THE SYNTACTIC PARSING OF ASD-STE100 ADVERBIALS IN ARTEMIS

Francisco J. Cortés-Rodríguez
Universidad de La Laguna, Spain

Carolina Rodríguez-Juárez
Universidad de Las Palmas de Gran Canaria, Spain

Abstract: This paper seeks to offer an update of the syntactic representation of adverbials in the Lexical Constructional Model and the multipurpose lexico-conceptual knowledge base, FunGramKB, and to implement the conditions that are necessary for an effective parsing of such constituents within ARTEMIS, a NLP prototype within FunGramKB for the computational treatment of the syntax and semantics of sentences. As regards the status of adverbials in the Layered Structure of the Clause (LSC) proposed in Role and Reference Grammar, it is striking that they have been somewhat sidelined, despite the programmatic proposal in Van Valin (2005) for a distribution of adjuncts along the different layers in the LSC. Since then, almost no further contribution has been offered to fully expand this new scheme. Thus, our aim is to fully embody a layered approach for adverbials and to adapt our proposal to the conditions imposed by the Grammar Development Environment in ARTEMIS, by developing the rules that are necessary for the parsing of the catalogue of adverbials of a corpus written in the controlled natural language ASD-STE100.

Keywords: adjuncts, FunGramKB, ARTEMIS, parsing rules, simplified technical English.

1. INTRODUCTION

As it is already well established from a variety of studies (Periñán-Pascual, 2012, 2013; Fumero & Díaz, 2017; Mairal-Usón, 2017), for natural language processing (NLP) systems to be able to operatively and accurately develop NLP tasks, they have to be based on robust linguistic models which provide text processing applications with the necessary and adequate linguistic input for the parsing and production of utterances. This is the case of the knowledge base FunGramKB (Periñán-Pascual, 2013; www.fungramkb.com), which is "a user-friendly online environment for the semiautomatic construction of a multipurpose lexico-conceptual knowledge base for NLP systems" (Mairal-Usón, 2017:243). FunGramKB is grounded in two solid linguistic models, namely the functional theory of Role and Reference Grammar (RRG) (Van Valin & LaPolla, 1997; Van Valin, 2005) and the Lexical Constructional Model (LCM) (Ruiz de Mendoza, 2013; Ruiz de Mendoza & Galera, 2014), both of which contribute to the development of the lexical and grammatical modules of the knowledge base (see Figure 1). The lexical module (Lexicon) is based on the formalisms of RRG as regards the lexical representation of predicates (for example, *Aktionsart* ascription, macrorole assignment, status of variables, logical structures, etc.), whereas the grammatical module (Grammaticon) relies on the constructionist approach of the LCM for the classification of constructions into four different layers: argumental, implicational, illocutionary and discursive. FunGramKB also includes a language independent conceptual module which encodes deep conceptual semantic knowledge in the Onomasticon (encyclopaedic knowledge), the Cognicon (procedural knowledge) and the Ontology (hierarchical catalogue of concepts).

The scope of this paper is restricted to the study of adverbials in the English language and we seek, firstly, to offer an update of the syntactic representation of adverbials in the LCM and in FungramKB. Notwithstanding their centrality in any grammatical model, the status of adverbials in RRG has received, in our opinion, too little attention. Despite the radical reanalysis of such constituents proposed in Van Valin (2005), the impact of this proposal has been so scarce that most subsequent studies within the model still maintain the original single-layer analysis described in Van Valin and LaPolla (1997) (with some exceptions as are Toratani (2007) and Mora-Bustos

(2012)). Only recently has the work by Díaz-Jorge (2017) offered an extensive proposal for the analysis of adjuncts based on the programmatic description of Van Valin (2005).
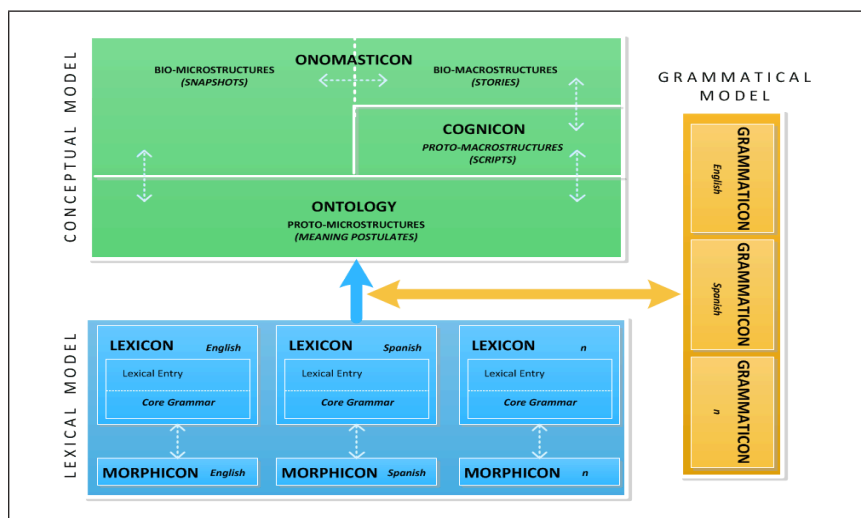

Figure 1. The FunGramKB architecture (www.fungramkb.com).

Secondly, we aim to implement the conditions which are necessary for an effective parsing of adverbials within ARTEMIS. ARTEMIS stands for "Automatically Representing Text Meaning via an Interlingua-based System" and is a parsing device that incorporates RRG analytical tools and that FunGramKB exploits for the automatic generation of the syntactic and semantic representation of linguistic expressions in the form of a conceptual logical structure (CLS), which is an enhanced representation of RRG logical structures (Periñán-Pascual & Arcas-Túnez, 2014). We also aim to provide the rules that are needed for the computational parsing of adverbials and which are stored in the Grammar Development Environment (GDE) module within ARTEMIS. Since the computational workability of ARTEMIS is still to be tested, we have chosen to apply it to a Controlled Natural Language, namely ASD-STE100, with the assumption that it will help to validate the performance of our parser. Hence, the scope of our analysis will be confined to the catalogue of adverbials that can be found in the Airbus corpus written in this controlled language. This will necessarily have to be taken into account in the set of rules that we have devised, as the range of adverbials in such a controlled language is expected to be more restricted than that found in natural English.

We have organised the rest of this paper in 4 sections. Section 2 deals with the description of adverbials based on different innovative proposals in order to obtain an appropriate framework for the syntactic parsing of adverbials in ARTEMIS. The third section offers an overview of the methodological adaptations required for an effective formalization of adverbials in ARTEMIS. In doing so, special attention will be paid to the following issues: the integration of an intermediate constructional node between the core and the clause nodes in the layered structure of the clause (namely, an L1-CONSTR), and the replacement of the operator projection by feature-bearing matrixes and unification mechanisms. The description of the positional and peripheral preferences of adverbials in Airbus ASD-STE100, together with the set of rules that we have formulated, will be offered in the fourth section of this paper. Finally, some concluding remarks will be presented in Section 5.

2. ADVERBIALS IN RRG AND THE LCM: A VERY BRIEF HISTORY

2.1. RRG Syntactic Representations

The Lexical Constructional Model (LCM) syntactic representation of sentences is primarily based on the Layered Structure of the Clause (LSC) as proposed in Role and Reference Grammar (RRG) (Van Valin & LaPolla, 1997; Van Valin, 2005; Pavey, 2010), but incorporates some variations motivated by the integration of constructional structures.

The LSC aims at capturing both universal and language-specific aspects of syntactic structures. With respect to universal features, two basic distinctions are considered: the first ones accounts for the difference between predicating elements and non-predicating elements, whereas the second concerns those elements that are arguments of the predicate and those which are not. This second opposition defines three syntactic units in the structure of the clause: the *nucleus* (which includes a verbal, an adjectival or a nominal predicate), the *core* (which

contains the nucleus and its arguments), and the *periphery* (which includes constituents that are not predicate arguments). This is represented in the so-called *Constituent Projection*, as shown in Figure 2:
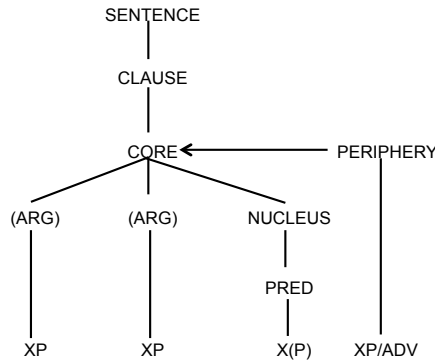

Figure 2. Formal representation of the LSC (Constituent Projection) (from Van Valin & LaPolla, 1997:31).

