

A categorial grammar of Spanish auxiliary chains

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Abstract

Spanish auxiliary sequences as in *Juan puede haber tenido que estar empezando a trabajar hasta tarde* 'Juan may have had to be starting to work until late', traditionally termed *auxiliary chains*, have two properties that are not naturally captured in phrase-structure approaches to syntax: (i) they follow no *a priori* fixed order; auxiliary permutations have different meanings, none of which is any more basic than any other (cf. *Juan puede estar trabajando* 'Juan may be working' and *Juan está pudiendo trabajar* 'Juan is currently able to work'); and (ii) the syntactic and semantic relations established within a chain go beyond strict monotonicity or cumulative influence; rather, they present different kinds of syntactic relations in distinct local domains. We show that an alternative to syntax grounded in a modification of the categorial grammar introduced in Ajdukiewicz (1935) that closely follows Montague (1973), Dowty (1978, 1979, 2003), and Schmerling (1983a, b, 2019) provides effective tools for subsuming Spanish auxiliary chains in an explicit and explanatory grammar.

Keywords: categorial grammar, Spanish grammar, auxiliary verb, auxiliary chain, lexical auxiliary, functional auxiliary

1. Introduction

In this paper, we present a framework for describing and explaining the properties of sequences of auxiliary verbs in Spanish in a theory that equally well accommodates the familiar but very different auxiliary sequences of English. English auxiliaries, which are surely the most widely studied auxiliaries of any language, have been investigated since the early work of Chomsky in the 1950's, in one or another version of phrase structure grammar (PSG) or a computationally equivalent context-free formalism, often supplemented with other types of rules (transformations, feature co-occurrence restrictions, etc.) or a universal template of syntactic projections. The versatility of the framework we present constitutes an important argument in its favour. This introductory section summarises the fundamental properties of Spanish auxiliary verb sequences. **Section 2** then addresses in depth what linguistic theory must permit a revealing account of, while at the same time permitting English-like auxiliary sequences. A novel account of Spanish auxiliary chains that makes use of no

independently unmotivated formal apparatus is the topic of **Section 3**. **Section 4** is our conclusion.

1.1. Verbal periphrases in Spanish

We begin our introduction to Spanish auxiliary sequences by defining *verbal periphrastic constructions* (or *verbal periphrases*). The term *verbal periphrasis* is characteristic of works written in or about the various Romance languages and has a venerable place in Hispanic linguistics specifically (Roca Pons 1958; Olbertz 1998; Fernández de Castro, 1999; Gómez Torrego, 1999; García Fernández, 2006; RAE-ASALE, 2009; Bravo & García Fernández, 2016; to cite but a few). Throughout this paper we use as equivalent the expressions *verbal periphrasis* (or simply *periphrasis*), *auxiliary verb construction*, and *periphrastic verb construction*. As classically used for Spanish, these terms refer to sequences of one or more auxiliary verbs and a non-finite form of a lexical (or “main”) verb, giving rise to a single predication and within the limits of a single clause (RAE-ASALE 2009: §28.5). Constructions with auxiliary verbs are exemplified in (1), with single auxiliaries, and in (2) with auxiliary sequences. The Spanish grammatical tradition refers to sequences of two or more auxiliaries as *auxiliary chains* (*cadena de verbos auxiliares*). As is common in Indo-European languages, each auxiliary determines the form of the following verb (whether auxiliary or lexical verb):^{1,2}

- (1) a. Juan **suele** levantar=se tarde
 Juan be.in.the.habit.of.3SG.PRES get.up.INF=SE late
 ‘Juan usually gets up late’.
- b. Juan **está** levantando=se tarde
 Juan be.3SG.PRES get.up.GER=SE late
 ‘Juan’s getting up late’.
- c. **Tener que** trabajar en agosto es agotador
 have.to.INF work.INF in August is exhausting
 ‘Having to work in August is exhausting’.
- (2) a. Juan **suele** **poder** **empezar a**
 Juan be.in.the.habit.of.3SG.PRES can.INF start.INF
 trabajar tarde
 work.INF late
 ‘Juan’s usually able to start working late’.

¹ We use the following abbreviations: AUX = auxiliary; COND = conditional; CONT = continuative aspect; GER = gerund; HAB = habitual aspect; INCH = inchoative; IPFV = imperfective; INF = infinitive; MOD = modal (auxiliary); PTCP = participle; PASS = passive; PFV = perfective; PL = plural number; PRES = present tense; PROG = progressive; SG = singular number; TNS = temporal auxiliary.

² Elements like *a*, *de*, or *que* (among others) in auxiliary verb constructions must be distinguished from homophonous prepositions (*a* and *de*) and complementisers (*que*). García Fernández et al. (2020) offer a detailed study of these items, which do not constitute a unified class, and which they term *intermediate elements*.

- b. Juan **puede** **haber** **tenido que** **estar**
 Juan may.3SG.PRES have.INF have.to.PTCP be.INF
empezando a trabajar hasta tarde
 start.GER work.INF until late
 ‘Juan may have had to be starting to work until late’.

The examples in (1) and (2) illustrate that in Spanish, as in many Indo-European languages (though no longer in contemporary English), all auxiliary verbs, with the exceptions in fn. 7 below, may show inflection; modal verbs, for example, have full inflectional paradigms and are identifiable as such primarily by semantic criteria (see Bravo 2016, 2017 for recent overviews of modality in Spanish), whereas in contemporary English the class of modals is defined primarily by a lack of inflection and by a restricted distribution (McCawley 1975; Pullum & Wilson 1977).³

As we have indicated, there is general agreement that only the lexical verb in a verbal periphrasis has argument structure and that the verbs making up the periphrasis jointly express a single eventive predication. This property is usually referred to as *monoclausality*. The central role of monoclausality in defining verbal periphrases cross-linguistically has been widely recognised in the literature, regardless of framework (see, among many others, Gómez Torrego 1999: 3325; Rochette 1999: 151; Cinque 2004; Wurmbrand 2004; Anderson 2006: 7, 2011: 795; RAE-ASALE 2009; Sag et al. 2020).⁴ Thus, Anderson (2011: 796) states that “A(uxiliary) V(erb) C(onstructions) are ... mono-clausal verb phrases that minimally consist of an auxiliary verb component ... and a lexical verb component”.

1.2 Lexical and functional auxiliaries

Examples of the auxiliary chains of our title are given in (2) above and in (3), where auxiliaries are bolded:

- (3) a. **Podrían** **estar** **siendo** interrogados toda la tarde
 may.3PL.COND be.INF be.GER question.PTCP.M.PL all the afternoon
 ‘They may be being questioned all afternoon.’
- (4) b. **Va a** **tener que** **seguir** trabajando
 Go.3SG.PRES have.to.INF keep.INF work.GER
 ‘She/he is going to have to keep working.’

³ As recently as the seventeenth century, English auxiliaries were similar to those in Spanish where inflection was concerned; this included the modals. A detailed account of how various changes in English led to modals’ becoming uninflected particles is offered in van Kemenade (1992); see also the references cited there.

⁴ Within generative grammar, there have historically been differences over whether this monoclausal structure is achieved transformationally or through PS rules (in more recent terms, whether monoclausality is a consequence of Internal or External Merge, the former presumably subsuming incorporation processes like Restructuring; see, e.g., Roberts, 1997). Aissen & Perlmutter’s (1976) *clause reduction* and Chomsky’s (1964a) grammar fragment, respectively, serve as early and very clear illustrative examples of these two analytical approaches.

We follow Bravo et al. (2015) and García Fernández & Krivochen (2019a, b) in defining an auxiliary chain as *any verbal periphrasis in which there are at least two auxiliary verbs*. The relative linear position of an auxiliary chain with respect to the lexical verb varies, but in the declarative sentences that we focus on in this paper, the chain always appears immediately to the left of the main verb, as in (2) and (5);⁵ an extension to other sentence types does not require additional theoretical machinery (see Bach, 1979; Schmerling, 1983b, 2019; Jacobson, 1987).

Spanish auxiliary chains display a variety of internal dependencies and word orders, none of which seems to be derivationally “more basic” than any other. Thus, (5a) and (5b) are equally grammatical; crucially, however, they are not synonymous:

- (5) a. Juan debe estar trabajando todo el día
 Juan must.3SG.PRES be.INF work.GER all the day
 ‘J. must be working all day long’ (Modality > Aspect > Verb)
- ≠
- b. Juan está debiendo trabajar todo el día
 J. be.3SG.PRES must.GER work.INF all the day
 ‘J. is having to work all day long’
 (Aspect > Modality > Verb)

In **Section 3** we will pursue the point that this critical property of their syntax motivates our adoption of an approach that departs from syntactic theories grounded in monotonic structure building in two important ways. The first is that it correctly recognises and captures a structural variety that those theories do not. Our second analytical departure involves an interaction between Spanish auxiliary structure building and the *semantic* properties of auxiliaries: some, which we (following Bravo et al., 2015; García Fernández et al., 2017, and related work) call ‘lexical’ auxiliaries, delimit domains for the transmission of temporal and aspectual information provided by other, ‘functional’ auxiliaries (e.g., temporal <*ir a* + infinitive>, aspectual <*estar* + gerund>).⁶ In other words, *lexical auxiliaries can be temporally and aspectually anchored independently of main verbs*; they are expressions assigned to a category. The *functional auxiliaries*, in contrast, forgo this kind of anchoring, contributing temporal and aspectual information themselves: they are akin to inflection rather than to basic categorematic expressions of the language. What is “lexical” about lexical

⁵ Crucially, the generalisation we have just cited does not hold, e.g., for interrogatives or instances of inversion in *verum focus fronting*, as in example (ii), for instance:

- i) Yo *tendría que estar muriéndome* para no ir a esa fiesta (*auxiliaries* to the immediate left of the **lexical verb**)
 ‘I would have to be dying not to go to that party’
- ii) **Muriéndome** *tendría que estar* yo para no ir a esa fiesta (*auxiliaries* to the right of the **lexical verb**)
 ‘Dying I would have to be not to go to that party’

Krivochen & García Fernández (2019) analyse this and other instances of non-declarative sentences where the Aux Chain–V order is disrupted.

⁶ These two auxiliaries mark future tense and progressive aspect, respectively.

auxiliaries is the possibility of their modifying lexical elements while at the same time being able to be modified themselves. Functional auxiliaries, in contrast, modify but cannot themselves be modified; they never take on temporal or aspectual information from other auxiliaries as lexical elements do, including lexical auxiliaries and main verbs. We will focus primarily on the interaction between functional auxiliaries and modal auxiliaries (for non-modal lexical auxiliaries, see García Fernández et al., 2017; García Fernández & Krivochén, 2019, among others. The same formal devices apply).

The difference between lexical and functional auxiliaries is illustrated in the examples in (5); lexical and functional auxiliaries are marked as such using L(lexical) and F(unctional) subscripts:

- (6)
- | | | | | | |
|----|--|------------------------|------------------------|----------|--------|
| a. | Juan va a _F | tener que _L | empezar a _L | trabajar | allí |
| | Juan go.to.3SG.PRES | have.to.INF | start.INF | work.INF | there |
| | ‘J. is going to have to start working there’ | | | | |
| b. | Juan puede _L | estar _F | trabajando | | |
| | Juan may.3SG.PRES | be.INF | work.GER | | |
| | ‘J. may be working’ | | | | |
| c. | Juan está _F | debiendo _L | llegar | a | tiempo |
| | Juan is.3SG.PRES | have to.GER | arrive.INF | on | time |
| | ‘J. is having to arrive on time’ | | | | |

In (5a), what is temporally anchored by the temporal future auxiliary *va a* is the obligation denoted by the deontic modal *tener que*, not the aspectual inchoative *empezar a* or the lexical verb *trabajar*. The obligation, in turn, pertains to the start of the event of working; that is, *va a tener que* modifies *empezar a*, which in turn modifies *trabajar*. However, *tener que*, and, by extension, *va a*, do not modify *trabajar*: we can see this from the lack of entailment (\nRightarrow) indicated in (5a’):

- (5a’)
- | | | | |
|-------------------------------------|-------------|-----------|--------------------------------------|
| Juan va a | tener que | empezar a | trabajar |
| Juan go.to. 3SG.PRES | have.to.INF | start.INF | work.INF |
| ‘J. is gonna have to start working’ | | | |
| \nRightarrow Juan va a | trabajar | | (= Juan trabajará) |
| Juan go.to. 3SG.PRES | work.INF | | (= J. will work) |
| ‘J. is gonna work’ | | | |
| \nRightarrow Juan va a | empezar a | trabajar | |
| | | | (= J. empezará a trabajar) |
| Juan go.to.3SG.PRES | start.INF | work.INF | |
| ‘J. is gonna start to work’ | | | |
| \nRightarrow Juan va a | tener que | trabajar | |
| | | | (= J. tendrá que empezar a trabajar) |
| Juan go.to.3SG.PRES | have.to.INF | work.INF | |
| ‘J. is gonna have to work’ | | | |

An adequate segmentation for (5a) must therefore be [[*va a tener que*] [*empezar a*] [*trabajar*]], where only the modal is affected by future tense. Bravo et al. (2015) call lexical auxiliaries *opaque* because, as (5a) illustrates, they do not let temporal and aspectual information from functional auxiliaries like *ir a* through: the future tense contributed by *ir a* modifies *only* the lexical auxiliary *tener que*, not having scope over

anything to its right. But in (5b), the functional auxiliary *estar* intervenes between the lexical modal auxiliary *poder* and the main verb. If functional auxiliaries are *transparent* for purposes of modification relations in auxiliary chains—that is, if they let that information through—we predict that the lexical auxiliary modifies the next lexical element namely, the main verb. This prediction indeed holds:

(5b') Juan puede estar trabajando ⇒ Juan puede trabajar
 Juan may.3SG.PRES be.INF work.GER ⇒ Juan may.3SG.PRES work.INF
 'Juan may be working' ⇒ 'Juan may work'

In (5c) (*Juan está debiendo llegar a tiempo*) the deontic modal auxiliary *deber* appears in a progressive periphrasis, as the complement of the functional auxiliary *estar*. As in (5a), the lexical auxiliary *deber* absorbs the aspectual (imperfective, progressive) modification from this functional auxiliary, so that what is understood progressively is the obligation to arrive on time. The event of arriving *per se* is not so understood. *Deber* is representative of the entire class of lexical auxiliaries in its behaviour with respect to the 'absorption' of functional information.

