanings that are excluded from the set of alternatives. In recent work (Assmann et al. 2023), this approach has been extended to and embedded into

a broader formal theory of focus marking, which is equally applicable to languages with focus marking by accent placement (like English) and to languages with morphosyntactic focus marking like Gúrúntúm, Hausa, Wolof and other African languages. Without going into the details of this approach, it offers an alternative way to capture the relation of focus marking and pragmatic focus, with special attention given to syncretisms of focus structures (i.e., when different pragmatic foci are marked in the same way, for example, Obj/VP/S-focus in English) across languages. As a main difference from earlier focus projection accounts, in their unified focus marking theory, Assmann et al. (2023) allow "Direct FOCAL-marking" of complex constituents (Assmann et al. 2023: 1350), from which the pragmatic focus is restricted by "Blocking" (Assmann et al. 2023: 1379).

Our proposal shares the core insight with Büring's work that syntactic F-marking is insufficient in the analysis of various focus structures, in particular of non-constituent focus domains. Nevertheless, our work considerably differs in its aims and motivations, as a result of our differing perspectives on focusing. While Büring's proposal is essentially Roothian, concentrating on semantic interpretation in terms of alternatives, our approach is based on the view that the primary contribution of focusing is a *pragmatic structuring* (Lambrecht 1994, Van Valin & LaPolla 1997).

Although Büring's UAS approach offers an elegant way to get rid of the problems caused by syntactic F-marking in the calculation of alternatives, it nevertheless raises some issues, in particular while considering the place of IS (including the focus structure) in the grammatical architecture. In UAS, there is no representation of the focus structure (i.e., pragmatic focus) at all. Assmann et al. (2023) explicitly argue that there is no empirical evidence for distinguishing the syncretic focus structures (i.e., different pragmatic foci that are marked in the same way, for example, Obj/VP/S-focus in English) in the grammatical structure. Therefore, they keep the FOCAL-marking in the grammar, which is used to calculate the alternatives in each case. This is not a problem for semantic approaches to focusing where the calculation of alternatives is central. However, as we argued before, the elimination of this representation level from the grammatical model is not preferred. In fact, there are certain grammatical aspects across languages that are sensitive to the focus structure of the sentence (see, e.g., Latrouite & Van Valin 2023, Bentley 2023), as will be illustrated in what follows. Focus structure affects verb selection: certain verb types are only compatible with a sentence focus structure. There are languages where focus structure interacts with case marking. This is the case, for example, in Kaluli (Papua New Guinea), in Korean (see Latrouite & Van Valin 2023, Bentley 2023) and in Kurtöp (Tibeto-Burman;

Hyslop 2010). There are more cases where focus structure interacts with grammatical organization, nonetheless, these examples already provide evidence that the representation of the focus structure (i.e., pragmatic focus) should be part of the grammatical model.

In our proposal, we implement the perspective of RRG on IS and on grammar architecture. The general grammatical model of RRG and the representation of IS is considerably different from traditional accounts based on syntactic F-marking, as well as Büring's proposal. The essence is that focus domains are sets of information units (IUs), that are linked to syntactic domains, but which do not necessarily correspond to nodes within the constituent structure. When the basic IUs are defined, their combination can make up the actual focus domain (i.e., the pragmatic focus). This predicts that non-constituent focus structures are not problematic and can be analyzed uniformly with other focus structures.

The paper is structured as follows. Section 2 briefly introduces the theoretical foundation, and is followed in Section 3 by our proposal of the formal grammatical model: Section 3.1 introduces the grammar formalism, and in Section 3.2, we propose the formalization of the IS-Projection. In Section 4, we apply the formal model to various focus structures, and Section 5 concludes the paper.

2 Information structure in RRG

Our proposal is based on the theoretical framework of Role and Reference Grammar (RRG; Van Valin & LaPolla 1997, Van Valin 2005, 2023b). RRG is a linguistic theory, developed from a strong typological and theoretical perspective, and maintaining a surface-oriented grammatical model. One of the theory's main aims is to capture both the universal characteristics of natural languages and their language-specific features. The general architecture of RRG is modular, with various levels of representation called "Projections" and well-defined linking relations between them, as shown in Figure 1. The syntactic representation (namely, the layered structure of the clause) captures universal notions in terms of predicate-argument relations, as well as language-specific aspects in terms of special syntactic positions. The heart of the semantic representations is a decompositional representation based on the classification made by Vendler (1967) and adapted from the decompositional system of Dowty (1979). The center of the grammatical system of RRG is the bi-directional linking algorithm between the syntactic and the semantic representations capturing both language production and comprehension (Van Valin 2023a).

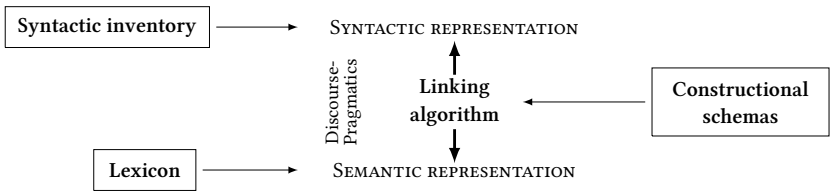


Figure 1: The general grammar architecure in RRG

As Van Valin (2005: 185) argues by characterizing a "cognitive model of context", discourse pragmatics affects all aspects of the grammatical system (for an overview see Bentley 2023, Latrouite & Van Valin 2023). An essential part of discourse pragmatics is captured by the *Focus Structure Projection* and its effects on the bi-directional linking between syntax and semantics. This projection, and the way of looking at IS in RRG, is based on the theory of Lambrecht (1994), where the main contribution of focusing is a *pragmatic structuring* into the pragmatic assertion and the pragmatic presupposition. As Balogh (2021) proposes, the projection should also model the topic-comment structure of the sentence for a comprehensive account of information structure and for an appropriate account of various phenomena where focus-structure and topic-structure interact (e.g., the linearization constraints of the focus-sensitive particle *also*). Following this proposal, we refer to the projection as the *Information Structure (IS-)Projection.*[2]