Concerning language-specific aspects, the Constituent Projection also incorporates two additional positions, the *extra-core* and the *detached positions*, which are both pragmatically motivated. Thus, in languages like English, fronted constituents and interrogative elements in questions occupy the PreCore Slot, whereas detached constituents are separated by a pause from the rest of the clause, a sign of their markedness for pragmatic purposes (Figure 3).
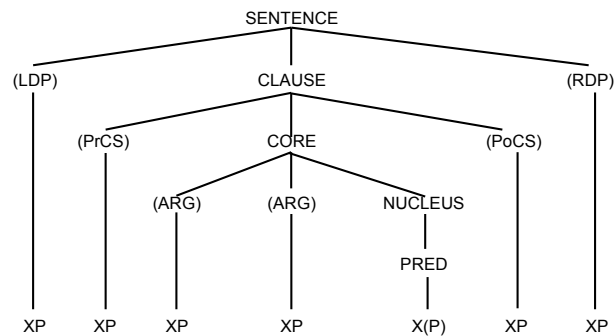

Figure 3. General format of the Constituent Projection (LSC) with extra-core and detached positions
(from Van Valin & LaPolla, 1997:38)

Figure 4 is a representation of the Constituent Projection analysis of the sentence "Yesterday, what did Robin show to Pat in the library?" (Van Valin & LaPolla, 1997:36):
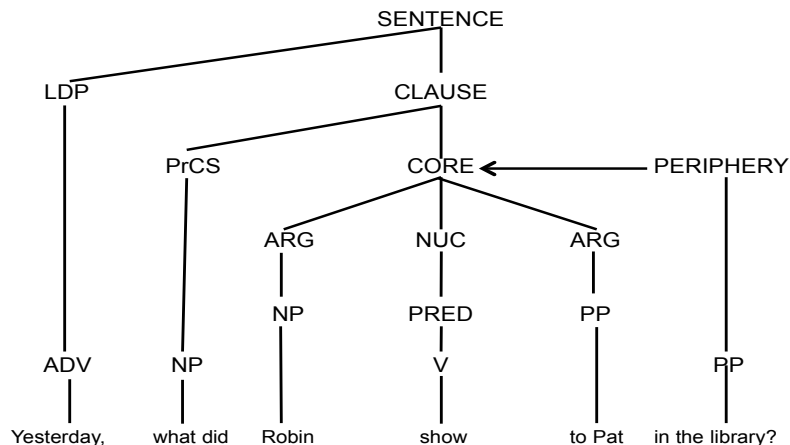

Figure 4. The LSC of a clause in English (Van Valin & LaPolla, 1997:36).

With regard to the status of adverbials, they are described as peripheral elements, acting as modifiers of the CORE node, as shown in Figures 2 and 4. It is interesting to note that the *periphery* node is not analysed as a daughter of any other node, but is related to the *core* by an arrow, a sign of its status as modifier of this layer.

It should be highlighted that the Constituent Projection of the LSC only provides a syntactic analysis of content units (words and phrases); function words such as auxiliaries and grammatical morphemes are analysed as operators in a different projection within the LSC. Operators are grammatical categories like aspect, tense or illocutionary force and modify different layers of the clause. Since they are technically not part of the nucleus, core or periphery, but rather modify these layers, they are represented separately in a different projection within the LSC, as proposed by Johnson (1987) in the following *projection grammar* formalization (Figure 5):
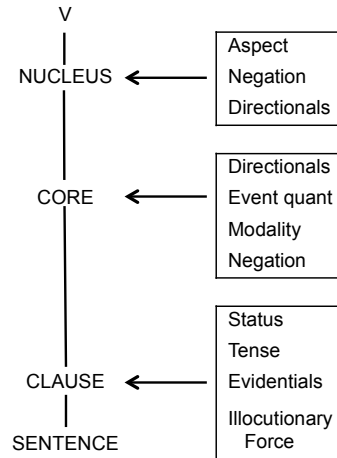

Figure 5: The Operator Projection (adapted from Van Valin, 2005:12).

A detailed syntactic description of a clause will then merge both the Constituent and Operator Projections, thus obtaining a fully detailed LSC analysis, as represented in Figure 6:
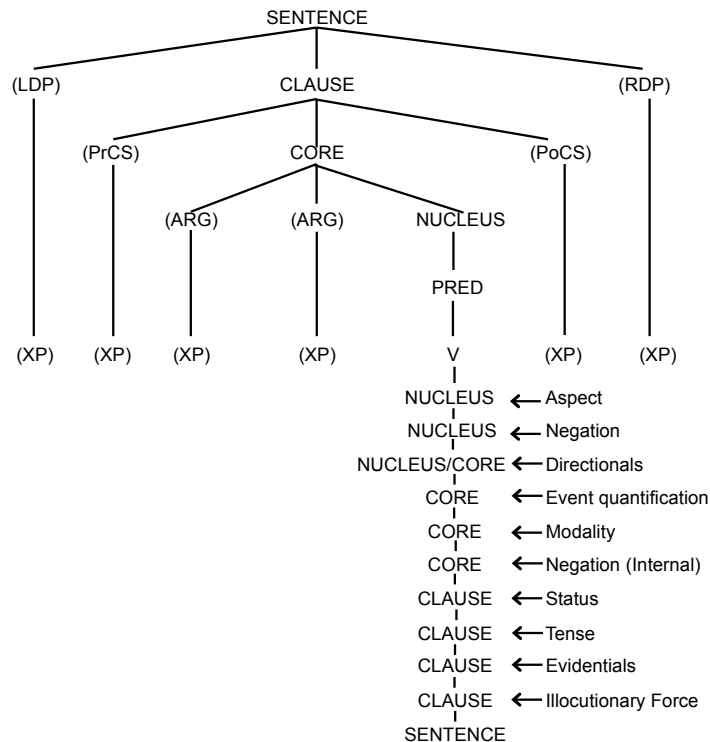

Figure 6. The Layered Structure of the Clause (Constituent and Operator Projections) (Van Valin, 2005:12).

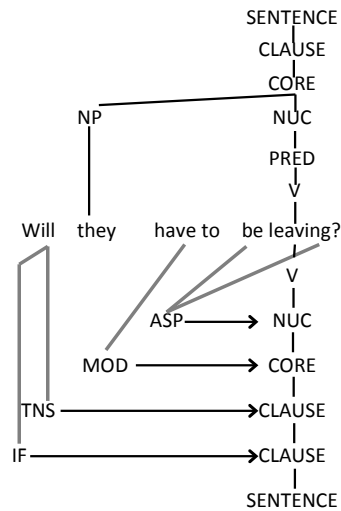Figure 7 shows the LSC analysis of an English sentence:

Figure 7: English clause structure (Van Valin, 2005:14).

2.2. The syntax and semantics of adverbials in RRG

As has been described in the preceding section, optional constituents are described in Van Valin & LaPolla (1997) as peripheral elements modifying the core layer in the Constituent Projection within the LSC. However, in Van Valin (2005:19-21) there is an important change as regards the description of such peripheral constituents since it is proposed that adverbials should be distributed as modifiers of the three different layers of the clause, namely, the nucleus, core and clause layers. Thus, not only must a *core periphery* be contemplated in the syntactic analysis, but also a *nuclear periphery* and a *clause periphery*. Van Valin (2005:19-20) claims that aspectual adverbs like *completely* and *continuously* modify the nucleus; *pace* and *manner* adverbials together with *time* and *place* adjuncts are core modifiers; and *epistemic* and *evidential* adverbs (like *probably* and *obviously*, respectively) modify the clause. The example (Van Valin, 2005:22) in Figure 8 illustrates the three-layered analysis of adverbs:
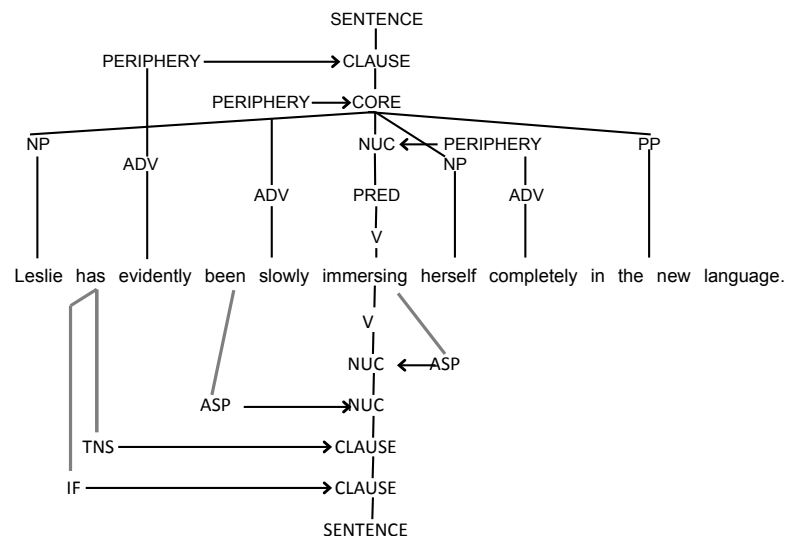
Figure 8. The LSC of an English sentence including peripheral elements (Van Valin, 2005:22).