The examples in (5) demonstrate how lexical auxiliaries define local modification domains; the *lexical / functional* distinction (or rather, the distinctions in dependency types that it captures) is critical to the adequacy of structural descriptions of auxiliary chains. This distinction will be pursued in **Section 3**.

The lexical auxiliary / functional auxiliary distinction that we have illustrated in examples (5a–c) is summarised in **Table 1**.^{7,8}

Table 1. Lexical and functional auxiliaries

⁷ Spanish linguistics has traditionally noted positional restrictions on some auxiliaries, notably <*soler* + INF> and <*haber de* + INF> (and the impersonal <*haber que* + INF>, which can only be conjugated in 3SG), which can only appear in declarative clauses and in first position in finite clauses (the infinitives we have cited are strictly citation forms; these auxiliaries have also no gerund or participle, see García Fernández, 2006: 245, 165 respectively). These restrictions reflect the auxiliaries' having defective paradigms, as noted among others in RAE-ASALE (2009) §4.4c and §28.9b and Bravo & García Fernández (2016): as an example, habitual *soler* can only be conjugated in the imperfective aspect (and even then, with temporal and modal restrictions: the indicative imperfective future does not exist, there is only one occurrence of the imperfective subjunctive future *soliese* and two of the alternative form *soliera* in the CREA corpus -consulted on 10/06/2022-). The defective paradigm of *soler* was noted as early as Correas (1625 [1903]).

⁸ Examples (5a), (8a,c), and others to be presented contain a further auxiliary, passive *ser* 'to be', which is in a class by itself. We discuss this auxiliary in **Section 3.2**.

Transparent / functional	Opaque / lexical
Progressive < <i>estar</i> + GER> ‘to be -ing’, perfective < <i>haber</i> + PTCP> (<i>have -en</i>), < <i>ir a</i> + INF> (<i>be going to</i>), < <i>acabar de</i> + INF> (in its ‘recent past’ reading; <i>have just -en</i>)	Phasals (< <i>empezar a / comenzar a</i> + INF> ‘to start’; < <i>terminar de / acabar de</i> + INF> ‘to finish’; < <i>continuar / seguir</i> + GER> ‘to keep -ing’), positionally unrestricted modals (< <i>tener que</i> + INF> ‘to have to’; < <i>poder</i> + INF> ‘to be able to/ to be allowed to’; < <i>deber (de)</i> + INF> ‘to have to’); scalars (< <i>llegar a</i> + INF> ‘to go as far as to’, < <i>acabar</i> + GER> ‘to finish by -ing’); first-position auxiliaries (< <i>soler</i> + INF> ‘to be accustomed to -ing’, < <i>haber de</i> + INF> ‘to have to’); < <i>haber que</i> + INF> ‘it is necessary to’; < <i>tardar en</i> + INF> ‘to take (time) to’.

The distinction between lexical and functional auxiliaries touched on here is critical to our CG analysis of the Spanish auxiliary system, which is the focus of **Section 3**. In particular, our discussion will focus on the syntactic properties of modal auxiliaries as lexical auxiliaries, but our formal analysis is more general (see the grammar fragment in **Appendix A**).

2. Categorical grammar

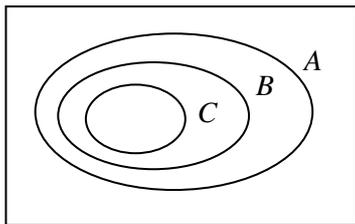
The theoretical framework for our analysis of Spanish auxiliary chains comes from the tradition of categorical grammar (CG). CG was introduced by the Polish philosopher and logician Kazimierz Ajdukiewicz (1935) and, like the PSG tradition, has evolved in more than one way; the version of CG that we adopt involves expansions upon Ajdukiewicz’s original proposal, most notably in Montague (1973), Dowty (1978, 2003), and Schmerling (1983a, b, 2019). CGs have the mathematical structure of an algebra, just as PSGs do; but rather than make use of rewriting operations as a PSG does, a CG’s formal operations manipulate a language’s expressions rather than grammatical symbols (lexical elements and their phrasal projections in classical PSGs; terminals and non-terminals, in formal language theory). Recall that an algebra consists minimally of a non-empty generator set A and a possibly empty set of operations on A ; if the set of operations is non-empty, as it is in any natural language, A is the smallest set that is closed under the operations. The generator set of the CG algebra is a set of *basic expressions*, and its operations recursively yield a set of *derived expressions*; the field of the algebra, then, is the union of these two sets. The early extensions of Ajdukiewicz’s CG by Bar-Hillel (1953) and Lambek (1958) follow his inasmuch as they recursively define syntactic categories on the basis of two kinds of information: the role they play in the language’s compositional semantics and, for derived expressions, the categories of their constituent expressions and how those expressions combine. In the more recent Montague-Dowty-Schmerling variety of CG, in contrast, a language’s system of syntactic categories is based only on the first kind of information: their role in the compositional semantics, which we illustrate shortly. Because the categories are no longer based solely on the language’s formal operations, the assignment of sets of expressions to categories is now accomplished by the supplementing of the category indices with a system of syntactic rules. These rules assign sets of expressions to categories, directly in the case of basic expressions and, in the case of derived expressions, by the categories of their constituent expressions

and the formal operations deriving them—since the latter are not already encoded in the categories themselves. In **Appendix A** of this paper, we include examples of both kinds of syntactic rule.

We will assume the basics of CG grammars presented in Montague (1973) and its extensions in Dowty (1979, 2003) and Schmerling (1983a, b; 2019), with some modifications to be developed in **Section 3**. We follow Montague (1970) and Schmerling (1983a, b, 2019) in defining a language L as containing an *algebra* $\langle A, P \rangle$, where A is a set of expressions and P is a set of formal operations defined over A —or, as they were called especially in the early twentieth-century American linguistics of Franz Boas, Edward Sapir, and their students, *processes* (the algebraic character of this model of grammar is discussed in Hockett, 1954; see Schmerling, 1983a for extensive discussion). The processes are *productive*; in mathematical terms, the set A is *closed* under the processes.⁹ Within the set A , we distinguish *basic* and *derived* expressions; derived expressions are those that are the outputs of formal operations.

Beyond the algebra that constitutes its formal core, a language contains a set of syntactic categories, each of which is a set of expressions indexed according to principles to be discussed shortly. The categories comprise a filter on this algebra. The structure of the system as a whole is shown in the Venn diagram in **Figure 1**.

⁹ That is, any output of a process is itself a member of the set of expressions. For example, if the process is prefixation of *un-*, and if *tie*, *untie*, *ununtie*, and so on are all members of the set A of expressions, then A is closed under *un-* prefixation: the outputs of repeated applications of this process are also members of A .



A = the set of all expressions of L
 B = the set of all expressions of L assigned to syntactic categories
 C = the set of all basic expressions of L

Figure 1. The formal structure of L

The *syntax* of a language then, in the variety of CG used here, is a set of *is-derived-from* relations (from a bottom-up perspective) or *comprise(s)* relations (viewed top down) among basic and derived expressions.¹⁰

The categories of a language, in a CG, have basic or derived indices, *basic category* indices (typically two) and a set of *derived* category indices. The set of universally available category indices is defined recursively from this base as *the smallest set containing the basic indices*—say, A and B , where we use A and B as metavariables ranging over category indices—and *the indices derived from them by repeated binary combinations of category indices expressed in fraction notation*. ‘The smallest set’ in this definition does the work of linguists’ more familiar *all and only*. We follow Ajdukiewicz in using fraction notation for the derived category names; for typographical simplicity, we use slash notation for fractions, designating a derived category index as, for example, A/B . The recursive definition we have just cited also makes available category indices such as B/A , A/A , $B/(A/B)$, and so on. A particular language makes use of a proper subset of these available indices,

A category name A/B (often referred to informally as a *slash category*) always indexes an expression that denotes a *function*; such an expression is called a *functor*. Specifically, an expression of category A/B always has the semantic value of a function from semantic values of B expressions to semantic values of A expressions.¹¹ As an example, in *tener que empezar a V* ‘has to start to V’, *tener que* ‘to have to’ belongs to an A/B category, and this functor expression is followed by the category B expression (*empezar a V* ‘to start to V’). In an example like this, where an A/B expression combines with a B expression, we refer to the B expression as the *argument* or the complement of the A/B expression; we also sometimes speak of the A/B

¹⁰ These CG relations have a very different motivation from those of the PS relations of dominance and precedence, their fundamental role being to constrain the relationship between the syntax and the compositional semantics (we will illustrate the workings of semantic rules in **Section 3**). Dominance has no counterpart in a CG, and what precedes what in a derived expression is specified by the language’s formal operations and syntactic rules.

¹¹ This is a critical feature of the variety of CG that we adopt in this paper, because, as we illustrate in **Section 3**, by its very nature it gives us a mathematical basis for rules for compositional semantic interpretation. The presence or absence of this intimate syntax/semantics link—in mathematical terms, a *homomorphism*—, among other formal properties, distinguishes the Montagovian variety of CG adopted here from *Combinatory Categorical Grammar* (CCG; see especially Steedman, 2014; Steedman & Baldridge, 2011) and perhaps other systems whose names contain the term *categorical grammar*. Unlike CCG, which derives more from the tradition of Lambek (1958) than the Montagovian tradition we use, the formal operations by which expressions of the language combine do not index the syntactic categories.

expression as *modifying* the B expression. Since the semantic value of a category A/B expression is always a function from expressions of category B to expressions of category A , such an expression is always appropriate for taking a category B expression as its argument—i.e., as its complement.

CGs, as we have summarised them, can be illustrated by the following English-based *toy grammar*, which includes a very reduced set of categories, expressions, formal operations, and syntactic rules. Syntactic rules for derived expressions must specify the categories of the expression or expressions that are inputs to the rule and the formal operations that derives them. The rules in (6) follow the format in Montague (1973); rules S_0 – S_3 are adapted from Schmerling (2019: §6.8):

(7) **Categories:**

FC (Finite Clause)

NP (Noun Phrase)

FC/NP (the category of expressions that have a single NP argument, the combination yielding a FC)

(FC/NP)/NP (transitive verbs: the category of expressions that combine with an NP to yield an expression of category FC/NP)

Basic expressions:

FC/NP = {sleeps, walks, shines, ...}

(FC/NP)/NP = {buys, hits, breaks, ...}

NP = {John, Mary, the vase, ...}

Formal operations:

$F_0(\alpha) = \alpha$, for every expression α . (Identity)

$F_1(\alpha, \beta) =$ the result of concatenating α to the right of β , for all expressions α, β .

Syntactic rules:

S_0 (rule S_1 in Montague, 1973). $B_A \subseteq P_A$, for every category A . (*The basic expressions of category A are a subset of all the expressions of category A , for every category A*)

S_1 . If $\alpha \in P_{FC/NP}$ and $\beta \in P_{NP}$, then $F_1(\alpha, \beta) \in P_{FC}$, for all α, β .

S_2 . If $\alpha \in P_{NP}$ and $\beta \in P_{(FC/NP)/NP}$, then $F_1(\alpha, \beta) \in P_{FC/NP}$, for all α, β .

With these rules, we can formulate a rigorous proof that the expression *John breaks the vase* belongs to the language as an expression of category FC:

(8) *The vase* is a basic expression of category NP.

Breaks is a basic expression of category (FC/NP)/NP

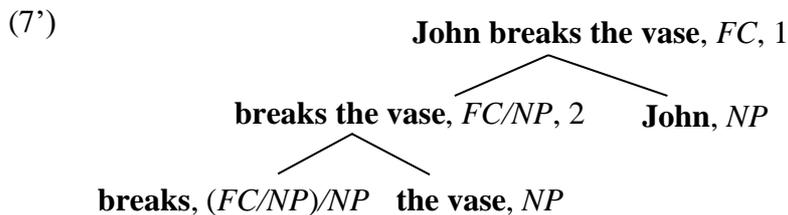
Breaks the vase is a well-formed expression of category FC/NP, by S_2 .

John is a basic expression of category NP.

Now if we add a line after the fourth line in (4) in which we make use of F_1 (breaks the vase, John), then we arrive at what we sought to prove:

John breaks the vase is a well-formed expression of category FC, by S_2 , QED.

Montague (1973) introduced a method for diagramming proofs of category membership like (7) that made use of what he called an *analysis tree*, with which (7) can be diagrammed as in (7’):



(7’), as a diagram of a proof, differs from PS trees in not being a part of the syntactic structure of any expression; it also conveys quite different information from a PS tree. Each node in (7’) is a 2- or 3-place sequence: (a) a linguistic expression, shown in boldface, (b) the category to which that expression belongs, shown in italics, and (c) the number of the rule that yields that expression, if it is derived.

In a Montagovian analysis tree, the relative order of the constituents making up an expression higher in the tree reflects which is the functor and which is the argument. This information is available from the categories of the expressions and the syntactic rule specified, in another departure from PS rules: ‘breaks the vase, FC/NP, 2’ is exactly equivalent to ‘*breaks the vase* is a well-formed expression of category FC/NP, by S_2 ’ (see Montague, 1973: 227). In this sense, analysis trees are more informative than PS trees: at every point we know the expression involved, its category index, and thus, for functors, the category of the expression they can combine with. The analysis tree in (7’) shows that the vase does not occur leftmost in the expression breaks the vase and that John does occur leftmost in the expression John breaks the vase; this information is given in syntactic rules 2 and 1, respectively, and (7’) shows that they are applied to breaks and the vase, in the first instance, and to breaks the vase and John, in the second. It should now be apparent that the mnemonic value of the fraction notation lies in the way it diagrams that concatenation of an expression of category A/B with an expression of category B yields an expression whose category index is the result of the two B ’s ‘cancelling each other out’, yielding an expression of category A : when the FC/NP expression breaks the vase combined with the NP John, the two instances of NP cancelled out, yielding FC as the category of the whole expression John breaks the vase.

A final way in which a Montague-style analysis tree is distinct from a PS tree is that a category index like FC/NP in (7’) is not a PS-style *label*: there is no ‘labelling algorithm’ (Chomsky, 2013) accompanying structure building or rules of the grammar making reference to labels or structural variables. In contrast to VP or NP in a PSG, FC/NP and FC in a CG are not non-terminal nodes that rewrite as whatever they dominate. CGs are not grounded in a *rewrites-as* relation; in other words, there is no *is-a* relation defined for *mother node-daughter node* pairs as in PSGs. In short: analysis trees in a Montagovian CG are not phrase markers, nor are they reducible to phrase markers.