The basic building blocks of the IS-Projection are the *information units* (IUs) (IUs; see Lambrecht 1994, Van Valin 2005, Bentley 2023), that have a dual nature, linking both to the syntactic structure and to the semantic representation: IUs are linked to minimal phrasal units in the constituent structure and to their respective contents within the semantic representation. RRG distinguishes two syntactic domains, both including one or more IUs: the *potential focus domain* (PFD), where the focus can fall in the sentence, and the *actual focus domain* (AFD), whose content is considered the "focus" in interpretational terms.[3] The notion of PFD is cross-linguistically relevant, and has an important role in the grammar theory. While, in English, the PFD is always the entire clause, this is not generally the case in other languages. For example, in Italian, the PFD excludes any core-internal pre-nuclear elements (Van Valin & LaPolla 1997, Bentley 2008), and in Hungarian, the structural topic position is clause-internal, but external to the PFD. Therefore, the notion of PFD is central to capturing the structural restrictions on the location of focus in various languages. Furthermore, as argued by

[2]The topic-comment structure plays no direct role in the analysis of our target phenomenon; therefore, in this paper, we simplify the IS-Projection and discuss only the focus structure.

[3]Note that the term *focus domain* is understood here within the terminology of RRG.

Van Valin (2005) and Shimojo (2023), the PFD plays a crucial role in the explanation of focus structure in complex sentences, and in the analysis of extraction phenomena. For the purposes of this paper, however, the notion of PFD has no direct relevance, therefore we omit a more detailed discussion of it.

The general grammatical model of RRG and the representation of IS as the IS-Projection is considerably different from traditional accounts based on syntactic F-marking. The essence is that focus domains are sets of IUs, linked to syntactic domains but not determined by (or read off from) the nodes of the constituent structure. Once defined, any combination of basic IUs can make up the AFD/focus. This predicts that non-constituent focus structures are not problematic, and the different focus structures can be captured via a uniform process. Despite the advantages that the RRG approach offers to our target phenomena, the formal implementation of the theoretical grounds asks for a further development. The core issue is the formal modeling of IUs in a way that links them to syntactic domains and pieces of semantic information without a traditional implementation of compositionality. Regarding the aim of a uniform analysis of the possible focus structures, a central question is at which point in the derivation and how the IUs are determined.

3 Formalization of the IS-Projection

In RRG, the composition of the constituent structure (i.e., the layered structure of the clause) in the syntactic representation is the combination of tree templates in the syntactic inventory. However, the way these templates combine is left undefined and informal. Keeping the core of the theoretical base of RRG, the use of a formalism based on Tree-Adjoining Grammar (TAG; Joshi & Schabes 1997, Abeillé & Rambow 2000) is a straightforward choice in the formalization of the syntactic combination. The formal specification of RRG syntax is defined in terms of *Tree-Wrapping Grammar* (TWG; Kallmeyer et al. 2013, Kallmeyer 2016), which is strongly based on TAG. The semantic representations are formalized in terms of decompositional frames (Barsalou 1992, Löbner 2014, 2017, Petersen 2015), formally defined as base-labeled typed feature structures (Kallmeyer & Osswald 2013). The current development of the formalization of RRG provides a specification of the syntax-semantics interface, but lacks a model of IS. We propose the necessary extension of the IS-Projection, towards a uniform formal representation of the various focus structures.

3.1 Grammar formalism for RRG: Tree-Wrapping Grammar

The tree templates of RRG are defined as the elementary trees of the TWG, and they are combined by the rewriting operations of standard *substitution* (Figure 2a), where a leaf node is replaced by another tree, and *(sister) adjunction* (Figure 2b), where an internal node is replaced by another tree. For the derivation of certain constructions (e.g., extraction phenomena, control constructions), an additional, more complex substitution operation is proposed: *wrapping substitution* (see Kallmeyer & Osswald 2023: 750), where a tree is split at a special dominance edge and wrapped around the target tree. Given that in our examples this latter operation does not occur, we do not introduce it any further. For the exact definitions of the operations used for syntactic composition in TWG, see Kallmeyer et al. (2013) and Kallmeyer & Osswald (2023).

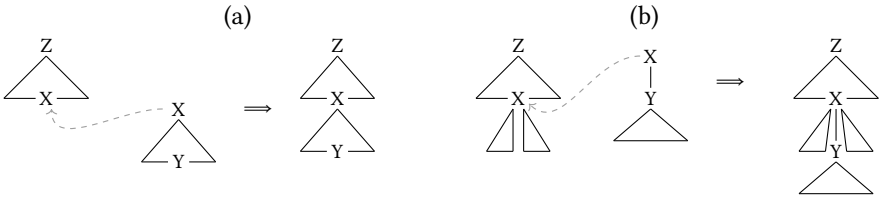


Figure 2: Substitution (a) and sister adjunction (b) in TWG

One of the important characteristics of formalized RRG representations is that the nodes in the tree representation are decorated with feature structures, including *index features* (*I*) which establish the link between syntactic structure and semantic representation, hereby capturing essential aspects of the syntax-semantics interface (see Figure 3). Within RRG, two oppositions are made prominent in the syntactic structure: (i) operators are distinguished from the predicate and its argument, and (ii) arguments are distinguished from adjunct modifiers, where the latter are represented as "periphery" elements. In TWG, we represent these distinctions as follows. The "operator nodes" are marked by OP-, together with the information of the operator type (OP-NEG for negation, OP-TNS for tense, OP-ASP for aspect, OP-DEF for definiteness, and so on). The information that an element is an adjunct modifier is encoded in the PERI+ feature on the respective node. The PRED+ feature marks the respective node as predicative.