Despite the relevance of this new analysis, it is significant that its impact within the RRG model has been very scarce. A revision of the recent literature in this model reveals that most studies still maintain the original single-layer analysis of adverbs as core peripheral constituents, thus neglecting the new programmatic nature of the proposal in Van Valin (2005) for a distribution of adjuncts along the different layers in the LSC. To our knowledge, only the work by Mora-Bustos (2012) has applied the new proposal to the description of adverbials in Spanish. Even though Mora-Bustos (2012) adds some more types of adverbs to the brief classification proposed in Van Valin (2005) – mainly because of the type of semantic information that they convey – we believe that this work does not provide a fully-embodied account of the typology of optional constituents within the new RRG framework.

Díaz-Jorge (2017) seems to be a more solid proposal for a complete implementation of the three-layered distribution of adverbials along the LSC, as it expands the typology and proposes a hierarchical arrangement of these optional elements by applying different criteria to support her classification. Díaz-Jorge (2017:13-14) explains that despite the fact that Van Valin's (2005) new system of classification for adjuncts is a turning point as regards the status of these constituents in RRG, it still remains insufficient in order to give a complete description of the syntax of adjunct modifiers. Therefore, she proposes: (i) to establish a detailed typology of adverbials in English along the lines of this new analysis, and (ii) to establish some criteria to support the distribution of adverbials as peripheral modifiers along the three layers in the enhanced LSC.

Concerning the first issue, Díaz-Jorge (2017) offers a taxonomy of adverbials by combining three different sources: the types mentioned in Van Valin (2005), the typology of the so-called *satellites* from Dik's (1997) Functional Grammar (FG), and the classification of *adjuncts* and *disjuncts* from Quirk *et al.* (1985)[1]. Her classification is captured in Table 1:

Layers	Adjunct Types	Subtypes	Examples
CLAUSE	Illocutionary		*briefly, frankly*
	Evidential		*reportedly, presumably*
	Epistemic		*cleverly, certainly*
CORE		Concession	*despite X, in spite of X*
	Contingency	Purpose	*for X, in order to X*
		Reason	*because of X, on account of X*
		Company	*with X*
	Process	Beneficiary	*for X*
		Manner	*silently, recklessly*
		Means/Instrument	*(travel) by car, (shoot) with a rifle*
	Pace		*quickly, slowly*
		Direction	*towards X*
	Space	Path	*along X, across X*
		Source	*from X*
		Time position	*today, tonight*
	Temporal	Span	*since X, by X, recently*
		Duration	*for X time*
NUCLEUS	Focusing	Restrictive/Limiters	*alone, just, only*
		Additives	*further, also, even*
	Degree		*still, completely*
	Frequency	Definite frequency	*hourly, once, twice*
		Indefinite 1(High frequency)	*often, regularly*
		Indefinite 1 (Usual/Mid frequency)	*on most days, generally, normally*
		Indefinite 2 (Low frequency)	*hardly ever, seldom, scarcely*
		Indefinite 2 (Zero frequency)	*never, no longer, nevermore*
		Indefinite 3 (Continual/ Universal frequency)	*always, continually*

As can be seen in Table 1, adjuncts are already distributed among the three layers of the LSC. The methodology developed by Díaz-Jorge (2017) in order to obtain this classification is based on two types of criteria, namely the semantic import of adverbials and their positional behaviour. With reference to the semantic aspects, this work establishes a correlation between the meaning of the different types of adjuncts and the operators of the LSC, in a similar fashion to the approach followed in the description of satellites in Functional Grammar (Dik, 1997). In FG, satellites are always depicted in lockstep with the operators so that both types of constituents are allocated to one layer by considering their semantic parallelism. In other words, both satellites and operators are considered as bearers of the same type of additional information pertaining to one of the layers in the semantic contour of clauses, their difference being morpho-lexical: satellites are lexical, and phrasal modifiers and operators are closed-class lexical units or morphemes. Van Valin (2005:19-20) also recognizes that "[a]dverbs are not operators, however,

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[1] Both Van Valin (2005) and Díaz-Jorge (2017) dispense with the distinction adjunct-disjunct and consider both as adjuncts; we will also use this as a cover term.

but do interact with operators". Díaz-Jorge (2017) applies this same rationale and establishes the equipollence between every semantic type of adverbial and a corresponding operator in the LSC. In fact, to ensure a proper equivalence between adverbials and operators, Díaz-Jorge (2017) not only considers the description of these units in RRG, but also pays much attention to the richer semantic descriptions offered by Quirk *et al.* (1985) and Dik (1997). The latter brings about a further methodological difficulty that she manages to overcome: finding the correspondence between the three-layer analysis of clauses in RRG and the four-tier description of FG. Another consequence of this approach is the fact that *reason*, *purpose* and *concessive* adjuncts are classified as core adverbials, whereas Van Valin (2005:195-196) proposes taking them as clause peripheries. Van Valin's analysis is based on the ordering co-occurrence restrictions that *purpose* and *concession* clauses have with regard to other core peripheral subordinate clauses: all these types appear consistently in clause final position but there is a preference to locate *purpose* and *concession* subordinate clauses after *setting* locative and *temporal* clauses in English. He further extends this classification to all *purpose* and *concessive* adjuncts. We believe, however, that these restrictions are not enough to justify the analysis proposed for these types of adverbials, but merely show some ordering restrictions which occur within the group of core adjuncts, a phenomenon similar to that taking place within certain operators from the same layer.

Díaz-Jorge (2017) also uses the positional criterion in order to confirm the distribution of adjuncts along the LSC. By paying attention to the more frequent and, therefore, more natural positions in which adjuncts (especially adverbs) tend to occur, and their relative flexibility to appear in several positions, it was possible to further argue that they were modifiers of one layer or another. Van Valin (2005:21) refers to this criterion when he states that "unlike operators, which have fixed positions, adverbs may occur either before or after the verb, but in both cases the scope constraints require that the nuclear adverb be closer to the verb than the core adverb, and likewise for the core adverb with respect to the clausal adverb". Following this line of reasoning, Díaz-Jorge (2017:18-19) draws some positional tendencies from her analysis based on an extensive sample of adverbials obtained from the British National Corpus (BNC), which can be summarized as follows:

- *Nuclear adjuncts*: all those adjuncts which tend to appear in mid position and are very rigid as it is not very common for them to appear in other spaces within the clause. For example, "You can **regularly** replace the fronts but not the straps" (BNC K6X), "She is reading a letter she has **just** written to her parents" (BNC FU4).

- *Core adjuncts*: all those adjuncts which tend to appear in end position and are very flexible as they are able to occur easily in other different positions as well. For example, "[…] a correspondingly green snake slithered **silently** across the wet patch." (BNC AK6), "I've enjoyed my first year as a pro **despite** everything" (BNC C9E).

- *Clausal adjuncts*: all those adjuncts which tend to appear in initial positions and do not usually appear elsewhere. For example, "**Frankly**, until somebody finds a better way to build a GTi, we´re […]" (BNC CFS), "**Presumably**, it was felt that businessmen could take care of themselves" (BNC 6T).

Let us now consider how this classification can be integrated within ARTEMIS in order to automatically obtain an effective parsing of adjuncts in English.

3. ADVERBIALS IN ARTEMIS

Once the updated analysis of adverbials in RRG (and the LCM as well) has been attained (Section 2), this section describes how we have had to adapt this analysis to the conditions imposed by the Grammar Development Environment (GDE) in ARTEMIS, which necessarily implies the need to address two key issues: firstly, we will briefly comment on the adaptations that have had to be made to the Constituent Projection from RRG in order to integrate certain features from the LCM and FunGramKB, which are essential for the architecture of ARTEMIS and, specifically, of its Grammar Development Environment (GDE) module (Section 3.1). Secondly, we will have to devise in what way peripheries are to be integrated into the syntactic rules that form part of the GDE (Section 3.2).

3.1. A brief description of ARTEMIS and the Grammar Development Environment

As already mentioned in the introductory section of this paper, ARTEMIS ("Automatically Representing Text Meaning via an Interlingua-based System") is a NLP prototype that has been implemented within FunGramKB and is conceived as a syntactico-semantic parsing resource for the computational treatment of the semantics and syntax of linguistic expressions (Periñán-Pascual, 2013; Periñán-Pascual & Arcas-Túnez, 2014). ARTEMIS resorts to the shallow and deep semantic information that is stored in the different modules of FunGramKB (the lexical, grammatical and conceptual modules (see Section 1)) in order to understand fragments of natural language and

bind them to their grammatical and semantic structure. In this process, three components are activated: the GDE, the Conceptual Logical Structure (CLS) constructor and the COREL-Scheme Builder (Figure 9):
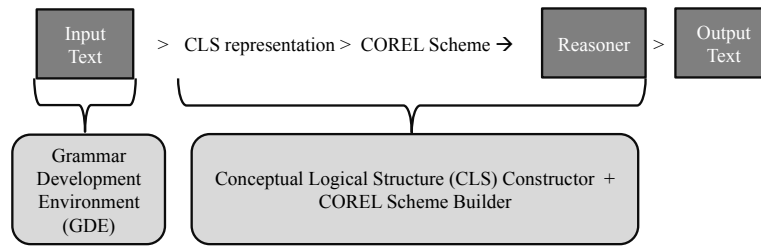

Figure 9. The architecture of ARTEMIS.