The grammatical formalism we have chosen for our analysis has the advantage of being both highly adaptable and fully explicit, in terms of both the categories it makes available and the combinatory potential of expressions of those categories. Recall that category indices in a CG are more informative than node labels in PSGs:

given the interpretation of the fraction notation introduced above, if we know that an expression is of category *A* and that one of its constituent expressions is of category *B*, we can *deduce* that the category of the other constituent expression is *A/B*. An important emphasis of Ajdukiewicz (1935) is that his CG allows one to *discover* previously unknown categories; for example, if we know that an expression is of category FC/NP and that one of its constituent expressions is of category NP, we can deduce that the category of the other constituent expression is (FC/NP)/NP.

Having now summarised the principal features of the variety of CG we are using and noted some of its overall benefits, we turn to a detailed look at the aspects of Spanish auxiliary chains that are problematic for PS-based approaches and a demonstration of the natural accounts of them that are available in our CG alternative.

3. A categorial grammar account of Spanish auxiliaries

3.1 Where monotonic approaches fall short

We have indicated that the works on Spanish auxiliary chains cited in **Section 1**, on which our analysis is based, identify technical and empirical difficulties faced by X-bar theory and its comparatively recent incarnations (Merge-based Minimalism; Chomsky, 1995 and much related work; see Bjorkmann, 2011; Harwood, 2014; Ramchand & Svenonius, 2014; Ramchand, 2018 for surveys of Minimalist approaches to auxiliary verbs; also Falk, 2003 for a Lexical Functional Grammar analysis that faces similar difficulties). We will now see that a critical property of Spanish auxiliary chains is that they display a variety of dependencies of varying computational complexity, according to the properties of the specific auxiliaries making them up. This variation is illustrated in examples (8a–c), to which we will return in **Section 3.2**.

- (9) a. Juan ha tenido que ser ayudado
 J. has.3SG.PRES have.to.PTCP be.INF help.PTCP.M.SG
 ‘Juan has had to be helped’

Essentially what we have in (8a) are two lexical elements (the lexical auxiliary *tener que* and the lexical verb *ayudar*), each modified by a non-lexical auxiliary (the perfect *haber* and the passive *ser*, respectively). *Ha tenido que* in turn modifies *ser ayudado*, such that the obligation pertains to an event in which someone is helped. An adequate analysis must group *ha* with *tenido que* in a syntactic unit that excludes *ser* and *ayudado* if it is to capture the semantic properties of the sentence.

- (8) b. María debía poder empezar a trabajar más temprano
 María had.to.3SG.IPFV be.able.INF start.to.INF work.INF more early
 ‘M. had to be able to start working earlier’

In (8b), each auxiliary modifies an immediately adjacent element of the chain; we have examples like this whenever the auxiliaries in the chain are all *lexical* auxiliaries. Example (8b) requires the deontic meaning expressed by *debía* to affect the modal *poder* but not the phasal auxiliary *empezar a ...*: the subject was obligated

to be able to start working earlier, but, as we have already seen with lexical auxiliaries, this does not entail that the subject was obliged to actually start working or that he/she was obliged to work. Because all the auxiliaries in this sentence are lexical auxiliaries, they are each, as we have indicated, opaque to aspectual information expressed by auxiliaries other than the one immediately preceding them. The modification pattern of (8b) is that predicted by a monotonically growing PSG (transformational or not; see Falk, 2003)'s system: [*debía [poder [empezar a [trabajar]]]]*].

- (8) c. El ministro va a haber sido asesinado
 The minister go.to.3SG.PRES have.INF be.PTCP murder.PTCP.M.SG
 'The minister will have been murdered'

In (8c), both functional auxiliaries, *va a* and *haber*, modify the lexical verb *asesinar*, as does the passive auxiliary *ser*, with no one auxiliary modifying any other. Note that if *va a* modified *haber*... there would be a clash between the future meaning supplied by *va a* and the temporal-aspectual meaning of *haber*, which always involves past time reference; *haber* cannot be localised in time by *va a*. Sentences like (8c) arise when a sequence of functional auxiliaries is immediately followed by passive *ser*; in sentences like these none of the auxiliaries absorbs the aspectual and temporal information of the auxiliaries occurring to its left. Recall that functional auxiliaries modify but cannot themselves be modified; this is also true of passive *ser*. In sentence (8c), then, the auxiliaries all modify the main verb *asesinar*, as we have indicated. These modification relations yield the correct future perfect interpretation of a passive VP.

Capturing the semantic relations among the items in a chain whose auxiliary members are all functional auxiliaries as in (8c) is not straightforward in Minimalism. As a consequence of its grammatical architecture, where structure building is severed from both the lexicon and semantics, it is not possible for internal properties of the elements which are manipulated by the syntactic operations of Internal- and External Merge—including in our case being a lexical or a functional auxiliary—to impact the format of phrase markers so that these always, in the case at hand, have the form [Aux_1 [Aux_2 [Aux_3 ... [Aux_n [VP]]]]]. These properties may interact with structure building only if they are expressed as features that can enter into Agree relations (Adger, 2003; Di Sciullo & Isac, 2008; Wurmbrand, 2014; see also Harwood, 2014 for an approach to auxiliary sequences that relies heavily on operations over lexical features). However, since the Agree operation requires asymmetric c-command relations between Probes and Goals (Chomsky, 2000), the format of the structure itself (the sequence of auxiliary heads mentioned above) still cannot change. Non-monotonicity in sequences of auxiliaries is not contemplated in structurally monotonic approaches.

Let us flesh these points out. Given our formal characterisation of a language (see Schmerling, 2019: 16–17 for a complete formal definition), we can ask whether the algebra $\langle A, P \rangle$ for Spanish has the property of *commutativity*. We can see that this is not the case when we consider the Spanish verbal domain; note that (6a-b) (repeated here as (9a-b)), while both grammatical, are not synonymous:

- (10) a. Juan debe estar trabajando todo el día
 Juan must.3SG.PRES be.INF work.GER all the day
 ‘J. must be working all day long’ (Modality > Aspect > Verb)
- ≠
- b. Juan está debiendo trabajar todo el día
 Juan be.3SG.PRES must.GER work.INF all the day
 ‘J. is having to work all day long’ (Aspect > Modality > Verb)

There is no evidence independent of the functional hierarchy itself that either (9a) or (9b) is transformationally derived from the other. That is, there is no empirical test to defend the position that one is more basic than the other, nor is there a way to test whether movement has taken place to repair the posited discrepancy between word order and an *a priori* universal functional hierarchy (Cinque, 1999, 2004).¹² This issue arises with any global functional skeleton based on an underlying universal order (e.g., Bjorkmann, 2011; Ramchand & Svenonius, 2014).^{13, 14} Here we reproduce Cinque’s (2004: 133) hierarchy (see also Cinque & Rizzi, 2016):

MoodP_{speech act} > MoodP_{evaluative} > MoodP_{evidential} > ModP_{epistemic} > TP_(Past) > TP_(Future) > MoodP_{irrealis} > ModP_{alethic} > AspP_{habitual} > AspP_{repetitive(I)} > AspP_{frequentative(I)} > ModP_{volitional} > AspP_{celerative(I)} > TP_(Anterior) > AspP_{terminative} > AspP_{continuative} > AspP_{retrospective} > AspP_{proximative} > AspP_{durative} > AspP_{generic/progressive} > AspP_{prospective} > ModP_{obligation} > ModP_{permission/ability} > AspP_{Completive} > VoiceP > AspP_{celerative(II)} > AspP_{repetitive(II)} > AspP_{frequentative(II)}

If we assumed Cinque’s hierarchy, then (9a) would have to be derived via movement of *deber* (which would be a head Mod_{obligation}) from a position below *estar* (which would be a head Asp_{progressive}) to a functional projection above *estar*. This is not a peculiarity of *deber*: the same paradigm emerges with all deontic modals (e.g., *está teniendo que trabajar* ‘is having to work’ vs. *tiene que estar trabajando* ‘must be working’: either epistemic or deontic) and also in the interaction between tense, aspect, and modality.¹⁵ In Cinque’s view the functional hierarchy is determined by Universal

¹² That is, any *a priori* functional clausal skeleton, as assumed in Exoskeletal models (Borer, 2005) and Nanosyntax (e.g., Baunaz & Lander, 2018).

¹³ Bravo et al. (2015), García Fernández et al. (2017), and Krivochen & García Fernández (2019, 2020) argue that this structural variety cannot be generated by an approach requiring uniformity and monotonicity in structure building, as with a Merge-based system like that in Kayne (1994, 2018) or Chomsky (1995, 2013), or a universal template like Cinque’s (1999, 2004).

¹⁴ Theories like HPSG diverge from Minimalism on this point: rather than assume a universal underlying fixed order of functional heads, HPSG makes use of sets of linearisation principles that are assumed to hold widely though not universally. See Müller (2019) for discussion. In classical LFG (e.g., Kaplan, 1995) the order of terminals is read directly off c-structure, but more recent developments separate terminal strings from c-structure (Dalrymple & Mycock, 2011).

¹⁵ In this respect, note the contrast between (i) and (ii) (from Krivochen, forthcoming):

Grammar (which also determines the format of phrase markers as binary-branching and projecting, as in Chomsky, 1995, 2013; Kayne, 1994, 2018; and much related work). Crucially, the hierarchy translates directly and uniformly into a clausal skeleton in which if A is higher than B, then the projection headed by A must c-command the projection headed by B. Since the order that emerges from Cinque’s hierarchy is (9b), the structure of (9a) must be that in (9a’):

(9) a’. Juan debe_i estar *t_i* trabajando todo el día

But apart from the fact that such a view forces us to choose arbitrarily that certain auxiliary sequences are more basic than others, a strictly syntactic interpretation of the Cinque hierarchy runs into problems, most notably because it allows a limitation to a single kind of predication structure; our examples (8a–c) showed that no such limitation exists for Spanish.¹⁶ If, with Ladusaw (1980), May (1985), and many others, we define the *scope* of a node α as the set of nodes in a PS tree that α c-commands, then we are forced to predict that a single kind of modification is possible:

(11) [Aux 1 [Aux 2 [Aux 3 [Lexical verb ...]]]]

-
- i) Pudiste haber=le disparado, {*y de hecho lo=hiciste /
 can.2SG.PFV have.INF=him shoot.PTCP {and in fact it=do.2SG.PFV /
 pero no lo=hiciste}
 but NEG it=do.2SG.PFV}
 ‘You could have shot him {*and in fact you did / but you didn’t}’
- ii) Has podido disparar=le, {y de hecho lo=hiciste /
 have.2SG.PRES can.PTCP shoot.INF=him {and in fact it=do.2SG.PFV /
 pero no lo=hiciste} (epistemic / dynamic)
 but NEG it=do.2SG.PFV}
 ‘It was possible for you to shoot him {and in fact you did / but you didn’t}’

These examples show (a) that perfective aspect is possible above or below the modal, and (b) that the interpretations are not equivalent, since a perfect complement of a modal has a counterfactual interpretation that a perfect modal does not have.

¹⁶ An illustration of the procrustean character of a template-based approach is the following quotation from Cinque (2004: 133):

[...] the functional portion of the clause, **in all languages, is constituted by the same, richly articulated and rigidly ordered**, hierarchy of functional projections [...] [emphasis ours]

In such a scenario, the different orders found in Spanish auxiliary chains must be handled via movement transformations, an approach for which there is no independent motivation and which therefore has the status of an *ad hoc* stipulation. Furthermore, a functional hierarchy like Cinque’s can only generate one kind of modification pattern (the monotonic structure [X_P X [Y_P Y [Z_P Z [...]]]], defining a regular language; this has the problems noted above in delivering the correct segmentations), which—as we argue at length—undergenerates and is thus empirically inadequate; see also García Fernández & Krivochen (2019).

In the context of the analytical tradition for auxiliaries originated in Chomsky (1957, 1964b) and Ross (1969) and developed within X-bar theory and Minimalism,¹⁷ the predication structure in (10) is incorrectly predicted to be the only kind of modification pattern that can exist in a Spanish auxiliary chain (or indeed in any auxiliary chain, since the format for phrase markers is universal). As illustrated above, however, recursive monotonicity is only one of several possible modification patterns in auxiliary chains. Even if head movement could, however stipulatively, take care of the issue of auxiliary order in (9a), it would still yield an incorrect segmentation for (9b): the progressive only affects the modal, not the lexical verb. The correct segmentation for (9b), if a syntactic segmentation to be suitable for the compositional semantics as in the approach we have adopted here, must be [está debiendo] [trabajar], not [está [debiendo [trabajar]]]. A single universal template faces difficulties not only with respect to linear order, but also to the constituent structure assigned to a string.

Structural uniformity is not only a property of generative grammar. The type of dependency in (8c)—in which all auxiliaries modify the main verb but no other auxiliary—is the only one explicitly mentioned in the prominent RAE-ASALE Spanish grammar (2009, §28.1a):

The term *verbal periphrases* refers to syntactic constructions in which an *auxiliary* verb affects an *auxiliated* [Sp.: *auxiliado*] verb, variously called *main* or *full*, occurring in an impersonal form (that is, an infinitive, gerund, or participle) without giving rise to two distinct predications. The auxiliary verb is usually conjugated (...), but need not be, according to the syntactic properties of the sentence (...). Even so, auxiliary verbs can occur in a chain [translation ours].

The RAE-ASALE definition, representative of the Hispanic grammatical tradition, inevitably leads to the conclusion that auxiliaries, together or individually, affect only the “auxiliated” verb, which can only be the main verb. While this idea is not entirely wrong, it is insufficient, inasmuch as it predicts *only* the (8c) kind of structure. We have seen that this structure must be distinguished from the (8a) and (8b) structure types.