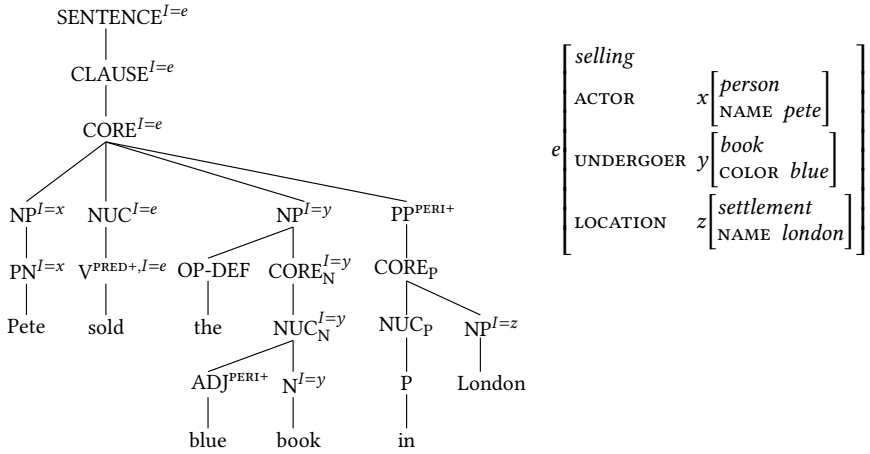


Figure 3: Syntactic and semantic representation in formalized RRG

An important advantage of the formalization of RRG with respect to the core theory of RRG is that syntactic and semantic composition can be carried out on a par. A detailed discussion of the formalized theory goes beyond the scope of this paper, therefore we only provide a basic introduction here. Syntactic templates, i.e., elementary trees, are paired with pieces of semantic representations. We call these pairs *elementary constructions*. The semantic composition is parallel to the syntactic composition, mediated by the index feature (I) on the nodes (Figure 4). The syntactic operations (Kallmeyer et al. 2013) trigger the unification of the semantic representations, thereby deriving the meaning representation of the sentence.

As shown in Figure 4 below, the tree for the predicate is substituted at the NUC node, triggering $\boxed{0} = e$ and providing the type of the eventuality. The NP trees are substituted at the respective NP nodes, triggering $\boxed{1} = x$ and $\boxed{2} = y$. The tree for the definite article is adjoined at the NP node of tree for *book*, triggering $\boxed{3} = y$, and the tree for the adjective *red* is adjoined at its NUC_{N} node, triggering $\boxed{4} = y$. The tree for the preposition *in* is (sister) adjoined at the CORE node of the tree for the predicate, triggering $\boxed{5} = e$, and the tree for *London* is substituted at the NP node within the tree for *in*, triggering $\boxed{6} = z$. In the derived semantic representation, the pieces of the meaning representations within the elementary constructions are unified under these restrictions. The derived construction, the syntactic tree and the corresponding semantic representation as a frame structure, is the one given in Figure 3 above.

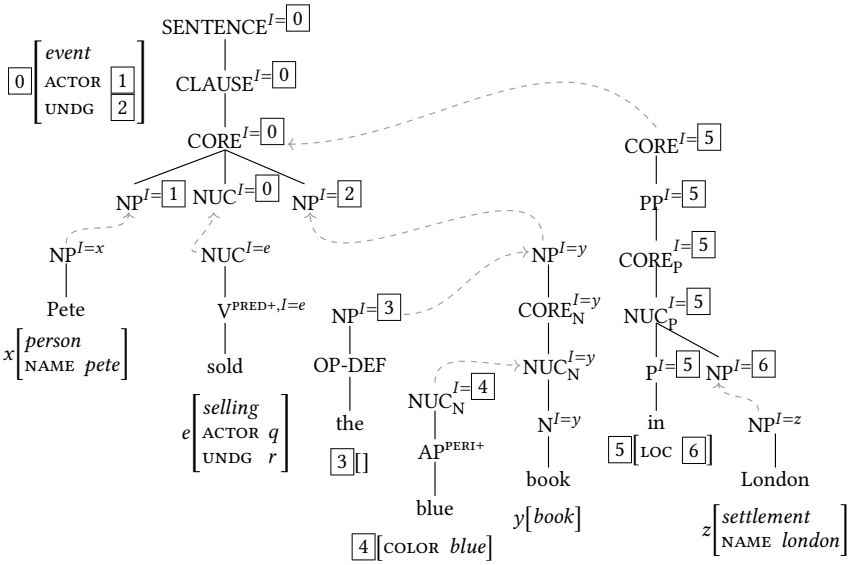


Figure 4: Elementary constructions and their composition

3.2 Formal representation of the information units

While the syntactic and semantic operations are fairly worked out in formalized RRG, the formalization of RRG's IS-Projection, an important mediator between syntax and semantics in the grammar architecture, is still missing.

In the theory of RRG (Van Valin 2005), IS is represented in a separate module, which is linked both to syntax and semantics. The basic components of the IS-Projection are the *information units* (IUs). They correspond to single syntactic constituents (Van Valin 2005, Bentley 2023) and their respective content. Following Lambrecht (1994), the basic IUs correspond to the content of the minimal phrasal categories in the constituent structure (Van Valin 2005: 78), i.e., the sub-trees corresponding to the NUCLEUS, the core arguments (NP and PPs) and the periphery adjuncts (PPs), as indicated by the dashed box in Figure 5. Hence, IUs are linked both to syntactic domains (sub-trees) and their respective semantic representations.