The GDE is responsible for decoding the morphosyntactic behaviour of predicates in the form of a parsed tree by applying the syntactic, constructional and lexical rules which are comprised within it. As explained in Cortés-Rodríguez (2016:81), the syntactic rules in the GDE "account for the generation/recognition of the underlying LSC"; constructional rules "guide the embedding of the structure of argument-predicate constructions (…) into the enhanced LSC"; and lexical rules "tokenize the abstract features encoded in the LSC by resorting to the information stored in the Lexicon and the Ontology of FunGramKB" (Cortés-Rodríguez, 2016:81).

In the next phase in the process, the shallow semantic representation of sentences is transformed into conceptually deeper structures in the CLS Constructor. As already mentioned, a CLS is an enhanced text meaning representation of RRG logical structures which includes *Aktionsart* ascription, the number of constructional variables of the predicate, thematic roles, macrorole functions (Actor/Undergoer), phrasal category, type of argument (argument, argument adjunct or a nucleus which contains the predicate), etc. The CLS is then turned into COREL (COnceptual REpresentation Language), which is the formal language that formalizes conceptual knowledge in FunGramKB (Cortés-Rodríguez, 2016:80; Fumero & Díaz, 2017). Example 1 by Fumero & Díaz (2017:38) illustrates this phase:

1.   Louise had baked a cake for the kids.

   CLS:

   $<_{IF}^{DECL}<_{TENSE}^{PAST}<_{CONSTR\_L1}^{FBEN}<_{CONSTR\_L1}^{KER2}<_{AKT}^{CACC}<[+BAKE\_00(\%LOUISE\_00\text{-}Agent, +CAKE\_00\text{-}Referent, +CHILD\_00\text{-}Beneficiary)] >>>>>>$

   Extended COREL scheme:

   $+(e1: +BAKE\_00 (x1: \%LOUISE\_00)_{THEME} (x2: +CAKE\_00)_{REFERENT} (f1: (e2: +DO\_00 (x1)_{AGENT} (e1)_{REFERENT} (f2: +CHILD\_00)Beneficiary))Purpose)$

As described in Periñán-Pascual & Arcas-Túnez (2014) and Cortés-Rodríguez & Mairal-Usón (2016), the RRG descriptive apparatus has undergone two necessary adaptations in the implementation process of ARTEMIS: (i) the integration of an intermediate constructional node, L1-CONSTR, in the layered structure of the clause between the CORE and the CLAUSE nodes; and (ii) the substitution of the operator projection by feature-bearing matrixes and unification mechanisms. The first modification is a direct consequence of the constructional orientation contributed by the Lexical Constructional Model (LCM) (Ruiz de Mendoza, 2013; Ruiz de Mendoza & Galera, 2014) in the design of both FunGramKB and ARTEMIS. According to the LCM, the syntactico-semantic contour of sentences is the joint result of a predicate-based approach (as the one from RRG) enhanced with the information from a repository of constructional structures (*Constructicon*) classified in terms of different levels of schematization. The four types of *Constructicons* are inspired in the four constructional layers of the LCM and are stored in the *Grammaticon*, which enriches FunGramKB in the sense that it can deal with both "the propositional and the non-propositional dimensions of meaning" (Mairal-Usón, 2017:246).

Therefore, the syntactic structure of sentences has to contemplate not only the projection of arguments from basic predicate frames in the Lexicon – described as *kernel constructions* in Periñán-Pascual (2013:214) – but also the possible modifications of such kernel frames (in terms of additions, reductions, shifts of constituents, or, even, as a result of different *Aktionsart* ascription) which involve the syntactic information pertaining to Level-1 (non-kernel) Constructions. Kernel constructions account for the configuration of the CORE in unmarked cases, as the core houses by default the arguments and the primary predicate of every clause. L1-Constructions, on the other hand, quite often introduce a secondary predicate (NUC-S), as, for instance, in resultatives; or an Argument-Adjunct (AAJ), as is the case of Beneficiary constituents like "for her sister" in "Ana caked a pumpkin pie for her

sister". There are even cases in which both types are simultaneously added as in "Bruno barks doors (AAJ) open (NUC-S)", which is analysed in the following way (Cortés-Rodríguez & Mairal-Usón, 2016:95) (Figure 10):
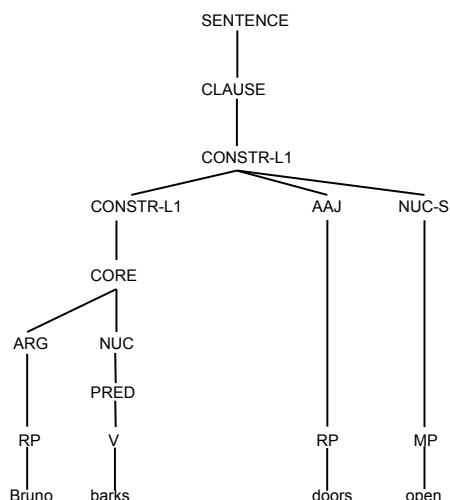

Figure 10: The enhanced LSC of an English sentence (Cortés-Rodríguez & Mairal-Usón, 2016:95).

The introduction of this new layer (CONSTR-L1) brings about some other changes, as is the case of the PreCore Slot Position (clause initial position), which has been re-described as a PreConstr-L1 position. In the case of adverbials, it seems feasible to reanalyze core adverbials as peripheral units modifying the CONSTR-L1 layer, according to the criteria proposed in Díaz-Jorge (2017): firstly, the semantic typology of L1-Constructional adjuncts would be the same as the one proposed for core adjuncts; secondly, their positional preferences are almost identical, as they tend to appear in clause final position[2]. Figure 11 illustrates the adaptations that have been incorporated as a result of the introduction of the CONSTR-L1 layer:
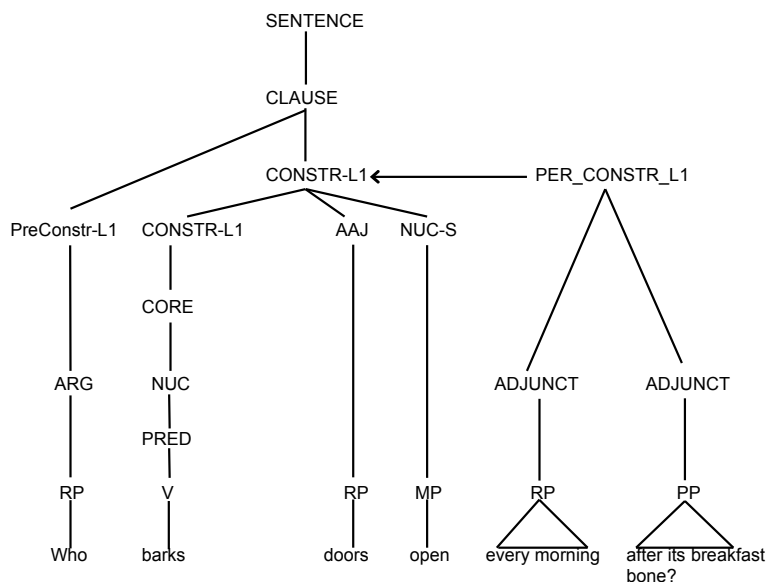

Figure 11. Analysis of an English sentence with core adverbials as peripheral units modifying the CONSTR-L1 layer.

Arguably, there would be only one possible case to justify the distinction between core and L1-Construction adjuncts, and that is when an adverbial appears in core final position followed by another constituent introduced by a non-kernel L1-Construction, as in example (2):

2.   [[I bake gluten-free bread] CORE (Kernel2) every Wednesday (Time Adjunct) for my celiac clientele (Beneficiary. AAJ)] - L1 CONSTRUCTION

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[2]   This is especially true of prepositional phrase adjuncts; as explained in Van Valin (2005:21), they normally follow the core (or in our analysis, the L1-Construction), and, if they precede the core (or the L1-Construction), they must be in the PreC-L1 position or Left-detached position.

However, we believe that this can be rather reinterpreted as a marked variant of the default final L1-Construction position (see Section 3.2 for a more detailed explanation).

The second methodological adaptation that is required for an effective formalization of adverbials in ARTEMIS consists of the replacement of the operator projection by feature-bearing structures called AVMs (Attribute-Value-Matrices), which encode the selectional and semantic information of different types of grammatical constituents in the format of attributes and values. This type of information cannot be retrieved from the Lexicon, the Grammaticon or the Ontology of FunGramKB (Cortés-Rodríguez, 2016:80-81). The AVM for the category *Adjunct* would be as follows:

```
<Category Type="ADJUNCT">
    <Attribute ID="Concept" />
    <Attribute ID="Phrase" />
    <Attribute ID="Prep" />
    <Attribute ID="AdjunctRole" />
</Category>
```

The attributes for this category include: the type of *Phrase*, and in case it is a prepositional phrase, the type of preposition (*Prep*). An important attribute refers to *Concept*, which shall be retrieved from the Lexicon (in the case of adverbs) and will be crucial to ascertain the semantic type the adjunct belongs to. In the case of prepositional phrases, this attribute is obtained indirectly retrieved from the information of the corresponding preposition encoded in the Lexicon.