We have seen that “[t]he order in which auxiliaries appear does not linearly correlate with interpretative effects, for a given string of symbols can display several kinds of structural dependencies which are all in principle applicable [...] (Bravo et al., 2015: 77–78)”. This point is not trivial. It does not entail that *all* possible orders (i.e., all logical permutations of terminal symbols) are grammatical (see García Fernández et al., 2017; García Fernández & Krivochen, 2020 for analyses of restrictions in chains), it states that more than one order is possible *and* that each of the grammatical orders given a sequence of auxiliaries corresponds to a distinct interpretation, to which a distinct structural description must correspond. In a monotonic, binary-branching-all-the-way-down generative engine, the only way to build structure is via discrete recursive combinatorics. If the only structure-building operation is (Internal or External) Merge, which always manipulates *two* elements, the

¹⁷ See, e.g., Adger (2003: §5.3.2) for a feature- and projection-rich Minimalist view, also Ramchand (2018). Falk (2003) presents a similarly monotonic LFG approach based on VP recursion at *c*-structure.

resulting object then being labelled depending on the identity of which of the two elements is the head (Chomsky, 2013), then, without the invocation of an independently unmotivated operation on phrase markers, there is no room for variation in phrase-marker format (see also Kayne, 1994, 2018). In this scenario, instances of {H, H} (two heads) or {XP, YP} (two maximal projections) require some readjustment to yield {H, YP} and restore derivational rhythm. The requisite process is usually movement (Internal Merge), as illustrated in (9a'), which in turn requires either operations to reconstruct the pre-transformational phrase marker or the inclusion of indices to the same effect.

As should be apparent by now, the English auxiliary system *does not work like the Spanish one* (a point that should not be cause for surprise in the categorial system, again because of CG's adaptability). To illustrate the differences between English and Spanish auxiliaries to which we have referred, we note that Schmerling's (1983b) arguments for modal and aspectual auxiliaries' forming a grammatical unit with nominative subjects in Finite Clauses (FCs) and Inverted Finite Clauses (IFCs) in English do not apply to Spanish:

- Only two English auxiliaries inflect like finite verbs for Tense, Aspect, Modality (TAM), and agreement: *have-has-had* and *be-is-was*. In Spanish, however, auxiliaries, with the two exceptions noted in fn. 7, inflect for TAM the same way lexical verbs do:

- (12) a. Juan trabajaba hasta tarde los fines de semana
 Juan work.3SG.IPFV until late the ends of week
 'Juan worked until late on weekends'
 (lexical verb inflected for TAM)
- b. Juan terminaba de trabajar tarde los fines de semana
 Juan stop.3SG.IPFV work late the ends of week
 'Juan stopped working late on weekends'
 (lexical auxiliary inflected for TAM)
- c. Juan estuvo trabajando hasta tarde toda la semana
 Juan be.3SG.PFV work.GER until late all the week
 'Juan was working until late all week'
 (functional auxiliary inflected for TAM)

- Spanish lexical verbs invert in interrogative contexts, as do partial chains or entire chains that include the lexical verb (see Krivochen & García Fernández, 2019 for discussion and more examples; García Fernández et al. 2020 for discussion about the behaviour of intermediate elements in inversion contexts):

- (13) a. Juan *dijo* que ... → ¿Qué *dijo* Juan?
 Juan say.3SG.PAST.PFV that ... → what say.3SG.PFV Juan
 'Juan said that ...' → 'What did Juan say?'
- b. Juan *había tenido que decir* que ... →
 Juan have.3SG.IPFV have.to.PTCP say.INF that ...
 ¿Qué *había tenido que decir* Juan?
 What have.3SG.IPFV have.to.PTCP say.INF Juan
 'Juan had had to say that...' → 'What had Juan had to say?'

- c. ¿Qué *había* *podido* Juan *estar* haciendo?
 What have.3SG.IPFV can.PTCP Juan be.INF do.GER
 ‘What had Juan been able to be doing?’

Importantly, however, in English only the *first* auxiliary in a sequence can invert (Quirk et al., 1985 refer to the auxiliary that inverts as the *operator* in a sequence):

- (14) a. He might have been being questioned by the police
 b. *Might have he been being questioned by the police?
 c. Might he have been being questioned by the police?
- Spanish auxiliaries are not restricted to specific clause types (again, see fn. 7).
 - Spanish does not have English-like stranding of auxiliaries together with subjects in so-called VP ellipsis.¹⁸
- (15) a. Robin ate a bagel for breakfast, and Leslie *will* [eat a bagel] too. (adapted from Culicover & Jackendoff, 2005: 283)
 b. *Juan ha *comido* un bagel de desayuno, y
 Juan have.3SG.PRES eat.PTCP a bagel of breakfast and
 María también ha *<comido un bagel>*
 María also have.3SG.PRES *<eat.PTCP a bagel>*
 ‘Juan’s eaten a bagel for breakfast and María has too’

There are many aspects of the Spanish auxiliary system that fall outside the scope of this work, including a detailed account of co-occurrence restrictions of the kind that forbid **está siguiendo cantando* (‘he/she is continuing singing’) (see García Fernández et al., 2017; García Fernández & Krivochen, 2020); some of these restrictions are orthogonal to the syntax of auxiliary chains. The focus of the present contribution is the interaction between auxiliaries that can modify other auxiliaries as well as be modified themselves and those which can only modify, and how to provide adequate characterisations for constructions where these appear. To the extent that Spanish is not the only language where modal auxiliaries are not positionally restricted

¹⁸ VP ellipsis in Spanish is impossible with perfect *haber*, future *ir a*, progressive *estar*, and passive *ser*:

- i. *María va a llegar tarde y Juan también va a / *pero Juan no va a. ‘María is going to arrive late, but Juan is not going to’
- ii. *María está trabajando y Juan también está / *pero Juan no está. ‘María is working and Juan is too’
- iii. *María ha trabajado y Juan también ha / *pero Juan no ha. ‘María has worked and Juan has too’
- iv. *María fue traicionada y Juan también fue / *pero Juan no fue. ‘María was betrayed and Juan was too’

VP ellipsis with modal and phasal auxiliaries forces us to consider data that go beyond the scope of the present paper (e.g., root modals allow for VP ellipsis but not epistemic modals; see Krivochen, forthcoming). Nevertheless, Spanish is crucially different from English in not having an English-like general VP ellipsis rule which applies regardless of the specific auxiliary involved or its interpretation.

as they are in English (cf. e.g., Italian *ho potuto lavorare*, ‘I have been able to work’, but crucially **sto potendo/dovendo lavorare* for most speakers ‘I am currently being able to/having to work’, unlike Spanish), the theoretical framework specified here has a wide applicability. Given the descriptive observations made above, a categorial segmentation of Spanish that is different from that of English not only in terms of what constitutes a criterion for auxiliary-hood but also in terms of what format the structural descriptions of sequences of auxiliaries require has strong empirical justification.

In **Section 3.2**, we will present a CG analysis of Spanish auxiliary chains that accounts straightforwardly for the modifying properties of lexical vs. functional auxiliaries that we have discussed in this section. These modifying properties follow from the architecture of the overall CG analysis as presented in **Appendix A**.

3.2 A categorial grammar of the Spanish auxiliary system

We can now give the following summary of the properties of Spanish auxiliary chains that we want our analysis to account for:

- There is no *a priori* upper bound on the number of auxiliaries that a chain may contain.¹⁹
- The relative order of auxiliaries is not fixed *a priori*, and each permutation is semantically significant (such that *ha podido trabajar* ‘has been able to work’ is not synonymous with *puede haber trabajado* ‘may have worked’).
- There are two kinds of auxiliaries, lexical and functional. Lexical auxiliaries may modify either a saturated FC/NP²⁰ or a basic or derived lexical auxiliary. They may also be modified by a lexical or functional auxiliary: in *ha debido hacer eso* (‘he/she has been under the obligation to do it’), *ha* modifies *debido*, and *ha debido* modifies *hacer (eso)*. Functional auxiliaries may only modify a main verb or a lexical auxiliary; they may not themselves be modified: in *va a haber hecho eso* (‘he/she will have done it’), *va a* does not modify *haber*, but only *hecho (eso)*; similarly, *haber* only modifies *hecho (eso)*.

We turn now to the categorial framework we will use to account for these properties.

In the version of CG introduced by Lambek (1958) (cf. **Section 1**) and in the work of those who take Lambek’s system as their point of departure (see Moortgat, 2011 for discussion), the formal operations deriving functors are built into the names of the categories that index them—so that syntactic rules like those we introduced in that section would have been redundant and therefore unnecessary. The toy grammar that we introduced in that section, which did make use of syntactic rules, anticipated

¹⁹ This does not mean, obviously, that auxiliary chains can be infinitely long. It means that, unlike English, it is impossible to formulate a single rule that makes reference to all possible auxiliaries and is valid *a priori* (cf., e.g., Chomsky’s 1957 phrase structure rule for English auxiliary chains).

²⁰ A *saturated* FC/NP is the category of basic (lexical) or derived intransitive verbs (verb phrases) which require no further arguments to become expressions with a single NP argument, the combination yielding a FC (saturated FC/NPs may still be modified by optional modifiers: lexical auxiliaries and traditional adverbs). In what follows we will often find it convenient to use Montague’s abbreviation IV for the (basic or derived) intransitive verb category.

the kind of CG that we adopt in the Spanish grammar fragment in the **Appendix B**. For our Spanish grammar fragment, the set C of available categories is defined as the smallest set such that:

- $FC, NP \in C$; and
- For all X, Y , if $X, Y \in C$ then $X/Y \in C$. X/Y designates a category of expressions that combine with expressions of category Y to yield expressions of category X .

Recall that the “slash categories” represent function/argument relations such that X/Y is a functor, Y is the category of its argument,²¹ and X is the category of the range of the function denoted by the functor; accordingly, the semantic value of $(X/Y)/Y$ is the semantic value of the functor X/Y applied to the semantic value of its argument Y . Let $\llbracket \alpha \rrbracket$ stand for the semantic value of α (Dowty et al., 1980). Then we can notate this as $\llbracket (X/Y) \rrbracket(\llbracket Y \rrbracket)$; an example that we discuss shortly is the semantic value of *empezar a* ‘to start to’ applied to the semantic value of the argument *trabajar* ‘to work’, or $\llbracket \textit{empezar a} \rrbracket(\llbracket \textit{trabajar} \rrbracket)$. Productive work on natural-language compositional semantics using CG did not make great headway before Montague (1973), but the innovation of basing the syntactic categories on function/argument relations goes back to Ajdukiewicz (1935), and the successful implementation of Ajdukiewicz’s insight has been a goal in all the versions of CG introduced after his.

3.2.1 Expressions and operations

In our analysis of Spanish auxiliary chains, we will assume the formal operations in (16), where α and β are variables over expressions. The syntactic rules we assume are then introduced as this section continues and summarised in **Appendix A**. In the remainder of this paper, the syntactic rule numbers refer to those in that appendix:

(16) Formal operations:

$F_1(\alpha, \beta)$ = the result of concatenating α to the left of β , for all α, β .

$F_2(\alpha, \beta)$ = the result of concatenating α to the right of β , for all α, β .

$F_3(\alpha, \beta)$ = the result of concatenating α **a** to the left of β , for all α, β .²²

We have described operations in some detail; we turn now to expressions. Consider, for instance, the different clause types that we can find in English or Spanish: indicative clauses, inverted indicative clauses (including interrogatives), subjunctive clauses, imperative clauses, and various non-finite clauses (infinitival, gerundial, participial). Montague (1973) introduced the innovation of *splitting*

²¹ In Montague (1973) and work based on it like Dowty (1979, 2003) and Schmerling (1983b, 2019), the operations that effect this combining need not be simple concatenation. Consider for example our operation F_3 in **Appendix B**, which not only concatenates two expressions but also adds the object marker *a* (see fn. 22).

²² This operation applies in the derivation of expressions like *interrogar a Juan* ‘to question Juan’, which exhibits the *a* of so-called *Differential Object Marking* (DOM) in Spanish. DOM, broadly speaking, introduces animate direct objects; see Fábregas (2013) for a survey of research on this phenomenon. Since CG does not assign any special significance to orthographic words, as we have indicated, F_3 is properly seen as including case inflection, marking the direct object *Juan* as accusative.

categories into subcategories such as those we have seen, while assigning each subcategory the same type of semantic value. Splitting Montague's clause category *t* into subcategories like indicative clause, infinitival clause, and so on allows the grammar to recognise different clausal subcategories and hence to capture the differences among them in internal constituency and distribution.²³ Because of such differences, Schmerling (1983b) analyses the clause category in English as being split into clausal subcategories that include FC (indicative finite clause), IFC (inverted indicative finite clause), etc. In turn, expressions of each of these categories may have internal structure; expressions of the category FC may be basic (as with *Yes* or *No*), but they typically result from the application of operations to their constituent expressions. Where categories are concerned, we have focussed on category *names* in CG. A category itself is a *set of expressions* that is *indexed* by a category name. So, just as a subset of a set is itself a set, a subcategory like FC is itself a category. Accordingly, everything we have said about categories in this paper pertains equally well to subcategories. Category splitting as introduced in Montague (1973) is formally a trivial modification of CG theory; this is true despite the nontrivial increase it makes in CG's adaptability, our focus in Section 3. Consider now that in Schmerling's system the functor in an English FC is not an FC/NP, as in the toy grammar in Section 1, but the subject: a nominative NP, or member of the category FC/IV. This category assignment was motivated, among other things, by facts pertaining to VP ellipsis in English, which may leave a modified subject as a remnant. Neither our toy grammar nor the more ambitious Spanish grammar fragment we present in Appendix A has a category of nominative subjects like Schmerling's; the basic building blocks we motivate for clause formation in Spanish are the crucially different FC/NP and NP. An important thesis of this paper is that the CG system presented here has the adaptability to account for languages that, from a structurally monotonic perspective, can only be considered formally incommensurate.

We have seen that in a CG, basic expressions are distinct from PSG terminals; thus, *basic expressions* are not to be confused with *words*, which, as we have indicated, constitute terminals in mainstream approaches. In a CG approach a basic expression can consist of more than one orthographic word, as in (16) and (17) below. These examples use category names from Schmerling's (1983b) analysis of English; the use of multiple slashes will be discussed shortly:

(17) John *would rather* walk \rightarrow (FC//IV)/(FC/IV)

(18) John *will have* walked \rightarrow (FC///IV)/(FC/IV)

(Schmerling, 1983b: 14, 22)

In Schmerling's analysis the subject is defined as belonging to a category that must combine with an expression of category IV. (12) and (13) contain multi-word basic expressions,²⁴ which belong to categories that are English auxiliaries which combine with nominative subjects (FC/IV) to yield formally modified expressions of category

²³ Montague (1973: 249) did not in principle limit category splitting to the categories he split in that work, although, since he included only indicative clauses there, *t* was not among those he split.