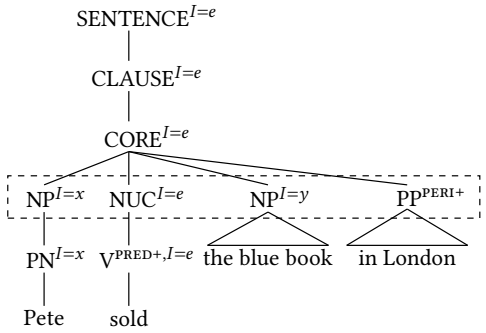


Figure 5: The syntactic domains of basic IUs

The IUs linked to the argument NPs are such that their content can be directly determined on the final semantic representation (see Figure 3) by pointing at the corresponding nodes labeled x and y in the frame. The IUs corresponding to the NUCLEUS and the adjunct PP are different, as their content cannot be addressed via frame nodes. Each clause has a unique NUCLEUS, that expresses the type of the eventuality (2a). The content of the periphery PP in the case at stake includes that the location of some unspecified eventuality is London (2b).

(2) a. IU corresponding to the NUCLEUS:

$$e\begin{bmatrix} selling \\ \text{ACTOR} \;\; q \\ \text{UNDERGOER} \;\; r \end{bmatrix}$$

b. IU corresponding to the PP$^{\text{PERI+}}$:

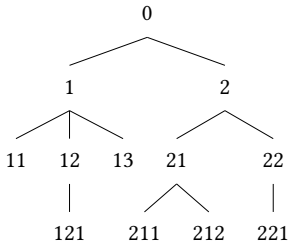
$$\boxed{5}\left[\text{LOCATION} \;\; z\begin{bmatrix} settlement \\ \text{NAME} \;\; london \end{bmatrix}\right]$$

The IUs correspond to the content of certain syntactic domains, i.e., sub-trees in the constituent structure. Despite the clear intuitions regarding what semantic contents are contributed by these sub-trees, the question arises of how to reach or how to derive all basic IUs in a uniform way, in other words, how they are determined in the formal model. We propose that the content of the syntactic domains linked to the basic IUs are determined by the "derivation tree", adapted from the TAG formalisms.

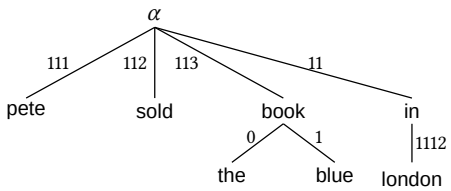
In a TAG derivation, in addition to the final phrase structure tree (called the "derived tree"), a "derivation tree" is given, which uniquely describes the TAG derivation in question, i.e., which trees are combined at which nodes. The derivation tree contains nodes for all elementary trees used in the derivation, edges for all syntactic compositions performed throughout the derivation, and edge labels

indicating the target node of the given syntactic operation. For referring to the nodes in the elementary trees, Gorn addresses (Gorn 1967) are used, where the root node of the tree has address 0, and the i^{th} daughter of the node with address n has address ni. Whenever an elementary tree γ rewrites the node at Gorn address n in the elementary tree γ', there is an edge from γ' to γ labeled with n (see 3a).

(3) a. Gorn addresses:



b. Derivation tree for Figure 4:



inducing the unification of the frames under: $\boxed{1} = e$, $\boxed{1} = x$, $\boxed{2} = \boxed{3} = \boxed{4} = y$, $\boxed{5} = e$, $\boxed{6} = z$

In the derivation of the sentence *Pete sold the blue book in London* (see 3b), the tree for the base structure of a transitive construction (referred to by α here) has three substitution nodes, one labeled NUC and two labeled NP. The tree for *Pete* is substituted at node 111, the tree for *sold* at node 112 and the tree for *book* at node 113. The tree for *in* is adjoined (by sister adjunction) to α at node 11. The trees for *the* and *blue* are (sister) adjoined to the tree for *book* at nodes 0 (root) and 1 respectively, and finally, the tree for *London* is substituted at node 1112 to the tree for *in*. All these operations are registered in the derivation tree (3b), which implicitly includes the respective unifications of the corresponding pieces of semantic content. For example, the node labeled 'book' stands for the elementary construction of the pair of the elementary tree anchored by the noun *book* and its corresponding semantic frame.

We propose that the information units, i.e., the designated syntactic domains and their content, correspond to the non-operator daughter sub-trees of the root node of the derivation tree. Together with the information on the substitution/adjunction sites of each of these parts – what is also described by the derivation tree – we derive the set of IU contents in the given sentence (Figure 6). We refer to this set as IUS.

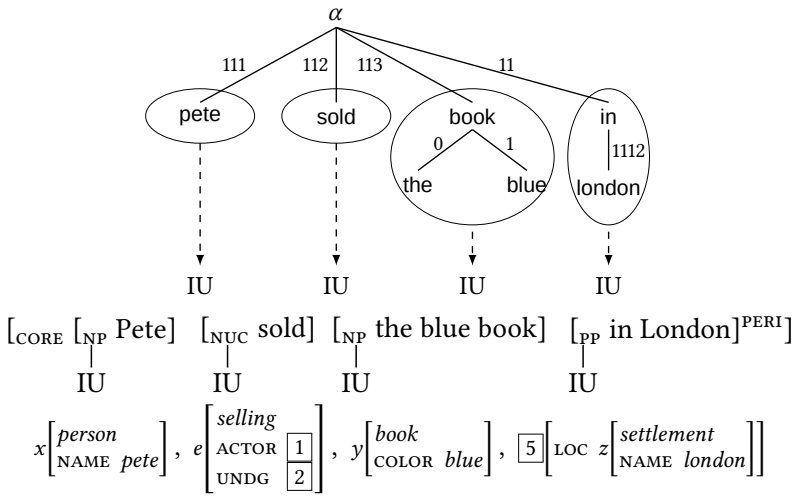


Figure 6: Derivation tree and the set of information units

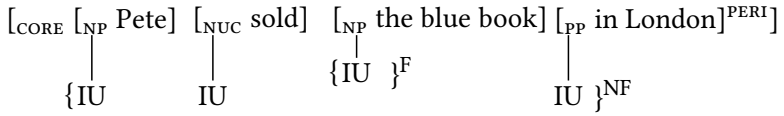
The basic IUs are the minimal elements of the various IS-domains, such as the actual focus domain, the comment and so on. These IS-domains are formally defined as subsets of the IUS. The minimal focus domains correspond to basic IUs, but not vice versa: not every basic IU can be part of a focus domain. Therefore, we can model the potential focus domain (PFD) as the set of all minimal focus domains (MFDs). These minimal focus domains can be marked by the feature MFD+ on given nodes in the constituent tree, which is language-specific.