The AVMs for *adverbs* (ADV) and *prepositions* (PREP)[3] are as follows:

```
<Category Type="ADV">                      <Category Type="PREP">
    <Attribute ID="Concept" />                 <Attribute ID="Concept" />
    <Attribute ID="Degree" />                  <Attribute ID="Prep" />
    <Attribute ID="Form" />                </Category>
<Attribute ID="AdjunctRole" />
    </Category>
```

The last attribute in the AVM for adjuncts (*AdjunctRole*) refers to the semantic type of adjunct; the list of available values for this attribute is encoded in its corresponding AVM, and is based on the classification proposed by Díaz-Jorge (2017) and presented in Section 2.2:

```
<Attribute ID="AdjunctRole" obl="+" num="1">
    <Value>Additive</Value>
    <Value>Beneficiary </Value>
    <Value>Company</Value>
    <Value>Concession</Value>
    <Value>Definite frequency</Value>
    <Value>Degree </Value>
    <Value>Direction</Value>
    <Value>Duration</Value>
    <Value>Epistemic</Value>
    <Value>Evidential</Value>
    <Value>Illocutionary</Value>
    <Value>Indefinite frequency</Value>
    <Value>Instrument</Value>
    <Value>Limiter</Value>
    <Value>Manner</Value>
    <Value>Means</Value>
    <Value>Pace</Value>
    <Value>Path</Value>
    <Value>Purpose</Value>
    <Value>Reason</Value>
    <Value>Source</Value>
    <Value>Span</Value>
    <Value>Time position</Value>
</Attribute>
```

These values will also appear distributed in the syntactic rules that account for the realization possibilities of the different peripheries, thus restricting the array of possible semantic types admitted in each of them; the (partial) rule for Nuclear Peripheries would be as follows:

PER_NUC [Adjunct Role=Additive|Definite frequency|Degree|Indefinite frequency|Limiter]

→ADJUNCT [Concept=[FIND: core > concept > concept | CHECK: %\w*], Phrase= [FIND: core > phraseset > tag], Prep= ?p, AdjunctRole= Additive|Definite frequency|Degree|Indefinite frequency|Limiter]

Figure 12 shows the refined tree of the LSC of an English sentence that includes the analysis of the additive adjunct *also*:
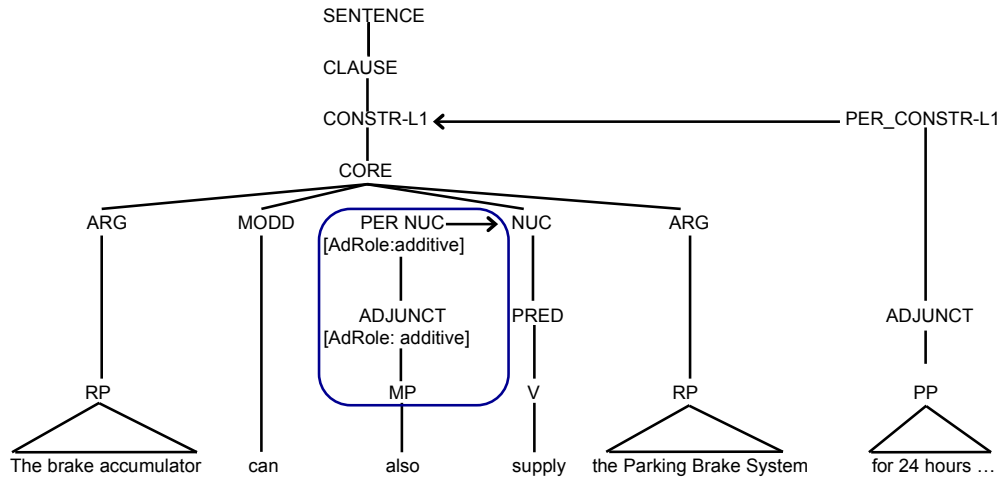

Figure 12. Refined tree of the LSC.

3.2. Locating adjuncts in the GDE

In order to develop the set of syntactic rules that form part of the Grammar Development Environment of ARTEMIS and that account for the ordering of constituents in those sentences that have optional adjuncts as constituents, it is necessary to further the explanation of the positional behaviour of adverbials offered in Díaz-Jorge (2017) by thoroughly identifying the different locations where they tend to appear within sentences, and, then, by showing the preferences for each type of periphery on a scale of positional markedness.

Following Greenbaum & Quirk (1990:161-162), and in addition to Diaz-Jorge's (2017) basic clause positions (initial, medial and final positions), we have identified some subvariants of these three positions and distinguished the clause external detached positions that are also available for locating adverbials in English sentences. Figure 13 captures the set of possible positions available for the location of peripheral units:

PERIni: Initial-position PERiphery
PERIniE: Initial-position PERiphery (end variant)
PERMed: Medial-position PERiphery
PERMedE: Medial-position PERiphery (end variant)

PERFinI: Final-position PERiphery
(initial variant)
PERFin: Final-position PERiphery
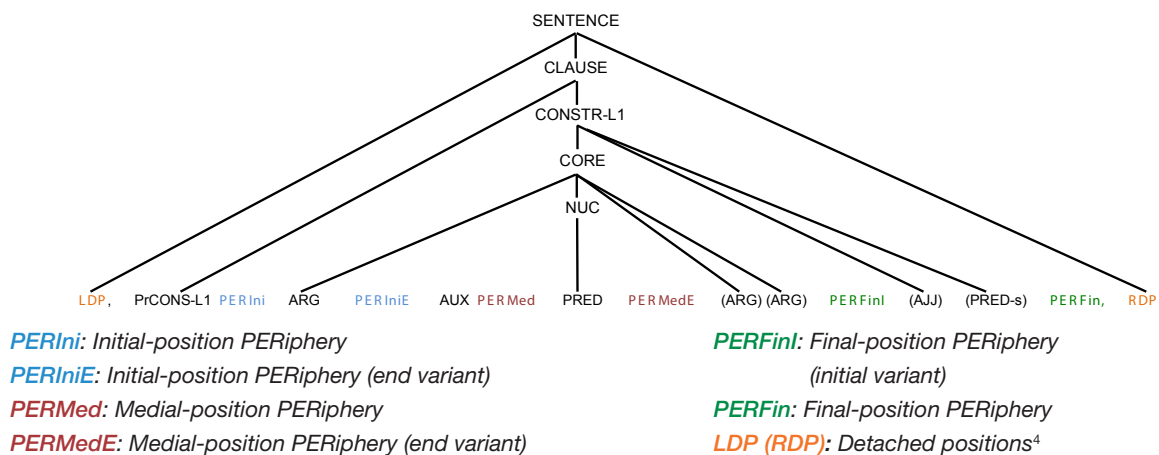*LDP (RDP): Detached positions*[4]

Figure 13: Locating peripheries in the enhanced LSC in ARTEMIS.

---

[4] On our scales of preferences we have only considered the LDP, as the RDP is subject to the same conditions of use as the LDP, though it seems to be less frequently used in English.

We can now establish a scale of the positional preferences for the different types of adjuncts (especially adverbs; cf. note 2) described in Díaz-Jorge (2017) in terms of the positions established above (+ preferred > …>…>…> – preferred). On the scale, only the major positions (initial, medial, final and detached) are considered; therefore, subvariants are not taken as different positions. Hence, "by then" in the following sentences (Greenbaum & Quirk, 1990: 161) will be taken as occupying a medial position in all cases on the scale of preferences that we posit:

3. The book should **by then** (PERMed) have been returned to the library.

4. The book should have been returned **by then** (PERMedE) to the library.

This scale primarily refers to the position of adjuncts in declarative clauses, although it is also applicable to interrogatives and imperatives, with some minor considerations. For instance, in the case of imperatives, PERIni, PERIniE and PERMed are all neutralized since there is no intervening subject (ARG):

5. **Only** give these drinks with meals and dilute the juice by at least the same amount (BNC CH5).

Notice also that PERIniE and PERMed are neutralized in declaratives without an AUX constituent. On such occasions, the adverbial will be assigned to either of these two positions depending on its semantic type.

Clausal adjuncts will be analyzed as occupying PERIniE positions (example (6)), but CONSTR-L1 adjuncts will be parsed as PERMed adverbials (example (7)):

6. Although Mr Berghofer **reportedly** $_{PERIniE}$ said he was not competent […]. (BNC A4H)

7. Fergie and the Queen often rode together, but the troubled Duchess **quickly** $_{PERMed}$ found that her mother-in-law would shy away from anything too personal. (BNC CH1)

Manner adverbs in medial position can be sometimes interpreted as epistemic adjuncts; Van Valin (2005:20) explains that manner adverbs occurring before the tense operator can be construed as clausal modifiers. Thus, "cleverly" in sentence (8) has two interpretations (and possible positions): the first one shows that the manner in which she hid the cash was clever (hence the adverb occupies a PERMed position) whereas the second one shows that the fact that she hid the cash was clever.