²⁴ FC//IV and FC///IV could in principle of course also be category names for derived expressions.

FC//IV or FC////IV: subjects with which an expression of a subject modifier category, here *would rather* or *will have*, has been concatenated. Following the practice of Montague (1973), these modified subjects are distinguished from the category of non-modified subjects (FC/IV) by the use of additional slashes, as we have indicated: FC//IV in (12) or FC////IV in (13). The “numerators” in the modifying expressions are written FC//IV and FC////IV because the modifiers in (12) and (13) take unmodified nominative subjects as their complements. The motivation for this analysis of auxiliaries as expressions that modify subjects is discussed in **Appendix A**. When a process applies to a basic expression, the result is a derived expression; in Schmerling’s analysis of (17) and (18), *John, would rather, will have*, and *walk* are all basic expressions, and *John would rather, John will have, John would rather walk*, and *John will have walked* are all derived expressions.

Generative grammar has traditionally analysed English *will* and *have* as two independent heads (from Ross, 1969, Huddleston, 1974; and Akmajian et al., 1979; to Cinque, 2004; Bjorkmann, 2011; Harwood, 2014; Ramchand & Svenonius, 2014; Cinque & Rizzi, 2016; Ramchand, 2018 and many related works; see also Falk, 2003 for an LFG analysis), projecting functional phrases in a strictly monotonically binary skeleton with a fixed order determined by Universal Grammar (expansions of the Inflectional domain, IP, include several kinds of AspectP, ModalityP, etc.). Schmerling (1983b), in contrast, analyses such expressions as ‘will have’ as basic, because of their lack of full syntactic and semantic predictability. The formal adaptability of CG makes it a suitable formalism for capturing the structural and semantic nuances of both the English and Spanish auxiliary systems; we detail this adaptability in **Appendix B**.

We have indicated that, following Montague (1973), Dowty (1979), and Schmerling (1983b, 2019), we use different numbers of slashes to indicate category splits, i.e., expressions of the same category but with different combinatory possibilities. For instance, in a Spanish-like SVO language an expression of category IV (FC/NP; cf. fn. 12) like *trabajar* must combine with an NP in the formation of an FC, via left concatenation of the NP expression to the IV expression: *Juan trabaja*. If the FC/NP combines with a functional auxiliary, yielding *ha trabajado*, the result of such combining still combines with an NP to form an FC, yielding *Juan ha trabajado*; we can designate the newly derived category FC//NP: a modified FC/NP. We will discuss modification of an FC/NP by a functional auxiliary shortly, as well as the justification for splitting the IV category.

We can now make explicit a point asserted in fn. 11: the fact that the CG theory by its very nature gives us a mathematical basis for rules of compositional semantic interpretation. This is clearest in the case of lexical auxiliaries, which can both modify and be modified; accordingly, we can say that (FC/NP)/(FC/NP) is of the category of functions from FC/NPs to FC/NPs, (IVs to IVs). To say this is to say two things: (i) that expressions of this category are syntactically defined to take FC/NPs (IVs) as their complements, and (ii) that, as we have discussed, they are at the same time semantically defined as the values of the functions they denote applied to the semantic values of those complements. As a specific example, consider that an expression of the (FC/NP)/(FC/NP) category like *empezar a* ‘to start’ is categorially defined to take an expression of the FC/NP (IV) category like *trabajar* ‘to work’ as its complement, yielding an expression of category FC/NP like *empezar a trabajar* ‘to start to work’. Simultaneously, an expression of this category is categorially defined to have the

default semantic effect of modifying the meaning of that complement. In this case, the architecture of the grammar automatically makes available a semantic rule saying that the result of combining a lexical auxiliary with an IV is a modification of the semantic value of that IV; translating the semantic rule schema just summarised into the interpreted Intensional Logic (IL) of Montague (1973) yields $\lambda P(\mathbf{empezar-a}(P))(\mathbf{trabajar})$,²⁵ where P is a variable ranging over IV *intensions* (or *senses*). Following Montague (1973), the exact way in which the intension of the complement is modified is specified by the *extension*, or *referent*, of the auxiliary. Given the lexical semantics of *empezar a*, we have the result that in *empezar a trabajar* the internal temporal structure of *trabajar* in *empezar a trabajar* is modified so that the beginning of the working is focussed upon rather than the work's entire course (Freed, 1979; Klein, 1992: §3; Laca, 2004).

We indicated earlier and reiterate now that this intimate syntax/semantics link is an essential feature of the Ajdukiewicz/Montague CG we have adopted in this paper. This fact has a crucial consequence: it makes no sense in this system to speak of something as “being handled in the semantics rather than the syntax” or *vice versa*; the two work in tandem. It cannot be overemphasised that the relationship between syntax and semantics in the variety of CG we are assuming follows from the architecture of the theory. Because of this intimate connection between syntax and semantics, it is unnecessary, in the case of lexical auxiliaries, to state a semantic rule for each syntactic rule we propose: the default structure of the relevant semantic rules is always inferable from the syntactic rules. The reader should bear this in mind, since we often discuss matters from the syntactic side of things; this does not obscure what sort of semantic rule we are assuming in any given example.²⁶ Where the lexical semantics of the

²⁵ In IL, the symbol ' immediately following a ‘non-logical’ (lexical) word indicates that it and the immediately preceding word constitute an abbreviation for that word in an IL translation that included lexical as well as logical expressions.

Although in Montague-inspired approaches in linguistics it is common to give translations into IL as if those translations were themselves semantic rules, the practice of translation into IL is one Montague devised for his own purposes; we can think of it as shorthand for true semantic interpretation (which he called *interpretation induced by translation*). IL is itself a language, albeit a formal one, and as such it is in need of semantic interpretation every bit as much as any natural language. We give the IL translation in the text to emphasise the *structure* of the semantic interpretation we are assuming for lexical auxiliaries generally; an actual semantic rule would be what we summarise for our example with *empezar a*. The semantics for the whole modified IV *empezar a trabajar* depends of course on the lexical semantics of the elements of the IV as well—in this case, the simple *trabajar*—and, for a more complex IV, the semantics of the elements of that IV.

²⁶ A semantic rule we employ with great frequency is *functional application*; as an example, the value of an IV (FC/NP) derived from a lexical auxiliary and an IV is the value of the function denoted by the X/Y expression—which in the case at hand is the auxiliary, as illustrated in the text—applied to the meaning of its complement as argument. Here, Y in the X/Y schema is IV. Functional application, though the default, is not the only semantic rule our grammar fragment requires (we will see, for example, that the semantics of functional auxiliaries is quite different from that of lexical auxiliaries, and the semantics of the passive auxiliary *ser* is quite different from either of these). In making use of more than one semantic

various auxiliaries is concerned, we keep our discussion at a general, informal level, since our focus is on their syntax (but see, e.g., Dowty, 1979; Fernando, 2015 for discussions of the semantics of tense and aspect; also García Fernández, 2000: Chap. 1-3 for a focus on Spanish specifically).

Spanish intransitive verbs, basic or derived, belong to the category FC/NP: they take subjects as their complements in the formation of finite clauses. This analysis is sufficient to capture the combinatory behaviour of Spanish auxiliaries in detail. Before getting into our proposal, however, it will be useful to restrict the class of adequate grammars for Spanish auxiliary chains by observing in **Section 3.2.2** how neither the traditional Spanish structuralist / functionalist perspective on auxiliary chains nor a strictly monotonic approach captures the variety of internal dependencies within auxiliary sequences.

3.2.2 *Functional application and functional modification in auxiliary chains*

What we can call the traditional perspective on auxiliary chains, in both structuralist and generative frameworks, is that their structure simply extends the syntax of single-auxiliary constructions—in other words, that their structure is strictly monotonic (see, among others, Ross, 1969; Zwicky, 1993; Guéron & Hoekstra, 1998; Falk, 2003; Cinque, 2004; RAE-ASALE, 2009; Bjorkman, 2011; Ramchand & Svenonius, 2014; Ramchand, 2018). Within this traditional view, we can distinguish (a) approaches in which the auxiliary chain constitutes one syntactically simple predicate (e.g., Alarcos Llorach, 1994; Gómez Torrego, 1999) and (b) approaches in which auxiliaries in a chain are distinct objects but share their configurational properties (i.e., they all head their own projections in an exhaustively binary-branching structural description).

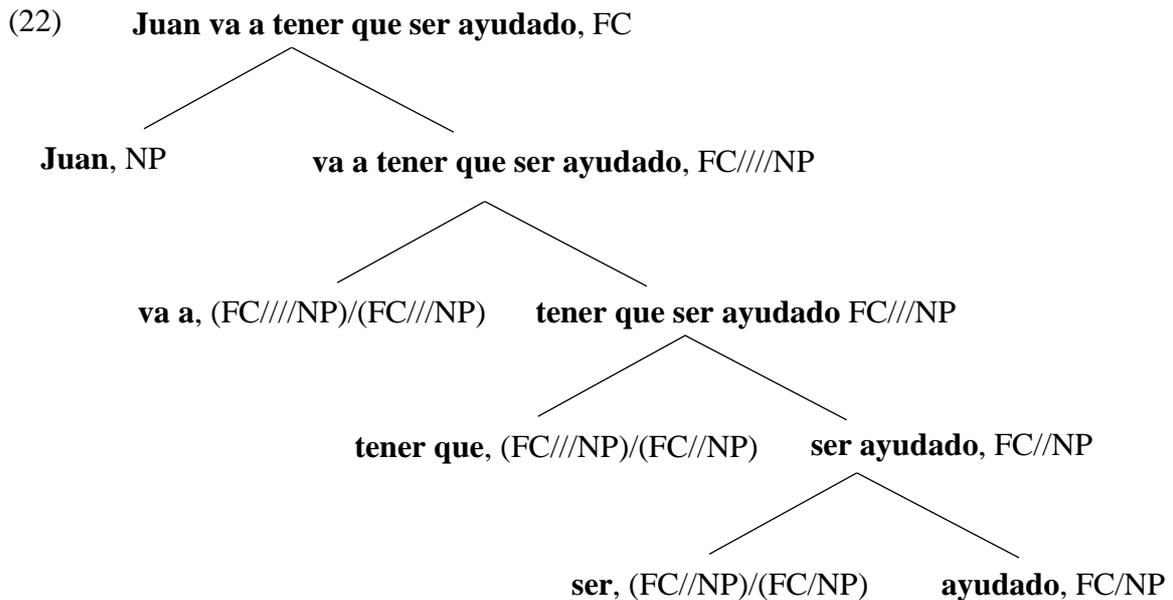
When we focus on what auxiliaries modify, the following issue arises. *If* auxiliaries modified *only saturated FC/NPs* (in other words: if auxiliaries did not modify other auxiliaries), then an auxiliary chain would have a structure along the lines of either (19a) or (19b), the former inspired by approaches of type (a) above and the latter by approaches of type (b):

- (19) a. (FC//NP)/(FC/NP)
 b. (FC/.../NP)/(FC/NP)

Let us analyse (19a) first. Structuralist-functionalist analyses of Spanish auxiliary sequences have traditionally assumed that a verbal periphrasis and an auxiliary chain have the same structure, *modifier + modified*, the only difference being that in auxiliary chains, the *modifier* contains more than a single auxiliary. These analyses offer no glimpse of any structure internal to the chain. The idea that auxiliary chains act as uniform objects is expressed, for instance, by Gómez Torrego (1999):

On occasion, auxiliaryity [*auxiliaridad*] in a single periphrastic head is given by an auxiliaryity chain, that is, by two or more auxiliary verbs linked together which have an influence on the auxiliated verb, **which can only be a single one** [...] Syntactically, we are dealing with simple sentences which can be

operation we are following an innovation by Montague (1973) and those whose work is built on his, including Dowty (1979) and Schmerling (1983b, 2019).



(22)—or any similar monotonically growing structure, such as those based on the so-called functional sequence (Cinque, 1999; Rizzi & Cinque, 2016)—is inadequate, because it fails to capture the internal dynamics of the chain: that is, its appropriate modification patterns (see the discussion of our example (8c) above. This is because it is not possible under a strictly monotonic view of syntactic computation to define an object that includes only the analytic future form *va a tener que* and excludes the rest of the chain (compare the synthetic counterpart *tendrá que*, which is perhaps more transparently isolable from its complement *ser ayudado* in *tendrá que ser ayudado*); recall that only the obligation denoted by *tener que* is located in the future. If a node has scope over everything in its c-command domain, as we have noted, following Ladusaw (1980), May (1985), and much subsequent work, then (22) predicts that *va a* (the third-person-singular present form of the auxiliary *ir a*) should have scope over *ayudado*; in other words, the event denoted by the saturated FC/NP should be located in the future. But, in fact, *va a* only affects the deontic obligation to be helped; this auxiliary modifies *tener que*, but that information does not pass through to lower elements in the tree. These modification patterns can only be captured with a segmentation like [[*va a tener que*] [*ser ayudado*]], which X-bar theory or Merge do not make available if each auxiliary corresponds to a syntactic head which projects a phrase: the only tree that such a system can generate is [_{AuxP} Aux₁ [_{AuxP} Aux₂ [... [_{AuxP} Aux_n [VP]]]]]. In configurational terms, the same objections apply to uniform VP-embedding analyses such as Ross' (1969) and related work (see also Falk, 1984, 2003 for a similar idea within LFG). The structure in (22) permits *only* dependencies like (8b) to be adequately represented. For (8c), where auxiliaries *cannot* modify one another – where they must therefore all modify the lexical verb – and for (8a), where

command, which is instrumental to the LCA). Furthermore, note that considerations of familiarity lead us to depart in the top tier from the CG tradition of always writing functors to the left. (21) should be thought of as a hybrid between a PS tree and a Montagovian analysis tree, which we use for expository purposes only.

we need to define an object that includes only two members of the auxiliary chain and excludes the rest, (22) is descriptively inadequate.