4 Focus structures

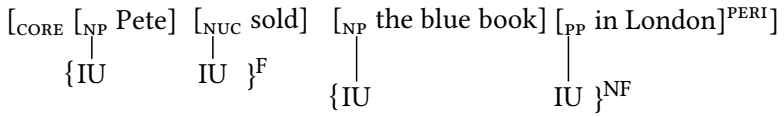
The basic idea of a uniform representation of different focus structures is relatively simple: within the IS-Projection, the IS-domains are formally represented as sets of IUs. This provides the necessary flexibility to deal with non-constituent focus, since focus structure is not directly determined on the syntactic tree. Note that the relation to the syntactic structure is not lost, as determining the basic information units is based on syntactic domains. For the aims of this paper, two IS-domains are directly relevant: the FOCUS (corresponding to RRG's AFD) and the NON-FOCUS. Both are subsets of the set IUS, structurally determined as shown before. The FOCUS (F) is a non-empty subset of the IUS, and the NON-FOCUS (NF) is the (possibly empty) complement set of the FOCUS with respect to the IUS. The partition to these IS-domains is the core of the representation of all focus structures, as illustrated in (4a) for object focus structures or in (4b) for subject-verb focus structures.

(4) Example focus structures

a. object focus:



b. subject + V focus:



How to derive these partitions is a complex matter. It is determined by the interplay of the language-specific focus marking strategies, the discourse context (in terms of questions under discussion) and the given communicative function. The set of IUs is structurally determined, and this set can formally be partitioned in various ways. These partitions are formally possible focus structures, that are constrained by focus marking and the local discourse context (e.g., an explicit question). A detailed discussion of all these aspects and this complex interplay goes beyond the scope of this paper, and need to be discussed in subsequent work.

The partition into the IS-domains essentially represents the focus structure of the given sentence. These IS-domains are based on the IUs in the sentence, and as such they are linked both to syntax and semantics. The relation to the syntactic domains, as well as the content of the IUs are shown above. What remains is the issue of how to capture the content of these IS-domains and their relations, which leads to the analysis of the function of focusing. Considering these issues, two distinctions are relevant: whether the FOCUS contains a single IU or multiple IUs ([±single IU]), and whether the FOCUS contains the IU of the main verb/predicate ([±V]). These aspects guide how to derive the content of the IS-domains, and also how these relate to each other. By these aspects we also distinguish four basic focus structures: complement focus ([-V, +single IU]), multiple focus ([-V, -single IU]), verb focus ([+V, +single IU]) and broad focus ([+V, -single IU]).

The content of the IS-domains FOCUS and NON-FOCUS corresponds to the IS notions of *focus* and *pragmatic presupposition* in terms of Lambrecht's (1994) theory of information structure. We take the core function of focusing in pragmatic terms: resolving the underlying issue or question under discussion (QUD; Roberts 2012). The focus structure of the sentence reflects its inherent issue, which is not necessarily the same as the explicit question (if any).

Similarly to Lambrecht (1994), we take the *pragmatic assertion* to be a special relation between the pragmatic presupposition and the focus. We propose that the content of the IS-domain NF is the inherent issue of the sentence, which is resolved by the content of the FOCUS. The matter of IS at the sentence level, i.e., the F-NF division, is anchored to an eventuality, given the basic assumption that declarative sentences describe eventualities.[4] An issue queries some part(s) of the described eventuality, or, intuitively speaking, it represents the "missing/requested" information within that particular eventuality under discussion. Considering what the inherent issue targets, there are two basic options: (i) the type of the eventuality is given and the query targets some particular participant(s) (see Section 4.1), and (ii) some participants are relationally given and the query targets the type of the eventuality that relates them (see Section 4.2). This opposition is reflected in the [±V] aspect distinguishing the basic focus structures.

4.1 Complement focus and multiple focus

In case the FOCUS contains a single IU different from the IU of the main verb (or main predicate), the content of the NON-FOCUS has an attribute with an unspecified value. This reflects the underlying issue that queries one of the participants of the described eventuality. Focusing indicates that the value of the given attribute is the content of the single IU within the FOCUS, which models a narrow focus structure, like the narrow object focus in (5a) and narrow adjunct focus in (5b). This is considered the pragmatic assertion of the sentence.