8. Ruth **cleverly** hid the cash.

Notice, however, that, in our analysis, epistemic "cleverly" is occupying the PERIniE position. Only if there is an intervening tense auxiliary as in example (9), should the adjunct be analysed as occupying a PERMed position. This type of pattern of a clausal adjunct in mid position is quite infrequent.

9. The Security Council has **wisely** ruled out the death penalty. (BNC K5C)

Below we present the scales of positional preferences for the different types of adjuncts at each of the peripheral levels together with illustrating examples:

CLAUSAL PERIPHERY

ILLOCUTIONARY ADJUNCTS: *PERIni > LDP*

10. I **frankly** $_{PERIniE}$ don't understand. (BNC J41)

11. **Briefly,** $_{LDP}$ there is nothing more I can do about it. (Quirk *et al.,* 1985:616)

12. Totally unexpected because **frankly** $_{PERIni}$ no government, no civil service would have given us much money for (…). (BNC J9M)

EVIDENTIAL ADJUNCTS: *PERIni > LDP*

13. Although Mr Berghofer **reportedly** $_{PERIniE}$ said he was not competent […]. (BNC A4H)

14. **In my experience,** $_{LDP}$ such questions are seldom solved. (Dik, 1997:297)

15. What about the moralizing? **Evidently** $_{PERIni}$ there is something odd about the expression imperator noster divus Marcus. (BNC B2P)

EPISTEMIC ADJUNCTS: *PERIni > LDP > (PERMed)*

16. Ashman **wisely** $_{PERIniE}$ reinserted the character into the film. (Web: thedissolve.com)

17. Ashman **wisely** $_{PERMed}$ reinserted the character into the film. (Web: thedissolve.com)[5]

18. **Fortunately,** $_{LDP}$ we found him immediately. (Dik,1997:297)

19. **Undoubtedly** $_{PERIni}$ progress has been made, but it has been patchy. (BNC FT5)

CONSTR-L1 PERIPHERY

CONTINGENCY ADJUNCTS: *PERFin > LDP > PERIni*

20. They refused to leave on request and attempts to eject them failed **on account of the sudden arrival of reinforcements from the local station** $_{PERFin.}$ (BNC ASB)

21. **In order to redeem,** $_{LDP}$ the mortgagor must give six months' notice or pay six months' interest. (BNC ABP)

22. **Despite his personal battle against deafness** $_{PERIni}$ he fought to help battered wives and rape victims. (BNC CH1)

PROCESS ADJUNCTS[6]: *PERFin > PERMed /LDP > PERIni*

23. Foley, of Finchley, north London, admitted driving **recklessly** $_{PERFin}$ while unfit through drink or drugs. (BNC CBF)

24. But London Ambulance Service **categorically** $_{PERMed}$ denied that it had plans to cut off phone lines. (BNC AAL)

25. **Foolishly,** $_{LDP}$ she had set them opposite each other. (BNC FBD)

26. I suddenly realised I had forgotten to bring my own umbrella to work that morning. **Silently** $_{PERIni}$ I cursed. (BNC HD7)

PACE ADJUNCTS: *PERFin > PERMed /LDP > PERIni*

27. Erm, it's great having a neighbourhood area where all the traffic goes **slowly** $_{PERFin.}$ (BNC J44)

28. Fergie and the Queen often rode together, but the troubled Duchess **quickly** $_{PERMed}$ found that her mother-in-law would shy away from anything too personal. (BNC CH1)

29. **Very hurriedly,** $_{LDP}$ Charles tried to save a situation that threatened to end his whole career. (BNC ACE)

30. **Slowly** $_{PERIni}$ people are moving away from the marginal fringe. (BNC B1H)

SPACE ADJUNCTS: *PERFin > PERMed /LDP > PERIni*

31. Yes, I´ve got a show-stopper **there** $_{PERFin.}$ (BNC FU6)

32. Poor girl, what a sweet innocence is **here** $_{PERMed}$ destroyed. (BNC FU4)

33. **Here,** $_{LDP}$ to make amends for the fright I have put you in. (BNC FU4)

34. **Outside** $_{PERIni}$ it was a soft day -- and getting softer by the bucketful. (BNC CH1)

---

[5] These examples ((16) and (17)) reveal that PERMed and PERIniE are neutralized in the absence of an AUX constituent. Compare it with the following variation, where the neutralization dissolves: "Ashman has **wisely** $_{PERMED}$ reinserted the character into the film".

[6] Díaz-Jorge (2017:45-46) remarks the fact that, even though core (now CONSTR-L1) adverbials are usually in end positions, *process* adjuncts are very flexible and it is not strange for them to occupy middle positions. *Pace, space* and *temporal* adverbs can also occupy different places with relatively little stylistic or semantic effect (cf. Quirk *et al.,* 1985:505, 519).

TEMPORAL ADJUNCTS: *PERFin > PERMed /LDP > PERIni*

35. Today we are printing a special token to complete the voucher we gave you **yesterday** *PERFin.* (BNC CH1)

36. I think you should **now** *PERMed* begin to make another day in the week a happy one […]. (BNC FU4)

37. **Nowadays,** *LDP* there is no such thing as a bad job. (BNC BPE)

38. **Yesterday** *PERIni* we rang Frank at home only to be told by his mum: […]. (BNC CH1)

NUCLEAR PERIPHERY

FOCUSING ADJUNCTS: *PERMed > PERFin > (PERIni)*[7]

39. She is reading a letter she has **just***PERMed* written to her parents. (BNC FUA)

40. **Merely** *PERIni* the experience of being governed was enough to provide a political education. (BNC HY9)

41. Who ever blamed Lucretia! All the shame lay on the ravisher **only** *PERFin.* (BNC FU4)

DEGREE ADJUNCTS: *PERMed > PERFin*

42. Costa Rica has **partially** *PERMed* recovered, though without solving its underlying economic problems. (BNC B12)

43. […] the pressure of the groundwater it contains forces apart the mineral grains and increases the volume of the pores **slightly** *PERFin.* (BNC ANX)

DEFINITE FREQUENCY: *PERFin > PERIni > (PERMed)*

44. ELECTION fever is mounting **hourly** *PERFin* in the Stretchford Conurbation. (BNC AHN)

45. **Once a week** *PERIni* a ten-minute helicopter flight soars over the harbor. (BNC CH1)

46. A third would think **twice** *PERMedE* about moving home if it would upset their pets. (BNC CH5)

INDEFINITE FREQUENCY 1: *PERFin / PERIni / LDP / PERMed*

47. He used to help my brother out **quite often** *PERFin*. (BNC CH6)

48. **Occasionally** *PERIni* official syllabuses contain very detailed advice for teachers. (BNC BLY)

49. **Occasionally,** *LDP* the Princess would wince in horror as she heard how women often arrived. (BNC CH1)

50. […] that there will be dramatic changes in the lives of the favourite characters that have **regularly** *PERMed* pulled in 16 million viewers over the last six years. (BNC CH1)

INDEFINITE FREQUENCY 2: *PERMed > PERIni* > PERFin*

51. Copeman of the Friends, told us that he **seldom** *PERMed* went out without seeing corpses lying about. (BNC A64)

52. **Never before** *PERIni** has a news story triggered such sensational sales. (BNC CH1)

53. He was told he wasn't wanted **any longer** *PERFin.* (BNC CH1)

---

[7]   It is very rare to find *focusing* adjuncts in initial positions. Even more infrequent is it to find *degree* adverbs in such a place in the sentence.

INDEFINITE FREQUENCY 3: *PERMed (>PERIni/LDP)*

54. But Radio One will **always** _{PERMed} be first and foremost a pop station. Just occasionally we will be more serious. (BNC CH1)

55. **Continually** _{PERIni} adepts are warned that they must not strain themselves. (BNC CD4)

Frequency adjuncts are by far the most complex group in terms of positional preferences and restrictions. As a general rule, they tend to appear close to the predicate in rather rigid positions (Díaz-Jorge, 2017:23); furthermore, they are not expected to occupy clause external positions (i.e. left or right detached positions). However, different location tendencies can be identified which seem to be related to the specific semantic import of the adverbs. Because of this, we have established four subgroups, which correspond to a great extent to the distinctions posited in Díaz-Jorge (2017): firstly, we have differentiated between *definite* and *indefinite frequency* adjuncts. Díaz-Jorge (2017:29) explains that *definite frequency* adjuncts (*once, hourly, three times, weekly*) behave differently from other frequency adverbials as they appear in initial and end positions; she refers to Ramaswamy's (2007:349) words when he states that "they do not usually go in mid-positions". We have marked this on the scale by placing *PERMed* at the end of the scale and between brackets; we proceeded similarly with initial positions in the case of *focusing* adjuncts.