Having now looked at empirical inadequacies in two prominent approaches to the structure of Spanish auxiliary chains, we turn to the approach we advocate. To the best of our knowledge, there are no previous CG analyses of Spanish auxiliaries; to illustrate our point about the problems of *a priori* structural uniformity we need to refer to works dealing with English. For example, Bach (1983: 111) offers a model of the English auxiliary system that in fact follows rather closely the postulates of phrase structure grammar—though he separates *modals* (*will, must, may, can...*) from *aspectual* auxiliaries (*have, be*). Bach’s system also incorporates features (*à la* Chomsky, 1965) as diacritics distinguishing categories, such that *will* and *would* are both $(T \setminus S)/(e/t)$,²⁸ differing in the presence of a feature [pres] in the former and [past] in the latter (Bach, 1983: 112). We will return to Bach’s proposal for English auxiliaries in **Appendix A**. In any case, it is important to note that any descriptively and explanatorily adequate theory of the English auxiliary system must be able to capture the fact that auxiliary ordering is rigid in English, quite unlike the case with Spanish:

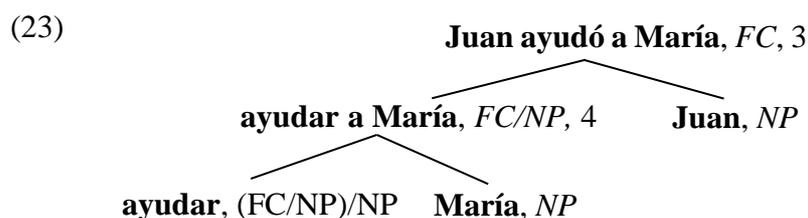
In a theory of the [English] auxiliary, we would like to be able to account for the ordering of auxiliaries, so that they occur in the right order before the verb. Auxiliary sequences such as *will have been eating* are not at all uncommon, and can only be well formed with this exact ordering. (Carpenter, 1989: 210)

For Spanish, however, we have shown that there is variability in the position of auxiliaries in a chain that is both restricted and systematic, such that the *modal + perfect + progressive + passive* template that holds uniformly for English chains, and on which many claims about the purportedly rigid structure of the *functional sequence* are based, *reflects only one of the several auxiliary orders available in Spanish*; both (20) and (21) wrongly assign all auxiliaries to a single syntactic class, obscuring differences in distribution and interpretation. We have seen that Spanish auxiliary chains are syntactically and semantically heterogeneous; the approaches we here reject fail to take this heterogeneity as something empirically real. In contrast to the approaches to the structure of auxiliary chains that we have rejected, which are monotonic from theory-internal necessity, the architecture of our CG alternative has the flexibility to permit lexical auxiliaries to define local domains within which downward transmission of temporal and aspectual information in a chain is blocked, as discussed in **Section 2**. See also Krivochen & García Fernández (2020).

We are now ready to see how CG is particularly well suited to capturing the systematic syntactic-semantic behaviour we observe in the data; in particular, the possibility of having modals affected by progressive, perfective, and temporal

²⁸ In Bach’s Generalised Categorial Grammar, *t* is the category of truth-value-denoting expressions and *e* the category of individual expressions. Both are adopted from PTQ (see Montague, 1973: 222). *T* is the category of Terms, essentially NPs, and *S*, as in much of generative syntax, is ‘sentence’; the symbol \setminus , adopted from Lambek (1958), indicates concatenation of the argument to the *left* of the functor. Bach’s use of features, as well as some of his category names, are usual neither in vanilla (Adjukiewicz / Lambek / Bar-Hillel)- nor in Montague-style CG.

auxiliaries. It will be useful here to go step by step through the category definitions we are assuming. From this point forward, the syntactic rules we refer to are those given in Appendix A. We have already mentioned that intransitive verb phrases (IVs) need to combine with NPs to yield Finite Clauses. Lexical verbs are basic expressions of category TV (transitive verb, or (FC/NP)/NP) or IV (or others, in an extended fragment), according as they are transitive or intransitive; expressions of category TV combine with expressions of category NP to yield derived intransitive verb phrases, of a category defined as FC/NP like basic intransitive-verb expressions. Then, expressions of this category need to combine with expressions of category NP, by rule S₂, to form expressions of the Finite Clause category (FC).²⁹ We illustrate this in (23), now indicating which syntactic rule has applied at every point:³⁰



Recall now that we have emphasised a distinction between functional and lexical auxiliaries in Spanish. We have mentioned the following generalisation, due to Bravo et al. (2015) and Garc a Fern andez et al. (2017) and related work: lexical auxiliaries can modify and be modified, whereas functional auxiliaries can only modify; they cannot themselves be modified (i.e., anchored temporally or aspectually) by other auxiliaries. Rather, functional auxiliaries like <ir a + INF> or <haber + PTCP> are direct modifications of the expressions they are added to; they are in this respect more akin to inflectional elements than to expressions of a verbal category. We propose that this asymmetry reflects the following generalisation:

Functional auxiliary generalisation: Functional auxiliaries differ from lexical auxiliaries in not being introduced by concatenation.

If functional auxiliaries are not themselves (basic or derived) expressions of the language—i.e., if they are elements of set C in **Figure 1** but not set B—then it follows

²⁹ We stick to simple verb phrases in this paper, because our focus is auxiliary chains; for these purposes, the choice of lexical verb is of little if any consequence. A full grammar of Spanish lexical verbs must, of course, ultimately capture the semantic and syntactic richness of verb typology, which would require additional categories (for example, ditransitive verbs, inherently pronominal verbs like *avergonzarse (de)* ‘to be ashamed (of)’, *apoderarse (de)* ‘to take possession (of)’, *arrepentirse (de)* ‘to regret’, and many others).

³⁰ Our syntactic rules omit details of verb inflection. Note our rule S₄, however, which addresses nominal morphology with a formal operation that concatenates **ayudar** with a direct object that we treat as marked with the differential object marker **a**. In its role as an accusative marker, **a** contributes no lexical meaning of its own to the larger expression of which it is a part. Items with this property are traditionally called *syncategorematic*. An analysis tree includes all and only the *categorematic* items—items assigned to categories—that make up the expression at its root.

that they cannot be modified: *there is nothing to be modified where they are concerned*. Our analysis thus explains Bravo et al. (2015)'s generalisation that they modify but cannot themselves be modified.

We now introduce a function ϕ , defined as in (24), to formalise the analysis of Spanish auxiliary chains defended in Bravo et al. (2015) and the later works we have cited:

$$(24) \quad \phi(X/Y) = X//Y$$

ϕ applied to an expression of category X/Y (e.g., FC/NP) yields a modified expression, as we have indicated; we notate this modification with an additional slash: $X//Y$ (e.g., FC//NP is a modified X/Y expression, in this case a modified FC/NP). Note that, in accordance with our generalisation stated above, ϕ *does not concatenate two expressions*. The semantics of functional auxiliaries is accordingly different in a significant way from the semantics of lexical auxiliaries that we have discussed: since only one linguistic expression is involved in modification by a functional auxiliary, we are not dealing semantically with a rule of functional application (see fn. 25); rather, a single expression is the input to a rule of *functional modification*, and a functional auxiliary is accordingly a 1-place operator—which, given our syntax, does not belong to a syntactic category. The specific modification involved depends of course on the functional auxiliary—but, as we have noted, functional auxiliaries as a class have to do with modification involving tense or external aspect. To give one example of the semantics of a functional auxiliary, the meaning associated with the addition of *<estar + gerund>* is progressive aspect; this can modify a lexical auxiliary (as in *no está pudiendo ofrecer un buen servicio* ‘he/she is not currently able to offer good service’) or a lexical verb (as in *está trabajando* ‘he/she is working’).

We come now to the passive auxiliary *<ser + participle>* (Bosque, 2014),³¹ which is in a class by itself, as we have suggested: it is neither a lexical verb nor a lexical auxiliary nor a garden-variety functional auxiliary, because of both its syntax and its semantics. Passive *ser* does not form a natural class with temporal-aspectual auxiliaries; the semantic rule corresponding to S_7 —the rule that adds *ser*—simply uses a 1-place identity operation. Where passives are concerned, semantic complexity reflects rule S_6 , according to which the input is detransitivised. This change in *diathesis* involves not tense or aspect but the distribution of grammatical relations and thematic roles.

Before going into more detail about the rules that govern the introduction of functional auxiliaries, we need to make explicit the properties that differentiate passive *ser* from functional auxiliaries. In this paper we depart from Bravo et al. (2015) and García Fernández et al. (2017), who group passive *ser* with functional auxiliaries on the basis of the familiar criterion of its being able to modify but not itself be modified. This property does hold (see (8c) and the discussion that follows).

³¹ Spanish has a second passive auxiliary, *<estar + participle>*, which differs semantically from *<ser + participle>*: it is used to derive resultative passives (Bosque, 2014; RAE-ASALE, 2009: §28.5.2), whereas *<ser + participle>* forms eventive passives. There seems to be no formal difference between the two auxiliaries—although passive *ser* appears in auxiliary chains more frequently than *estar*: as an example, a Google search for *ha podido estar ocupado por* on 17 February 2021 yields three results, whereas *ha podido ser ocupado por* yields more than 5600.

Passive *ser* differs from prototypical functional auxiliaries in two ways. First, its meaning is simply a 1-place identity function; in this respect it has a meaning like that of copular *ser*, which we have not treated as an auxiliary in this paper. Second, it is introduced into syntactic structures by a simple rule that does not depend on the steps of the formation of a preceding input expression; in this respect it differs from the rules for functional auxiliaries making use of the function ϕ defined in (23) above, rules that we discuss shortly. This formal property of *ser* corresponds to the informal observation that *ser* always occurs immediately adjacent to the lexical verb, unlike prototypical functional auxiliaries.

Having seen the syntactic and semantic effects of functional auxiliaries, we can formulate the rule schemata for functional modification that are given in (25). First, however, we must recall that the functional auxiliaries are not assigned to syntactic categories as the lexical auxiliaries are but are introduced directly into structures, much as affixes are (compare our treatment of passive *ser*). The operations introducing the functional auxiliaries are given in (25):

- (25) $F_5(\alpha)$ = the result of concatenating **estar** to the left of α , for all α .
 $F_6(\alpha)$ = the result of concatenating **haber** to the left of α , for all α .
 $F_7(\alpha)$ = the result of concatenating **ir a** to the left of α , for all α .
 $F_8(\alpha)$ = the result of concatenating **acabar de** to the left of α , for all α .

Each of these operations plays a role in one of the rule schemata in (26), one schema for each functional auxiliary:³²

- (26) a. S_6 . If $\alpha \in P_{X/nY}$, then $F_5(\alpha) \in P_{X/n+1Y}$, for all α, X, Y , where X and Y are variables ranging over the “numerators” and “denominators”, respectively, of functor categories, and where n is an integer and $/_n$ an abbreviation for n slashes.
 b. S_7 . If $\alpha \in P_{X/nY}$, then $F_6(\alpha) \in P_{X/n+1Y}$, for all α, X, Y , where X and Y are as in S_6 .
 c. S_8 . If $\alpha \in P_{X/nY}$, then $F_7(\alpha) \in P_{X/n+1Y}$, for all α, X, Y , where X and Y are as in S_6 .
 d. S_9 . If $\alpha \in P_{X/nY}$, then $F_8(\alpha) \in P_{X/n+1Y}$, for all α, X, Y , where X and Y are as in S_6 .

We can furthermore use the function ϕ introduced in (24) to formulate the meta-rule schema in (27):

- (27) S_{10} . If $\alpha \in P_{X/nY}$, then $\phi(\alpha) \in P_{X/n+1Y}$, for all α, X, Y , where ϕ is a metavariable ranging over F_5 – F_8 and where X, Y, n , and $/_n$ are as in (26a).³³

³² We use the notation $/_n$ as an abbreviation for “ n slashes”. The use of variables in the rules in (25) maintains CG’s objective of having heuristic value for the determination of new grammatical specifications: once a new Spanish functional auxiliary is identified, a ready-made rule is automatically available for introducing it into structures.

³³ As of this writing, n in these rule schemata appears to us to range over 0–2.

(26a) pertains to the adding of progressive $\langle \textit{estar} + \textit{gerund} \rangle$ to an expression of category FC/NP or category (FC/NP)/(FC/NP). We refer to S_8 as a rule schema because it abbreviates rules adding this functional auxiliary to expressions that are unmodified by another functional auxiliary, modified by one, or modified by two. For example, if the input to S_8 belongs to the category FC/NP, then its output belongs to FC//NP; if the input belongs to FC//NP, then the output belongs to FC///NP: the number of slashes reflects the number of times the base expression has been modified in the derivation. This innovation does not distance us from Montague (1973: 223) in any formally significant way; as he observes,

[...] our syntactic categories diverge from those of Ajdukiewicz only in our introduction of two compound categories (A/B and A//B) where Ajdukiewicz would have had just one. The fact that we need only two copies is merely an accident of English or perhaps of our limited fragment; in connection with other languages it is quite conceivable that a larger number would be required.

The analysis presented in the present paper can be taken to confirm Montague's conjecture that the fact that A//B is the largest compound category is a consequence of his limited fragment; the Spanish fragment developed here requires more than two modified categories, due precisely to the syntax and semantics of functional auxiliaries. S_6 is thus responsible for yielding periphrases containing *functional* auxiliaries; (26) is simply a generalised version of (25). Introducing a functional auxiliary results in an expression assigned to a modified category.

Rule schemata for the remaining functional auxiliaries in **Table 1** are given in (26b–d).

As we have noted, when a functional auxiliary is introduced, *the logical type of the input category is maintained*. (28) below is an example: after introducing the perfect auxiliary *ha* (third person of *haber*), the expression still needs to concatenate with an expression of category NP to yield an expression of category FC:

(28) **ha trabajado**, FC//NP, 7
 |
 trabajar, FC/NP, 0

Lexical auxiliaries are not introduced in the same way as functional auxiliaries, because, as summarised in **Table 1**, they differ from them in two important ways: they express unique meaning types (lexical auxiliaries primarily express modality and external aspect, whereas functional auxiliaries express temporal information or internal aspect), and only lexical auxiliaries can be modified by other auxiliaries and also be modifiers themselves. Of the two auxiliary classes, only lexical auxiliaries are basic expressions of the language that are assigned to syntactic categories.

