EDICIONES COMPLUTENSE

Círculo de Lingüística Aplicada a la Comunicación
ISSN-e: 1988-2696

ARTÍCULOS

Is Alzheimer's Disease a Cross-Linguistic Issue? Comparing Corpora from a Role and Reference Grammar Perspective

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https://dx.doi.org/10.5209/clac.87529 Enviado: 10 de marzo de 2023 • Aceptado: 15 de enero de 2024

Abstract: Taking Role and Reference Grammar (Van Valin & LaPolla, 1997; Van Valin, 2005) as theoretical framework, we analyze three corpora of patients with Alzheimer's disease: two in Spanish — PerLA (Pérez Mantero, 2014) and Peraita & Grasso (2010) — and one in English — Pittsburgh (Becker et al., 1994). This grammar is part of the functionalist approaches to language and it provides a series of ordered steps that connect syntax and semantics, as well as incorporating discourse-pragmatics. Thus, we compare the results of the three corpora after applying this syntax-semantics interface to a representative sample with the aim of verifying how Alzheimer's disease behaves in the two languages. Our study shows that there are no significant differences in syntax and semantics in both languages, and that pragmatics plays a more important role than expected at first.
Key words: Alzheimer's disease, linking algorithm, Role and Reference Grammar, corpus linguistics, clinical linguistics

Cómo citar: Suárez Rodríguez, A. (2024). Is Alzheimer's Disease a Cross-Linguistic Issue? Comparing Corpora from a Role and Reference Grammar Perspective. *Círculo de Lingüística Aplicada a la Comunicación* 99 (2024) 249-261. https://dx.doi.org/10.5209/clac.87529

1. Introduction

In functionalist theories, the study of language includes meaning and the influence of context in their analyses, not only syntax. In this sense, Role and Reference Grammar (RRG; Van Valin & LaPolla, 1997; Van Valin, 2005) attempts to harmonize these three components in a single representation, with the formalization of semantics and the incorporation of information structure. Thus, this gives rise to its linking algorithm: a set of ordered steps that connect the syntactic representation and the semantic representation, taking into account the pragmatic content. Due to typological and psychological adequacy, RRG considers semantics to be universal, i.e., it can be applied to any language, whereas syntax is language-specific, and it provides the grounds on which cognitive aspects are regarded (Van Valin & LaPolla, 1997: 428; Van Valin, 2005: 182). At the same time, RRG can be viewed as a proper framework for linguistic analysis (Van Valin, 2015).

As part of the language sciences, clinical linguistics deals with the description and analysis of linguistic impairments and communicative deficits (McAllister & Miller, 2013; Ivanova et al., 2020). Most of the studies in this field have revolved around aphasia (Perkins & Howard, 2011: 111) and the psychological aspects of the disease (Mårdh, Nägga & Samuelsson, 2013), where phonetics has received special attention (Perkins, 2011: 923-925). As a result, there are many studies that do not consider syntactic or semantic approaches to language impairment, but only a phonological description (Gallardo Paúls & Valles González, 2008: 38). In this sense, our point of view considers clinical linguistics an integral part of linguistic research, since it provides tools and methods that can improve patients treatment and, consequently, it can improve their quality of life and their families', as expressed in studies such as Guillén Escamilla (2020).

The symptoms of Alzheimer's disease have been described as memory loss, disorientation, cognitive impairment, language difficulties, among others, and it can be classified in three stages — early stage, intermediate stage and late stage (Zvěřová, 2019). These symptoms are mostly found in populations of more than 60 years old and are more prevalent in women (Beam et al., 2018; Martinkova et al., 2021). When studied from a linguistic perspective, Alzheimer's disease has been subject to computational approaches (Fraser et al.,

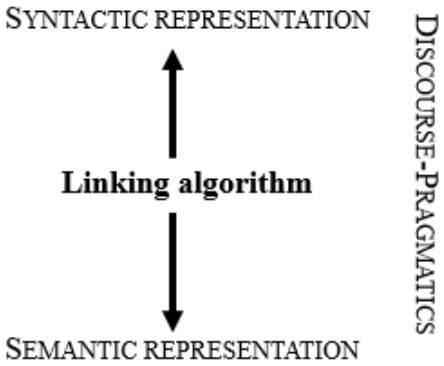
2016; Pérez Cabello de Alba, 2018; Clarke et al., 2021), although we can find theoretical-linguistic research as well (King, 2012; Fyndanis et al., 2013; Zhu & Huang, 2020). Thus, we are most interested in a qualitative, linguistics-driven approach to studying this neurodegenerative disease, along the same line as studies like Szatloczki et al. (2015) or Ivanova (2020).