Within the second group, three subtypes of *indefinite frequency* adverbials have been distinguished. In the first group, we have included the set of *frequency* adverbials that express *usual* (*usually, normally*), *high* (*often, regularly*) and *mid* frequency (*sometimes, occasionally*); the second group of *indefinite frequency* adjuncts will include those that convey a meaning of *low* (*scarcely, seldom*) to *zero* frequency (*never, no longer*). The two groups are distinguished because they have a different behaviour as regards their positional preferences. Group 1 adjuncts are characterized by being very flexible within the clause, whereas Group 2 are also flexible but they show some special features when in initial positions, as they trigger AUX inversion (which is marked with an asterisk on the scale). The third group includes adverbials that express *continual* or *universal* frequency (*always, continually*), which are unlikely to occur in positions other than mid positions.

Table 2 shows a summary of the adverbial positional preferences in each of the different peripheries:

Table 2. Scales of major positional preferences per periphery.

PERIPHERIES	SCALES OF POSITIONAL PREFERENCES
CLAUSAL PERIPHERY:	*PERIni > LDP > (PERMed)*
CONSTR-L1 PERIPHERY:	*PERFin > PERMed /LDP > PERIni*

NUCLEAR PERIPHERY (I):
  FOCUSING ADJUNCTS
  DEGREE ADJUNCTS
  INDEFINITE FREQUENCY 2
  INDEFINITE FREQUENCY 3
	PERMed > PERFin /PERIni

NUCLEAR PERIPHERY (II):
  DEFINITE FREQUENCY
  INDEFINITE FREQUENCY 1
	PERFin > PERIni / LDP / PERMed

As can be observed, *clausal peripheries* quite often appear in initial positions and are frequent both in clause internal or clause external initial positions; they seem to be less likely to appear in final positions. *Constr-L1 peripheries* appear naturally in end positions, but they are not rare in clause external detached positions and medial positions; they are less frequently located in clause initial positions. This is especially true of *contingency* adjuncts, which are frequently realized by prepositional phrases and are normally placed at the end of the clause. As stated above, *nuclear peripheral* elements are more flexible, although two tendencies can be observed: *focusing*, *degree* and *indefinite frequency group 2* (*zero/low* adverbs) and *indefinite frequency group 3* (*continual/universal*) adverbials tend to be more rigid and quite often appear in medial positions; they can, however, also be located in final or initial clause internal positions, and some of them trigger inversion when placed initially. The rest of nuclear adjuncts, *definite frequency* and *indefinite frequency group 1* (*usual*, *high* and *mid frequency*) adverbials are often in final positions, although *indefinite group 1* adverbials are not infrequent in other positions.

We can now locate the different peripheries in the abstract LSC of an English sentence, arranging them in a hierarchy of preferences of occurrence in the positions described (we have excluded the detached positions as all types of periphery show an equal tendency to appear in these pragmatically marked positions). Table 3 shows

the scale of peripheral preferences per position, whereas Table 4 presents the scale of positions in relation to their peripheral preferences:

Table 3. Scales of peripheral preferences per position

Position	Peripheral preferences
LDP (RDP) →	PER-CL /PER-CONSTRL1/PER-NUC
PER Ini *PERIniE*	PER-CL > PER-NUC > PER-CONSTRL1
PERMed *PERMedE*	PER-NUC > PER-CONSTRL1
PERFinI *PERFin*	PER-CONSTRL1> PER-NUC

Table 4. Scale of positions and peripheral preferences.

		POSITIONS							
		LDP	*PER Ini*	*PERIniE*	*PERMed*	*PERMedE*	*PERFinI*	*PERFin*	RDP
PERIPHERAL PREFERENCES	+High	all	PER_CL		PER_NUC		PER_CONSTRL1		all
	± Mid		PER_NUC		PER_CONSTRL1		PER_NUC		
	–Low		PER_CONSTRL1		(PER_CL)				

Table 4 can be especially helpful to decide in cases of ambiguity if used in combination with the ontological concepts which give form to the semantic information encoded in the lexical entries of adverbs and prepositions in the FunGramKB lexicons[8]. These concepts can be matched to the different semantic types identified in Section 2.2. Figure 14 presents the peripheries and positional preferences in the abstract LSC:
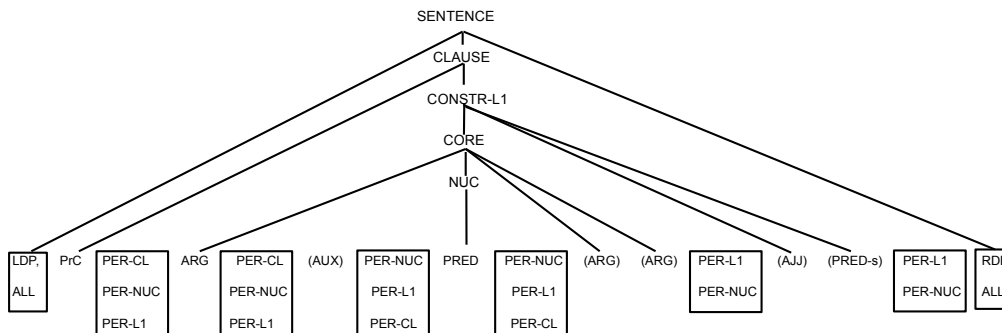

Figure 14: Peripheries and positional preferences in the abstract LSC.

There is still one pending issue to be solved for the effective parsing of peripheral constituents in the GDE. The formalization of RRG in our computational prototype must meet one difficulty which arises from the syntactic status of adjuncts in this grammatical model. As can be seen in Figure 4, the peripheries are not subject to dominance relations; i.e. they are not analysed as daughters of any other syntactic node or layer, but are taken as *modifiers* of a given layer; such a relation is expressed by means of an arrow pointing to the layer modified, and not by a branch. There is no way to capture this type of *modifying* function in the format of the syntactic rules of the GDE. Following the format of context-free grammar rules, syntactic rules can only capture immediate dominance and linear ordering. To circumvent this problem, we follow a strategy similar to Kallmeyer & Osswald's (2017) and

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8   This is especially true for the occurrence of adverbs in clause internal positions. Thus, in pairs like the following: *She sat there hopefully* vs *Hopefully it won't rain tomorrow,* the adverb *hopefully* will more naturally be understood as a clausal adjunct (PER_CL) if it appears in initial positions (as in the second sentence), but as a PER_CONSTRL1 adjunct if occurring in final positions (as happens in the first sentence). In the case of detached positions, it is much more difficult to decide upon ambiguous cases, since any kind of peripheral constituent can be assigned to these extraclausal positions for pragmatic purposes. It seems, however, that adverbs like 'sadly', 'happily', etc. which may be interpreted either as process (PER_CONSTRL1) or epistemic (PER_CL) adjuncts tend strongly to behave as clausal adverbials in such detached positions, as happens in *Sadly, she sang* (cf. *She sang sadly*, in which it behaves as a process adverbial), but there are also instances of process adjuncts in LDP, as in example 25 above. This is a pending issue which merits a more fine-grained analysis.

Osswald & Kallmeyer's (in press) and include peripheral nodes in our syntactic rules as if they were daughters of one of the layers in the LSC. For instance, the partial rule for the CLAUSE node proposed in Mairal-Usón & Cortés-Rodríguez (2017:16), which did not include any peripheral element[9] (CL → (PreCONSTR-L1) CONSTR-L1) must be enlarged to account for the possibility of having optional constituents in PERIni position:

CL → (PreCONSTR-L1) (PER-CL) (PER-NUC) (PER-CONSTRL1) CONSTR-L1

This rule will generate a tree where some further computational operations must be done to obtain peripheral elements as modifier nodes with an arrow notation[10].

Once assumed that the peripheries are to be described as daughter constituents of the central layers in the LSC, we still have to decide to which of those layers each of the peripheral positions in Figure 14 belong. In accordance with the tendencies observed on the scale of positional preferences and also taking into account that when there are several adverbs in a sentence they are subject to some iconic ordering constraints "in that adverbs related to more outer operators occur outside of adverbs related to more inner operators. In the simplest case 'outside of' means 'farther from the verb'" (Van Valin, 2005:20), we propose the following general scheme (Figure 15):
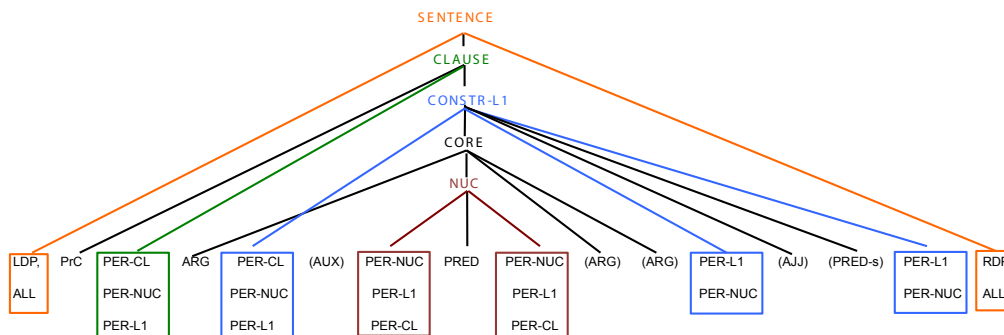

Figure 15: Peripheries and positional preferences in the abstract LSC (with dominance relations).