We turn now to the category lexical auxiliaries belong to. We know this *cannot* be FC/NP; this would wrongly predict that, for example, *Juan tiene que* was a well-formed expression of category FC, the result of concatenating an NP with an FC/NP according to rule S_4 . We must capture the fact that lexical auxiliaries are able to combine not only with lexical verbs (saturated FC/NPs) but also with other lexical auxiliaries, as in (29):

- (29) Juan podía empezar a trabajar más temprano
 J. can.3SG.IPFV start.INF work.INF more early
 ‘J. was able to start working earlier’

The result of the combination of a lexical auxiliary with another lexical auxiliary must itself be able to combine with a saturated FC/NP or another lexical auxiliary, and so on. A sequence of lexical auxiliaries is, of course, a chain, the longstanding recognition of which we have pointed out. A chain always modifies a saturated FC/NP. Therefore, a lexical auxiliary must have FC/NP as its ‘denominator’ category. Then, to be able to be a link in a chain of the sort we have been discussing, and as exemplified in (28), it must also have FC/NP as its ‘numerator’ category. We thus have (30) as the category of lexical auxiliaries, which we illustrated earlier:

- (30) (FC/NP)/(FC/NP)

Having established that lexical auxiliaries are of category (FC/NP)/(FC/NP), we must address the question of how this definition of lexical auxiliaries can play along with ϕ to give an appropriate characterisation of the interaction between lexical and functional auxiliaries. Consider (30):

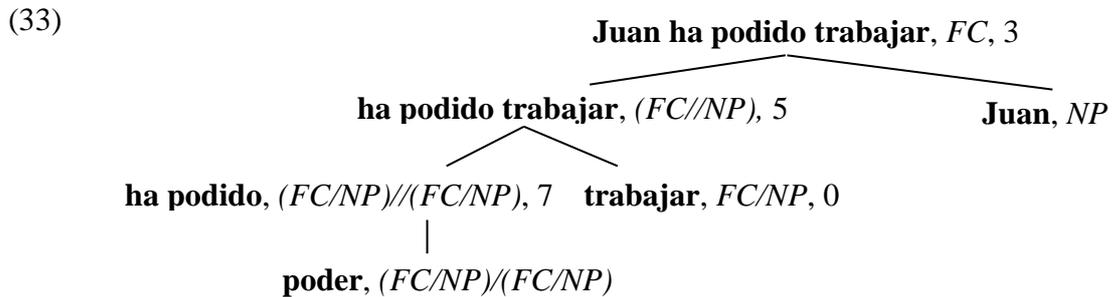
- (31) Ha podido trabajar
 have.3SG.PRES can.PTCP work_{INF}
 ‘He/she has been able to work’

Here, the perfective functional auxiliary *ha* (third person of *haber*) modifies the lexical modal *poder* but not the lexical verb *trabajar*: we will illustrate the structure shortly, but it is worth making a preliminary comment on this example. Recall from **Section 2** that if the predication structure in (30) were such that *haber* modified *trabajar* and that *poder* modified *trabajar*, we would be describing an eventuality of having worked plus one of having been able to work, both in the past (we could quasi-formally represent this view as PAST(*haber(trabajar) ∧ poder(trabajar)*)). This, however, is *not* what (31) means. In (31) we have an event of having been able to work but not necessarily an event of having worked. In other words, the perfective aspectual information does *not* affect *trabajar*; it simply affects *poder*. We can see this from the fact that there is no contradiction in (32)—because *haber* does not modify *trabajar*:

- (32) Ha podido trabajar, pero de hecho no
 have.3SG.PRES can.PTCP work.INF but in fact NEG
 ha trabajado
 have.3SG.PRES work.PTCP
 ‘He/she has been able to work, but he/she hasn’t actually worked’

We can now consider how to capture the correct modification relations. If a lexical auxiliary like *poder* is of category (FC/NP)/(FC/NP), as we have proposed, then it can be modified by a functional auxiliary to yield a modified lexical auxiliary: an expression of category (FC/NP)/(FC/NP). *We do not need to assume further rules to account for this kind of interaction between functional and lexical auxiliaries*: the

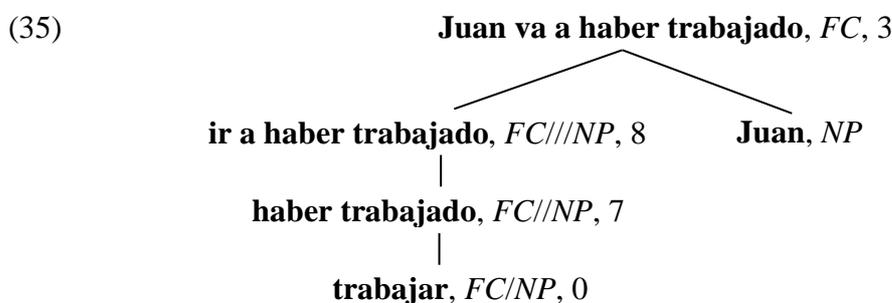
rules we have discussed already give us the analysis tree in (33), a proof that *Juan ha podido trabajar* is an expression of category FC, as required:



Before moving forward, we need to return to our earlier observation that auxiliary chains composed of only lexical or only functional auxiliaries are monotonically recursive. Consider (34a) and (34b):

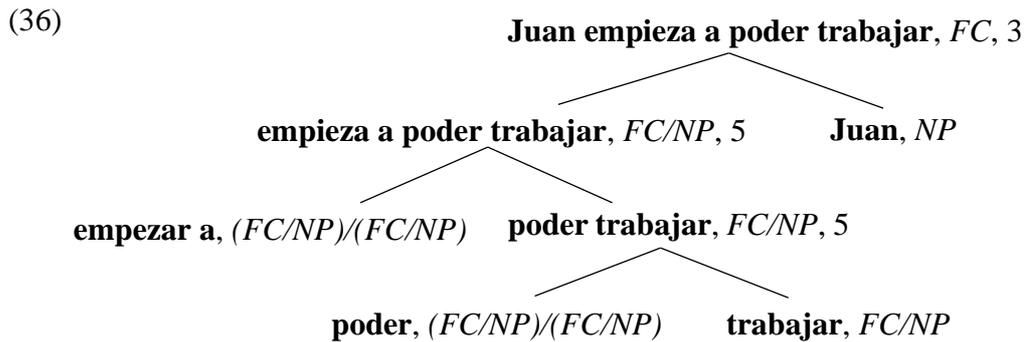
- (34) a. Juan va a haber trabajado
 Juan go.to.3SG.PRES have.INF work.PTCP
 ‘J. will have worked’
- b. Juan empieza a poder trabajar
 Juan start.3SG.PRES can.INF work.INF
 ‘J. starts to be able to work’

In (34a), the lexical verb *trabajar* is modified by two functional auxiliaries. All we need, then, is to apply S_8 recursively:



In a sequence of functional auxiliaries, illustrated in (34a) and diagrammed in (35), each modifies the lexical verb: recall that functional auxiliaries are *only modifiers* (contributing temporal or aspectual information about an eventuality); *haber* therefore cannot be modified by *ir a*. (34a) speaks of a point in time that is located after the moment of utterance but possibly before some other point in the future: in *Juan va a haber trabajado el viernes* ‘Juan will have worked on Friday’, the event of working takes place after the moment of utterance but during Friday or before Friday (see Carrasco & García Fernández, 1994; Carrasco, 2008). The pattern of dependencies here is exactly that shown in (8c).

For (34b), the situation is different: we have all lexical auxiliaries, each of which combines with an expression of category FC/NP. (36) diagrams a proof that *Juan empieza a poder trabajar* is a well-formed expression of category FC:



In (36) we have the lexical verb *trabajar* and the auxiliary sub-chain *empieza a poder*, which contains two lexical auxiliaries (*empezar a* and *poder*). The modification pattern is that of (8b): *empezar a* modifies *poder* (we are talking about the beginning of a possibility), and *poder* modifies *trabajar* (that possibility pertains to the event of Juan working). In cases involving sequences of lexical auxiliaries, modification is strictly local: recall again that, unlike functional auxiliaries (which only modify), lexical auxiliaries can both modify and be modified. *This accounts for our observation that the presence of a lexical auxiliary blocks the transmission of information downward through the chain.* Whatever is above *empezar a* modifies only *empezar a*, whatever is between *empezar a* and *poder* modifies only *poder*, and *poder* modifies *trabajar*.

Consider now a chain of auxiliaries belonging to all three of the classes we have discussed (lexical, functional, and the passive). In (37), the lexical auxiliary *tener que* is modified by the functional auxiliary *haber*, and the lexical verb *ayudar* immediately follows the passive auxiliary *ser*:

- (37) Juan ha tenido que ser ayudado
 Juan have.3SG.PRES have.to.PTCP be.INF help.PTCP
 ‘J. has had to be helped’

Since the lexical verb *ayudar* is not modified by the perfective auxiliary *haber*, an adequate segmentation for (37) must be equivalent to (38):

- (38) [[ha tenido que] [[ser ayudado]]]

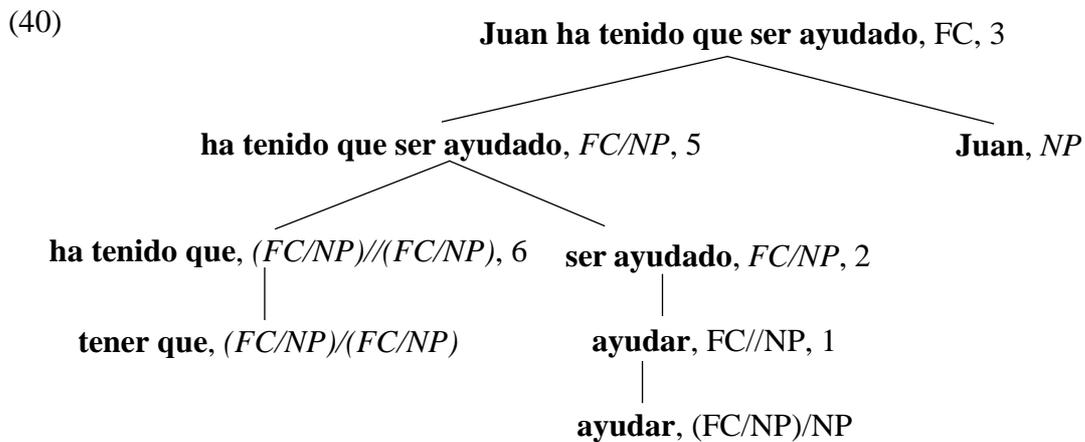
That is, only the modal auxiliary *tener que* is modified by the auxiliary *haber*, and *haber tenido* modifies the passivised lexical verb. We need to take into consideration that (35) contains a *passive*, so a new operation and two further syntactic rules are needed:

- (39) S₂. If $\alpha \in P_{TV}$, then $F_0(\alpha) \in P_{FC/NP}$, for all α .
 $F_4(\alpha)$ = the result of concatenating *ser* to the left of α , for all α .
 S₃. If $\alpha \in P_{FC/IV}$, then $F_4(\alpha) \in P_{FC/NP}$, for all α .

The addition of passive *ser* requires its own syntactic rule because, as we have indicated, it is in a class by itself: it cannot be a lexical auxiliary because it patterns with the functional auxiliaries where modification possibilities are concerned. Unlike functional auxiliaries, however, it has the distinctive property not of expressing temporal or aspectual information but rather of marking diathesis. Diathesis has

profound effects on clause organisation, in terms of both grammatical functions and thematic roles.

The relations among the elements of (37) are diagrammed in (40):



Note that in all examples, there is only one expression of category FC: the concatenation of a chain of auxiliaries (always of the form FC/NP) with an NP is a finite clause. Monoclausality is captured in the CG analysis without additional stipulations.

4. Conclusions

A monotonic approach to structure building has inherent limitations that prevent it from providing adequate structural descriptions for the dependencies we observe in Spanish auxiliary chains, which we showed in **Section 1** exhibit formally varying dependencies. Among other limitations, monotonic branching is uniformly to the right or to the left, and semantic relations, based on a syntactic c-command relation (defined either in classical PS-terms or in terms of co-containment in sets), are similarly monotonic. One advantage of categorial grammars is that they allow us not only to create non-monotonic structures when these are empirically necessary, but, especially, to be fully explicit in the formal mechanisms that generate those structures while at the same time allowing such cross-linguistic variation as occurs. For example, categorial grammars allow us to choose either the IV or the subject as the functor in a clause, leading us to group auxiliaries with the subject or with the lexical verb depending on the operations that a given natural language licenses. It also allows us to group auxiliaries by means of either concatenation or functional modification (as opposed to only concatenation as in mainstream approaches), which constitutes the theoretical novelty of the present paper. A CG approach can yield empirically adequate descriptions without needing to assume an *a priori* sequence of labelled functional projections.

It is significant that the adaptability of CG, as illustrated by the fundamental difference between Spanish and English that we have proposed, already encompasses an account of “parameters”; their existence is derivable from the mathematics of the system of available category indices presented in **Section 2**. Accounting for this

variation in the way each language draws from the set of universally available categories results in overall systems that are self-contained and consistent.

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Appendix A: A grammar fragment for Spanish auxiliary chains

Categories	Category definitions	Basic expressions	Derived examples
FC	t		Juan trabaja, Juan tiene que trabajar, Juan puede haber empezado a trabajar, Juan tiene que haber podido ser ayudado, ...
e	e	—	—
NP	e	Juan, María	
FC/NP	t/e	Trabajar, caminar	Trabajar, caminar, interrogar a Juan, tener que trabajar, poder haber empezado a trabajar, ...
FC//NP	$t//e$		Estar trabajando, haber trabajado, ir a trabajar, ...
FC///NP	$t///e$		Acabar de estar trabajando, haber estado trabajando, ir a haber trabajado, ...
$X/_n Y^{34}$	See fn. 34.		

³⁴ X and Y are variables ranging over the categories FC/NP and (FC/NP)/(FC/NP). The number of slashes indicates the number of times an expression of one of these categories

TV	(FC/NP)/NP	Interrogar, ayudar	
(FC/NP)/(FC/NP)	(FC/NP)/(FC/NP)	Poder, tener que, empezar a, comenzar a, terminar de, volver a, deber (de)	
(FC/NP)/(FC/NP)	(FC/NP)/(FC/NP)		Haber podido, ir a empezar a, estar pudiendo, ...
(FC/NP)/(FC/NP)	(FC/NP)/(FC/NP)		Ir a haber tenido que ...

Formal operations:

$F_0(\alpha) = \alpha$, for all α .

$F_1(\alpha, \beta) =$ the result of concatenating α to the left of β , for all α, β .

$F_2(\alpha, \beta) =$ the result of concatenating α to the right of β , for all α, β .