(5) a. narrow object focus:

$$[_{\text{CORE}}\ [_{\text{NP}}\ \text{Pete}]\ [_{\text{NUC}}\ \text{sold}]\ [_{\text{NP}}\ \text{the blue book}]\ [_{\text{PP}}\ \text{in London}]^{\text{PERI}}]$$

$$\{\text{IU} \qquad \text{IU} \qquad \{\ \text{IU}\ \}^{\text{F}} \qquad \text{IU}\ \}^{\text{NF}}$$

content of NON-FOCUS:[5]

$$e\begin{bmatrix} \textit{selling} \\ \text{ACTOR} & x[\textit{pete}] \\ \text{UNDG} & \boxed{2} \\ \text{LOC} & z[\textit{london}] \end{bmatrix}$$

content of FOCUS:

$$y\begin{bmatrix} \textit{book} \\ \text{COLOR} & \textit{blue} \end{bmatrix}$$

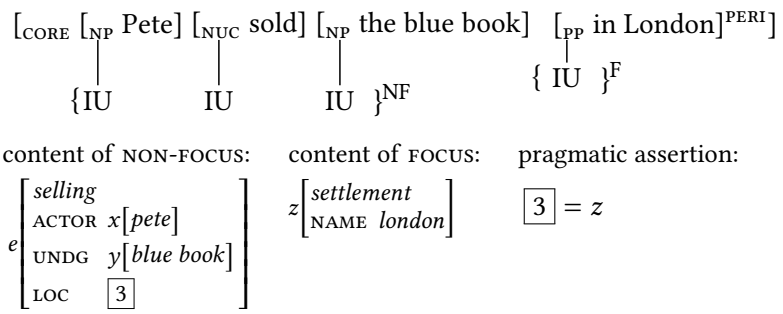
pragmatic assertion:

$$\boxed{2} = y$$

[4] In this paper, we only deal with declaratives, but, according to the theory of RRG, the analysis of IS equally applies to other sentence types. The extension of our formal model to interrogatives and imperatives is left for further work.

[5] For a simplification in the representations, at some places we use the following abbreviations: $x\begin{bmatrix} \textit{person} \\ \text{NAME} & \textit{pete} \end{bmatrix} \rightarrow x[\textit{pete}]$, $y\begin{bmatrix} \textit{book} \\ \text{COLOR} & \textit{blue} \end{bmatrix} \rightarrow y[\textit{blue book}]$, $z\begin{bmatrix} \textit{settlement} \\ \text{NAME} & \textit{london} \end{bmatrix} \rightarrow z[\textit{london}]$

b. narrow adjunct focus:



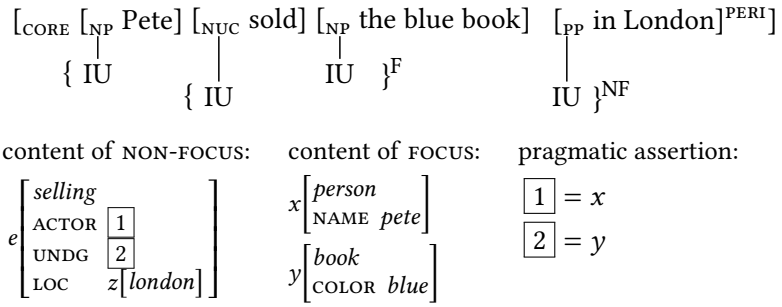
In complement focus structures, the calculation of the content of the FOCUS is straightforward: it equals the single IU it contains. The content of the NON-FOCUS is calculated by a composition of its IUs, restricted by the syntactic composition, which is registered in the derivation tree. In other words, the unification of the IUs in the NON-FOCUS is constrained by the syntactic operations and the corresponding unifications of the values of the respective index features.

The constructions where two (or more) complements are part of the FOCUS are subsumed under the focus structure type of *multiple focus*, illustrated in (7). Note that in case the IU of the verb and the IU of a complement (or the IUs of more complements) are within the FOCUS, they do not form a multiple focus, but are understood as a broad focus structure. See, for example, the English example in (6): a focal accent on the verb and on the indirect object can only be interpreted with a (non-constituent) broad focus structure.

(6) Pete GAVE the blue book to SAM.
QUD: *What did Pete do with the blue book?*

This suggests that we can only request the specification of the value of an argument/adjunct if the type of the event is known/given. In multiple focus structures, the values of two (or possibly more) attributes need to be specified, which is provided by the IUs within the FOCUS. This process, and thus the pragmatic assertion, is parallel to the cases in complement focus structures.

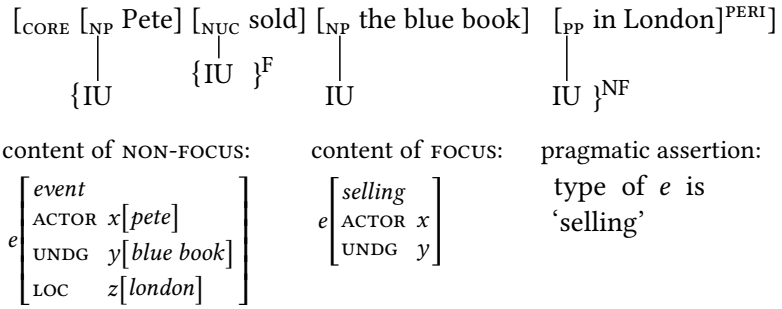
(7) multiple focus structure:



4.2 Verb focus and broad focus

The focus structures in the previous section all reflected the resolving of an underlying issue where one (or more) of the complements are queried, i.e., the type of the eventuality is known/given (part of the NON-FOCUS), while the value of one (or more) of the attributes in the event description must be specified. Cases of verb focus and broad focus structures differ as here the type of the eventuality needs to be specified by the focal part, while some of the attributes can be (and often are) given. Therefore, the pragmatic assertion is the type specification of the described eventuality, which can be simple as 'type: selling' or complex as 'type: selling the blue book'. To formally capture such complex types, the content of the FOCUS can be seen as a *frame type* (introduced by Balogh & Osswald 2021). The exact formal specification of such frame types and their relation to the content of the FOCUS needs a more thorough investigation, which we leave for further work. Nevertheless, the example in (8) reflects this idea, although presenting the pragmatic assertion still in an informal way.

(8) verb focus:



As illustrated in (8), in verb focus structure, the FOCUS contains the single IU by the verb/main predicate. The NON-FOCUS contains the information that the given participants are functionally related under an eventuality of an unknown type.[6] This information is jointly derived on the basis of the derivation tree and the set of IUs. The IUs are all connected under the node α, representing a yet unspecified eventuality. The FOCUS provides the type specification: *e* is of type 'selling'. The ACTOR and UNDERGOER attributes represent the obligatory attributes and thus a restriction as a consequence of having the event type 'selling'.