Once the different positions are identified as *daughters* of a given layer, it is feasible to devise the syntactic rules that will spell out the ordering of constituents for each of the layers in the LSC. Since the computational workability of ARTEMIS is still to be tested, we have chosen to apply it to a Controlled Natural Language, namely ASD-STE100, with the assumption that it will help to validate the performance of our parser. Hence, the scope of our analysis will be confined to the catalogue of adverbials that can be found in a corpus written in this controlled language. The following section will deal with this issue.

4. ADVERBIALS IN AIRBUS ASD-STE100

Given the basic principle of Simplified Technical English (STE), "make texts easy to read and understand. […] write short sentences and use simple sentence structure" (2017: Specification Issue 7, page 1-4-1), and the nature of the texts written in the controlled natural language ASD-STE100, we should expect a reduced gamut of semantic types and of positional preferences and a tendency not to concatenate several adjuncts. As a matter of fact, with regard to the first issue, it is extremely rare to find *clause* adjuncts such as *epistemic*, *evidential* and *illocutionary* adjuncts, which tend to codify personal assessment, subjective opinions of the speaker or "comments on how the Speaker wishes the speech act to be taken or understood by the Addressee" (Dik, 1997:67). The semantic import of these types of constituents is logically absent in ASD-STE100 documents, since the texts produced by means of ASD-STE100 are procedural and descriptive texts and safety instructions, in which the voice of the speaker is irrelevant. This is confirmed in our sample of the Airbus Corpus[11], with more than 17000 words, where only one instance of the epistemic adverb *possibly* has been found:

56. The aircraft is **possibly** not parallel to the ground. (DMC-AJ-A-32-11-76-00AAA-520A-A_027-00)

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9   The actual rule is a bit more complex as it includes the AVMs for the constituent nodes; we have dispensed with this information to make the description easier to follow.

10   Within a Tree Adjoining Grammar formalism, Kallmeyer & Osswald (2017) and Osswald & Kallmeyer (in press) apply *(sister) adjunction* to their tree templates. This mode of composition is available if the template has a root label which coincides with the label of the target node. Some parallel tactic would probably be available in our model provided that the tags for our PER nodes include information on the layer they modify.

11   The Airbus corpus is a selection of texts from aircraft maintenance written following the ASD-STE100 specifications (2017).

As far as positional preferences are concerned, it is also interesting to note that in our corpus we have not found cases of Level 1-Construction adjuncts in initial positions, which is also in consonance with their strong tendency to appear in final clause positions, followed by a more marked tendency to occur in medial positions. Here is a list of examples to illustrate the array of positions and types found in our sample selection from the Airbus corpus (Table 5):

Table 5. Examples from the Airbus corpus grouped by layers and peripheral positions.

SENTENCE LAYER:	
LDP	PER_CONSTR-L1: **Because of** their different design, the structural assemblies are not interchangeable with each other and their position in the MLG is only one. PER_NUC: **Also**, the Nose Gear System supports the weight of the aircraft during ground maneuvers.
RDP	PER_NUC: This type of equipment can put water and moisture in parts, and can cause damage to equipment, **specially to: Electrical equipment such as harnesses, proximity sensors and connectors.**
CLAUSE LAYER	
PER_Ini	PER_NUC: **Always** the top bleed valve (2) of the related brake unit (1) must be used.
CONSTR_L1 LAYER	
PER_IniE	PER_NUC: They **also** must be at a minimum distance from the structure and adjacent elements.
PER_FinI	PER_CONSTR-L1: Let the lateral link (2) turn **slowly** by gravity until it is in its balanced position PER_NUC: If the test gives a fault message related to the CPIOM-G **only**: Replace the CPIOM-G related to the fault message.
PER_Fin	PER_CONSTR-L1: The gas rod must be lowered **carefully.** PER_NUC: The RTO label and the deceleration arrow come into view **always**.
NUCLEUS LAYER	
PER_Med	PER_NUC: When you operate the Ground Door Opening (GDO) system, you must **always** stay aft of the gear leg. PER_CONSTR-L1: The Normal Extension and Retraction System **hydraulically** operates the MLG leg actuators.
PER_MedE	PER_NUC: In emergency mode, each MLG door actuator moves **only** that mechanism to open the related door. PER_CONSTR-L1: This occurs because brake pressure […] goes **directly** to the shuttle valves.

Table 6 captures the reductions in both types and positional preferences:

Table 6. Reductions on the scale of positions and peripheral preferences in Airbus ASD-STE100.

		POSITIONS							
		LDP	*PER Ini*	*PER IniE*	*PER Med*	*PER MedE*	*PER FinI*	*PER Fin*	RDP
PERIPHERAL PREFERENCES	+High	PER_NUC	~~PER_CL~~		PER_NUC		PER_CONSTRL1		PER_NUC
	± Mid	PER_CONSTRL1	PER_NUC		~~PER_CONSTRL1~~		PER_NUC		PER_CONSTRL1
	–Low	~~PER_CL~~	~~PER_CONSTRL1~~		(~~PER_CL~~)				~~PER_CL~~

Also in line with the spirit of ASD-STE100 to write short sentences, only in final positions have we found a tendency to amalgamate more than one adverbial, and when this takes place the maximum number of consecutive adjuncts seems to be three, as in the following sentences:

57. This operation can be possible <u>during</u> landing <u>after</u> a delay of twelve hours <u>between</u> a loss of blue hydraulic supply and the brake applications. (3 ADJUNCTS IN PER_CONSTRL1)

58. Let the lateral link (2) turn <u>slowly</u> <u>by</u> gravity <u>until</u> it is in its balanced position. (3 ADJUNCTS IN PER_CONSTRL1)

In our sample from the Airbus corpus there is one rare example of four adverbials in a final position:

59. The brake accumulator manifold supplies hydraulic blue power <u>directly</u> <u>from</u> the brake accumulator <u>to</u> the brake units <u>through</u> the PBSELV. (4 ADJUNCTS IN PER_CONSTRL1)

However, on most occasions, no more than two adverbials appear together in sequence, with a variegated array of possible combinations of formal types or realizations:

60. The MLG leg actuators also keep the MLG legs locked <u>when</u> the MLG legs are retracted <u>because</u> they have inner uplocks. (2 clauses; 2 adjuncts in PER_CONSTRL1)

61. It is necessary to do this step <u>slowly</u> <u>to</u> prevent air bubbles. (MP (adverb) + clause; 2 adjuncts in PER_CONSTRL1)

62. The HP filter measures the pressure drop <u>across</u> the filter element <u>to</u> send the discrete signal. (PP (adverb) + clause; 2 adjuncts in PER_CONSTRL1)

63. The brake accumulator can also supply the Parking Brake System <u>for</u> 24 hours <u>on</u> a slope of 3 dega. (2 PP; 2 adjuncts in PER_CONSTRL1)

64. It is necessary to do the test <u>one or two times</u> <u>to</u> remove the air bubbles from the related hydraulic circuit. (RP + clause; 2 adjuncts in PER_CONSTRL1)

It is worth mentioning that catenation affects mainly Level 1-Construction adjuncts, whereas nuclear adjuncts tend to appear alone, a feature which will be reflected in their corresponding syntactic rules:

PER_NUC → ADJUNCT

PER_CONSTR-L1→ ADJUNCT || ADJUNCT ADJUNCT || ADJUNCT ADJUNCT ADJUNCT|| ADJUNCT ADJUNCT ADJUNCT ADJUNCT

ADJUNCT→ MP || PP || RP || CLAUSE

The last rule captures the realizational possibilities (*Modifier Phrase, Prepositional Phrase, Referential Phrase or Clause*) of any type of adjunct, irrespective of the peripheral constituent to which it will belong[12].

5. CONCLUSIONS

The first part of this paper offered an updated description of the typology of adverbials within RRG, following Díaz-Jorge´s (2017) extensive overhaul of the schematic three-tier proposal in Van Valin (2005). In doing so, in the second part of our study, we set up the basic conditions for the treatment of such constituents within the so-called Grammar Development Environment, a syntactic parser which forms part of ARTEMIS. This involved, on the one hand, systematizing the locational tendencies exhibited by the different types of adverbials; this allowed us to establish a scale of probability of occurrence of the three types of peripheries in an array of positions within the clause. On the other hand, in our analysis we also dealt with the formalization problems concerning the status of the peripheries in RRG as modifiers, not subject to dominance relations within the Layered Structure of the Clause. We adapted the solution put forward in Kallmeyer & Osswald (2017) and Osswald & Kallmeyer (in press) in our

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[12] cf. Cortés-Rodríguez (2016) for a detailed description of these types of phrasal units both within RRG and ARTEMIS.

proposal and assigned to each peripheral type a daughter status for the nodes that they modify, leaving it to the computational apparatus to relocate them as modifier units.

In order to carry this study, we restricted the scope of analysis to a sample selection of texts from the Airbus Corpus, written in ASD-STE100. Further work needs to be done to validate the positional behaviour of peripheral constituents in natural present-day English and to fully articulate the semantic classification of adverbials along the three-layered description within RRG and the LCM.

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