$F_3(\alpha, \beta) =$ the result of concatenating α **a** to the left of β , for all α, β

$F_4(\alpha) =$ the result of concatenating **ser** to the left of α , for all α .

$F_5(\alpha) =$ the result of concatenating **estar** to the left of α , for all α .

$F_6(\alpha) =$ the result of concatenating **haber** to the left of α , for all α .

$F_7(\alpha) =$ the result of concatenating **ir a** to the left of α , for all α .

$F_8(\alpha) =$ the result of concatenating **acabar de** to the left of α , for all α .

Basic rules:³⁵

S₀. If $\alpha \in P_{IV}$, then $F_0(\alpha) \in P_{FC/NP}$, for all α .

has been modified by a functional auxiliary in a derived expression (recall that functional auxiliaries do not have categorial status).

³⁵ If we were following the formatting of Montague (1973) religiously, we would start our syntactic rules with the following, as in our toy grammar in **Section 2**: B_A (or the set of basic expressions of category A) $\subseteq P_A$ (or the set of expressions of category A), for every category A. We use the above table to express the information in this rule, which is essential for our grammar fragment's completeness, as part of the larger presentation of our syntactic categories.

S₁. If $\alpha \in P_{TV}$, then $F_0(\alpha) \in P_{FC/NP}$, for all α . (This rule forms the heart of the passive construction, by detransitivising the TV ((FC/NP)/NP) so that the NP argument of the FC/NP in its input is now the (only) argument of its output.)

S₂. If $\alpha \in P_{FC/NP}$, then $F_4(\alpha) \in P_{FC/NP}$, for all α . (This rule adds the semantically empty auxiliary *ser* to the output of S₁, to complete the creation of an FC/NP expression in the passive voice. Recall that diathesis plays a role in distinguishing *ser* from the functional auxiliaries of Spanish, which are introduced by S₇–S₁₀ and which are not semantically empty but modify functor expressions with the addition of temporal or aspectual specifications.)³⁶

Rules of functional application:

S₃. If $\alpha \in P_{FC/NP}$ and $\beta \in P_{NP}$, then $F_2(\alpha, \beta) \in P_{FC}$ for all α, β

S₄. If $\alpha \in P_{TV}$ and $\beta \in P_{NP}$, then $F_1(\alpha, F_3(\beta)) \in P_{FC/NP}$, for all α, β .³⁷ (P_{TV} in this rule, or the category of transitive verbs, combines with an NP to the left of which accusative **a** (fn. 22) has been inserted to form an intransitive verb: we define the category TV as (FC/NP)/NP. The result of satisfying this requirement is, clearly, a construction that no longer requires a non-subject NP complement: this result is simply an FC/NP.)

S₅. If $\alpha \in P_{(FC/NP)/(FC/NP)}$ and $\beta \in P_{FC/NP}$, then $F_1(\alpha, \beta) \in P_{FC/NP}$, for all α, β .

Rule schemata for functional modification:³⁸

S₆. If $\alpha \in P_{X/nY}$, then $F_5(\alpha) \in P_{X/n+1Y}$, for all α, X, Y , where X and Y are variables ranging over functor categories, and where n is an integer and $/_n$ an abbreviation for n slashes.

³⁶ Recall that it is the algebraic structure of a categorial grammar that gives us the difference between active and passive IVs, as these are derived in distinct ways. To know what kind of IV we are dealing with in a given instance, we consult the grammatically significant relations existing among the expressions forming that IV, according to the syntactic rules; the syntactic rules recapitulate the relevant algebraic structure. All of this is recoverable from the proof that an active IV is that and the proof that a passive IV is that, as diagrammed in the analysis trees we have presented.

³⁷ This rule is an oversimplification, inasmuch as combinations of transitive verbs with direct objects use F_3 only if those objects are animate; otherwise, the operation effecting this combining is F_1 .

³⁸ Syntactic rule schemata S₆–S₁₀ represent an innovation over Montague (1973), but it is purely a matter of notation. These schemata are reminiscent of rule collapsing in relatively early generative grammar (especially in generative phonology), inasmuch as each schema is an abbreviation for a set of garden-variety syntactic rules. Montague (1973: 252) used rule schemata (for a different purpose) as his “rules of quantification”.

- S7. If $\alpha \in P_{X/n}Y$, then $F_6(\alpha) \in P_{X/n+1}Y$, for all α , where X, Y, n, and /n are as in S6.
 S8. If $\alpha \in P_{X/n}Y$, then $F_7(\alpha) \in P_{X/n+1}Y$, for all α , where X, Y, n, and /n are as in S6.
 S9. If $\alpha \in P_{X/n}Y$, then $F_8(\alpha) \in P_{X/n+1}Y$, for all α , where X, Y, n, and /n are as in S6.

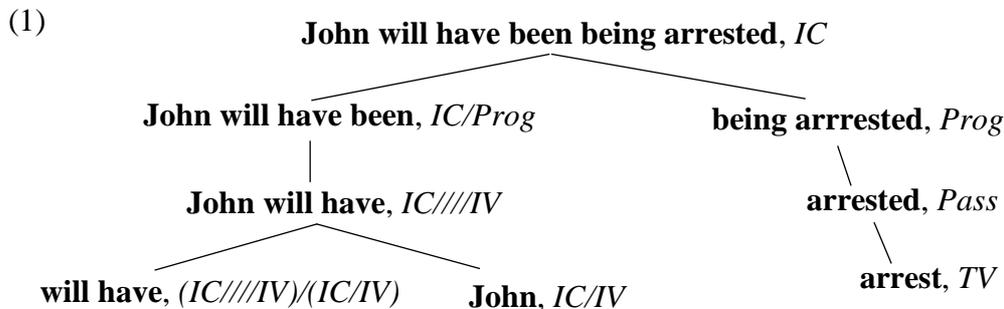
Meta-rule schema for functional modification:

- S10. If $\alpha \in P_{X/n}Y$, then $\phi(\alpha) \in P_{X/n+1}Y$, for all α , X, Y, where ϕ is a metavariable ranging over F5–F8 and where X, Y, n, and /n are as in S6.

Appendix B: A note on the English auxiliary system: a CG approach to comparative syntax

We have indicated that previous applications of CG to auxiliary verbs have been limited to auxiliary verbs in English, which are very different from those in Spanish. It is therefore revealing to compare the representations we have defended for the Spanish auxiliary system with two approaches to that of English. Contemporary English is different from Spanish, to begin with, in that its auxiliary system presents a very rigid order, as we have noted. In this section, we will consider the representation assigned to the full chain Modal + Perfective + Progressive + Passive in English by two variants of CG: Schmerling's (1983b, 2019) and Bach's (1983).

Schmerling's (2019) account builds on her (1983b) proposal ((1) is adapted from Schmerling, 2019: 163; we omit the indices of Schmerling's rules that derive the non-basic expressions):³⁹



- (2) Mary will not have been being arrested, but $\left\{ \begin{array}{l} * \text{John will have been being} \\ \text{John will have been} \\ \text{John will have} \end{array} \right\}$

Examples like (2) provide support for passive *be* (here the present participle *being* since it follows progressive *be*) not forming a constituent with the subject, as the other auxiliaries do in her analysis, but with the lexical verb; if *John will have been being* were a constituent like, for example, *John will have* and *John will have been*, then all the elliptical expressions in (2) ought to be grammatical – but the first is not, a fact

³⁹ IC = Indicative Clause

studied in detail by Akmajian & Wasow (1975). With *Modal*, *Perfective*, and *Progressive* belonging to distinct categories, whose discovery CG makes straightforward (as Schmerling emphasises) and in which these auxiliaries combine first with the subject and the result forms a constituent with the saturated verb phrase (here IC/IV), Schmerling's categories capture not only both the fixed order of English auxiliaries and the correct generalisations pertaining to VP ellipsis. Spanish, in contrast, exhibits different kinds of dependencies and meaningful variation in auxiliary order (recall, for example, the contrast between *poder estar trabando* 'may be working / be able to be working' and *estar pudiendo trabajar* 'currently be able to work'). Recall, too, that Spanish has nothing corresponding to English-style VP ellipsis; see fn. 17 for illustration. In Spanish, there is no motivation for modals' forming a constituent with the subject; all auxiliaries are contained in a saturated IV, and so there is no way to strand them together with subjects. This difference between English and Spanish means that Spanish lacks the motivation English has for analysing the subject as the functor. Recall the further difference between English and Spanish that whereas English auxiliaries are highly restricted in which clause types permit them, auxiliaries in Spanish can appear in clauses of any type. Schmerling's account, in which the subject is the functor in a clause and auxiliaries combine first with subjects, captures auxiliaries' limitation to occurrence in specific clause types.

For our analysis of Spanish, we have adopted what is essentially a mirror-image of Schmerling's analysis of English, and we have shown it to be empirically successful *for that language*. We must emphasise that both analyses have strong empirical support from the languages for which our explicit accounts have been provided. In Schmerling's analysis, the IC/IV subject category is keyed to the specifically indicative and inverted indicative clause categories, so that IC/IV is the category of subjects that are specifically nominative. Thus, in *John would rather walk* and *John will have walked*, it is a nominative subject that the addition of an auxiliary modifies, yielding expressions of category IC//IV for *John will* and *John would rather*. The auxiliary itself must be of an appropriate category to modify a nominative subject; in the cases we have mentioned, *will* and *would rather* thus belong to the category (IC//IV)/(IC/IV); they are categorially defined to occur in indicative clauses specifically. It is interesting to note that the definition of nominative subjects in terms of indicative clauses also automatically includes a relationship between Nominative Case and Tense that has been a commonplace observation in generative syntax since Chomsky (1981), see also Pesetsky & Torrego's (2007) proposal that Nominative Case is a T feature in DPs.⁴⁰

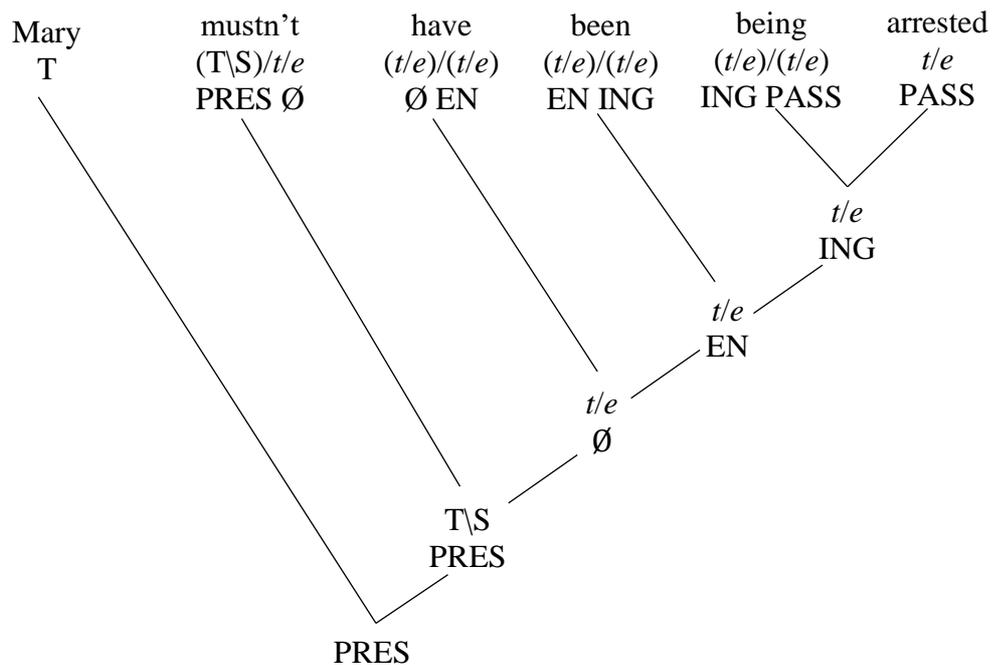
The only other major CG work on auxiliaries that we know of, which is exclusively dedicated to the English system, is Bach's (1983) mixed categorial approach.⁴¹ We say "mixed" because whereas Bach's semantic machinery is

⁴⁰ In Schmerling's analysis, indicative clauses with no auxiliaries get tense inflection on main verbs as a morphological consequence of the combining of expressions of the FC/IV category with expressions of the IV category in the formation of FC expressions.

⁴¹ Dowty (1996: §4.6) sketches a treatment of English auxiliaries focused on ordering issues (he refers to his own approach as a 'linear-oriented theory'). All auxiliaries are assigned to the category VP/VP, and the stepwise introduction of lexical functors orders them *before* the lexical head of the phrase (i.e., the V). However, that requires a definition of *lexical head*, which is a category that differs from the others assumed in his paper. He presents, as an alternative treatment, the possibility of introducing rules like (i):

unabashedly Montagovian, his definition of categories incorporates elements from phrase structure grammars, particularly the strictly context-free version in Gazdar et al. (1982), while remaining CG-based in large measure. Let us illustrate the structure that Bach (1983: 111) assigns to a complete chain of auxiliaries in English (the example and analysis tree are Bach's):

(3) Mary mustn't have been being arrested



We note first that this structure is strictly monotonic (it grows constantly and always at the same rate), homomorphic to what a PSG could generate. That is not a problem in and of itself, as long as the grammar is flexible enough to accommodate the necessary category splits (which are an integral part of a Montagovian framework). In (3), each lexical element is annotated with not only a CG-based category definition but also the inflectional features of its surrounding elements: *must* selects a bare infinitive (\emptyset) – here the bare form of *have* – while *have* selects the past participle *-en*, and so on. If one element does not select another, only its own inflectional features are specified, as in the passive form of *arrest*.

Bach's version of CG is very much influenced by Gazdar et al.'s rich feature system, as we have indicated; PRES, EN, ING, PASS are values of a single undifferentiated feature INFL(ection). We think that this influence of PSG constitutes

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- (i) If $\alpha \in \text{VP}/\text{VP}_{[+aux]}$, $\beta \in \text{VP}$, then $F_2(\alpha, \beta) \in \text{VP}$, where $F_2(\alpha, \beta) = \alpha \ll \beta$. [α , an auxiliary, is ordered before the head of β , a lexical V]

Note the addition of a GPSG/HPSG-style [+aux] feature.

Because Dowty's CG treatment is not complete, as he acknowledges, we will not discuss it in any more detail.

a weakness in Bach's proposal, because it denies the adaptability of CG that we have been at pains to emphasise, by imposing unwarranted monotonicity on the representation, as (3) illustrates.