When the FOCUS contains the IUs of the verb and one (or more) of its arguments/adjuncts, we talk about a broad focus structure. Although these cases can be divided into further subtypes, their pragmatic assertion is uniformly captured as providing a possibly complex event type (in terms of frame types). The special subtypes that can be distinguished are: (i) cases where the NON-FOCUS is a singleton set (9), this type including the traditional "predicate focus" structure; (ii) cases where both the NON-FOCUS and the FOCUS are non-empty, non-singleton sets (10), these cases being often referred to as "non-constituent" focus in other approaches, and (iii) cases where the NON-FOCUS is an empty set, which is referred to as "sentence focus". In the latter focus structure, all IUs within the sentence are in the FOCUS, while the NON-FOCUS is empty. In such cases, the content of the whole sentence is considered new information. Nevertheless, an empty NON-FOCUS does not mean that such sentences are unrelated to the local discourse context (see, for example, the notion of "stage topic" by Erteschik-Shir 2007).

(9) a. (traditional) predicate focus:

$$[_{\text{CORE}}\ \underset{\{\text{IU}\}^{\text{NF}}}{[_{\text{NP}}\ \text{Pete}]}\ \underset{\{\text{IU}}{[_{\text{NUC}}\ \text{sold}]}\ \underset{\text{IU}}{[_{\text{NP}}\ \text{the blue book}]}\ \underset{\text{IU}\ \}^{\text{F}}}{[_{\text{PP}}\ \text{in London}]^{\text{PERI}}}]$$

content of NON-FOCUS:	content of FOCUS:	pragmatic assertion:
$e\begin{bmatrix} \textit{event} \\ \text{ACTOR}\ x[\textit{pete}] \end{bmatrix}$	$e\begin{bmatrix} \textit{selling} \\ \text{ACTOR}\ x \\ \text{UNDG}\ y[\textit{blue book}] \\ \text{LOC}\ z[\textit{london}] \end{bmatrix}$	type of *e* is 'selling the blue book in London'

[6] The type specification 'event' in the frame is highly underspecified.

b. relationally given UNDERGOER:

$$[_{\text{CORE}}\ [_{\text{NP}}\ \text{Pete}]\ [_{\text{NUC}}\ \text{sold}]\ [_{\text{NP}}\ \text{the blue book}]\ [_{\text{PP}}\ \text{in London}]^{\text{PERI}}]$$
$$\{\text{IU} \qquad \text{IU} \qquad \{\ \text{IU}\ \}^{\text{NF}} \qquad \text{IU}\ \}^{\text{F}}$$

content of NON-FOCUS:	content of FOCUS:	pragmatic assertion:
$e\begin{bmatrix} \textit{event} \\ \text{UNDG}\ \ y[\textit{blue book}] \end{bmatrix}$	$e\begin{bmatrix} \textit{selling} \\ \text{ACTOR}\ \ x[\textit{pete}] \\ \text{UNDG}\ \ y \\ \text{LOC}\ \ z[\textit{london}] \end{bmatrix}$	type of e is 'selling by Pete in London'

In both examples in (9), the NON-FOCUS expresses a yet unspecified eventuality, of which one of the participants is specified. These structures correspond to the topic-comment division, however, we claim that the topic-comment structure represents a different aspect of IS, that needs to be represented separately. It also requires a representation of the referential structure of the sentence in context, that is not yet included in our model.

The examples in (10) illustrate different cases where the verb together with an argument or adjunct form the FOCUS. In our approach, these cases are captured parallel to the ones in (8) and (9): the uniform core function of focusing is the specification of the (possibly complex) type of the eventuality under discussion.

(10) a. focal subject + V:

$$[_{\text{CORE}}\ [_{\text{NP}}\ \text{Pete}]\ [_{\text{NUC}}\ \text{sold}]\ [_{\text{NP}}\ \text{the blue book}]\ [_{\text{PP}}\ \text{in London}]^{\text{PERI}}]$$
$$\{\text{IU} \qquad \text{IU}\ \}^{\text{F}} \qquad \{\ \text{IU} \qquad \text{IU}\ \}^{\text{NF}}$$

content of NON-FOCUS:	content of FOCUS:	pragmatic assertion:
$e\begin{bmatrix} \textit{event} \\ \text{UNDG}\ \ y[\textit{blue book}] \\ \text{LOC}\ \ z[\textit{london}] \end{bmatrix}$	$e\begin{bmatrix} \textit{selling} \\ \text{ACTOR}\ \ x[\textit{pete}] \\ \text{UNDG}\ \ y \end{bmatrix}$	type of e is 'selling by Pete'

b. focal V + adjunct:

$$[_{\text{CORE}}\ [_{\text{NP}}\ \text{Pete}]\ [_{\text{NUC}}\ \text{sold}]\ [_{\text{NP}}\ \text{the blue book}]\ [_{\text{PP}}\ \text{in London}]^{\text{PERI}}]$$
$$\{\text{IU} \qquad \{\text{IU} \qquad \text{IU}\ \}^{\text{NF}} \qquad \text{IU}\ \}^{\text{F}}$$

content of NON-FOCUS:	content of FOCUS:	pragmatic assertion:
$e\begin{bmatrix} \textit{event} \\ \text{ACTOR}\ \ x[\textit{pete}] \\ \text{UNDG}\ \ y[\textit{blue book}] \end{bmatrix}$	$e\begin{bmatrix} \textit{selling} \\ \text{ACTOR}\ \ x \\ \text{UNDG}\ \ y \\ \text{LOC}\ \ z[\textit{london}] \end{bmatrix}$	type of e is 'selling in London'

5 Conclusion and further issues

5.1 Concluding remarks

In this paper, we introduced a first proposal towards a grammar formalism that offers a novel approach to the representation and analysis of information structure, in particular the focus structure of the sentence. Our proposal is based on the theoretical grounds of Role and Reference Grammar (Van Valin & LaPolla 1997, Van Valin 2005) and Lambrecht's (1994) theory of information structure, formally implemented using Tree-Wrapping Grammar (Kallmeyer et al. 2013, Kallmeyer & Osswald 2023) and decompositional frame semantics (Kallmeyer & Osswald 2013, Löbner 2014, Petersen 2015).

The core motivating phenomenon in this paper is "non-constituent focus", that is problematic for traditional compositional analyses capturing focus structure with the use of syntactic F-marking. The particular problems with this special information structure are addressed by Büring (2016), who offers a solution without F-marking, using Unalternative Semantics (Büring 2006, 2015). Büring's approach offers a highly appropriate and elegant solution for semantic theories where focus is defined as the source of alternatives. However, this approach not only eliminates the syntactic F-marking, but also the representation of the focus structure. We argue that from a linguistic and grammatical perspective this can be disadvantageous, since focus structure plays an essential role in the different stages at the linking between syntax and semantics (Bentley 2023, Latrouite & Van Valin 2023, Van Valin 2005).

In our approach, we aim to uniformly capture the various focus structures, in a way that straightforwardly extends to cases previously referred to as "non-constituent focus". The core of our proposal is that focus structure is not directly determined on the nodes of the constituent structure. Instead, information structure (containing focus structure) is represented in a separate module, which is linked both to syntax and to semantics. Consequently, the structures found at the level of IS do not need to be parallel to the structures found at the level of syntax, which is essentially correct, and naturally prevents the issues raised by "non-constituent" focus in traditional compositional accounts. The general architecture of RRG and our representation of IS are considerably different. In our approach, information units (IUs) play an essential role in determining the focus structure. Crucially, the IUs are linked to syntactic domains, but the focus structure is not read off the syntactic structure. Therefore, when the basic IUs are defined, any combination of them can make up the content of the FOCUS. The IUs are determined structurally together with the corresponding pieces of

semantic representations. Focus structure is essentially represented as a partition of the set of IUs into two IS-domains: the NON-FOCUS and the FOCUS. The core function of focusing is a pragmatic structuring, represented by the content of the NON-FOCUS and the FOCUS (which correspond to the underlying issue and the focus respectively), and the pragmatic assertion, which is seen as a special relation between the issue and the content of FOCUS. The formal derivation of the focus structure and the content of the IS-domains is uniform across all cases. A difference in pragmatic assertion is proposed based on whether the verb/main predicate is part of the FOCUS.

5.2 Further issues

As any new proposal, our approach has several loose ends, that ask for further investigation in terms of formalization and empirical coverage. For the formalization, we have two main tasks directly ahead of us: (i) the formal derivation/ calculation of the content of the NON-FOCUS and the FOCUS needs to be worked out in more detail, and (ii) the representation of their relation, i.e., the pragmatic assertion, needs to be formally characterized. As for the first issue, we proposed in this paper that this calculation is determined by the IUs and the derivation tree. Currently, we have two basic processes: in argument focus structures, the sub-tree corresponding to the IU within the FOCUS is cut-off the derivation tree, while the remaining tree determines the content of the NON-FOCUS; in broad focus structures, the derivation tree is divided into two sub-trees, both including a copy of the root node (which reflects that the content of the two domains describes information on the same eventuality). This needs to be refined in a more uniform way that applies to further problematic cases as well. We are currently exploring the idea of defining a more flexible composition, where we model the background-focus distinction within a construction, such that certain pragmatic factors are reflected in syntactic composition. This revision would also be seen as part of the formal characterization of the linking between syntax and pragmatics, which is core to our modular grammar architecture. Working out the second issue, our initial proposal is to include complex frame types. The formal definitions of this idea are currently being developed.

In this paper, we discussed rather basic constructions, that best served as a starting point of our formal grammatical model, and best facilitate the aim of introducing our approach and the basic processes globally. Needless to say, for a comprehensive model, we need to verify that our approach is applicable to more phenomena and complex constructions cross-linguistically. Currently, we

are investigating different types of adjunct modifiers that do not necessarily introduce an attribute in the event description (e.g., *almost*, *completely*, *intentionally*), clausal adjuncts and complex noun phrases. The core issues are what exactly counts as a basic IU and how to capture IUs and IS-domains in embedded constructions. Furthermore, we need to extend our proposal to further languages beyond English. Currently, we are looking at different case studies in Hungarian, Japanese and Lakota.

5.3 A brief note on related formalisms

While our approach is based on the theoretical grounds of RRG, the core proposal of the formal representation of the focus structure does not strictly require RRG-like syntactic structures. From the theoretical point of view, the important aspect of the grammatical model is its modular architecture without the primacy of syntax, and the linking between the different representation levels. The linguistic theory of RRG is developed proposing such an architecure, therefore it provides an excellent ground for our formal implementation. Nevertheless, the core proposal in this paper can be worked out with a standard Lexicalized Tree-Adjoining Grammar (LTAG) with frame-based semantics, and possibly also within a construction-based Lexical Functional Grammar (LFG) model (e.g., Findlay 2023). The theories of RRG and LFG both argue for a modular grammar architecture, which raises the issue whether the two offer similar or comparable approaches to information structure. The possibilities of the above mentioned alternative formal models, as well as a thorough comparison of the approaches to information structure within RRG (see, e.g., Van Valin & LaPolla 1997, Van Valin 2005, Bentley 2023) and within LFG (see, e.g., Butt & King 1996, Dalrymple & Nikolaeva 2011, Dalrymple et al. 2019, Zaenen 2023) are left for further work.

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