Thus, the aims of this paper are to compare the results of three corpora — two in Spanish and one in English — analyzed from an RRG point of view, i.e., by utilizing its linking algorithm, and to identify in terms of the syntax-semantics interface the differences and similarities among the three corpora and the differences and similarities between the two languages. These aims are based on the following questions: what would happen if we applied this linking algorithm to three different corpora and two different languages, considering that these corpora have not the same goals, methods and approach? What differences and similarities would we encounter? Furthermore, if we only applied the syntax-semantics interface, i.e., ruling out the pragmatic content, what information would it give us about the syntax-semantics-pragmatics linking algorithm of RRG? Are syntax and semantics enough to account for the interplay of language and Alzheimer's disease?

2. Theoretical basis

Role and Reference Grammar (RRG; Van Valin & LaPolla, 1997; Van Valin, 2005) is a functionalist approach to language that aims at explicating three linguistic elements: syntax, semantics and pragmatics, which are accordingly represented by means of the syntactic structure, the semantic content and sentence information. Besides, as shown in Figure 1, syntax and semantics are interconnected by the linking algorithm that permits us to cross from one of the representations to the other.

Figure 1. General structure of Role and Reference Grammar (adapted from Van Valin, 2005: 2)



The semantic content stems from the predicate, more generally but not necessarily from verbal predicates, so RRG establishes the lexical representation on the basis of verb classes (Van Valin, 2005: 31). In this way, this grammar adapts Vendler's (1967) classification of lexical aspect — also known as Aktionsart —, where there is a distinction between states, activities, accomplishments and achievements. At the same time, RRG modifies Dowty's (1979) representational schema and also introduces semelfactives (Comrie, 1976; Smith, 1997) and active accomplishments (Van Valin, 2005: 32). As a result, we have at least six classes of verbs and the causative analogues, where the verb classes are defined by Boolean values of four semantic features: [±static], [±dynamic], [±telic] and [±punctual] (Van Valin & LaPolla, 1997: 82-128; Van Valin, 2005: 31-49). In this way, each verbal class is defined by the interaction of these semantic features as shown in Figure 2.

Figure 2. Aktionsarten defined by the four semantic features (taken from Van Valin, 2005: 33)

State:	[+ static], [− dynamic], [− telic], [− punctual]
Activity:	[− static], [+ dynamic], [− telic], [− punctual]
Achievement:	[− static], [− dynamic], [+ telic], [+ punctual]
Semelfactive:	[− static], [± dynamic], [− telic], [+ punctual]
Accomplishment:	[− static], [− dynamic], [+ telic], [− punctual]
Active accomplishment:	[− static], [+ dynamic], [+ telic], [− punctual]

Thanks to this, a series of tests can be set to obtain the Aktionsarten and their causative analogues. RRG offers eight tests that are meant to be applied sequentially in order to avoid inconsistencies and misidentification (Van Valin, 2005: 40). We offer a summary of these tests, adapted from the full discussion in Cortés Rodríguez, González Vergara and Jiménez Briones (2012: 62-65), which varies slightly with respect to the tests shown in Van Valin (2005: 35-41).

- The first test analyzes the [±static] predicates. It distinguishes state verbs by means of questions like 'What happens?'. This kind of questions may have some problems to identify causative states.
- The second test considers staticity and punctuality, because it is meant to evaluate the progressive aspect in languages like English or Spanish. Only activities, accomplishments and active accomplishments are [–static] and [–punctual] at the same time.
- The third test has to do with the [±dynamic] feature and verifies the cooccurrence of verbs with adverbs that indicates dynamicity, like *vigorously* or *actively*. Thus, only activities and active accomplishments are fully compatible with this type of adverbs, as well as activity-derived semelfactive verbs.
- The fourth test distinguishes verbs that are [+punctual] from those that are [–punctual]. 'Pace' adverbs like *slowly* or *quickly* are used to identify activities, accomplishments and active accomplishments, i.e., they are [–punctual]. If these adverbs are used with semelfactive verbs, the only reading is iteration.
- The fifth test shows that states, activities, accomplishments and active accomplishments have inner duration, unlike achievements and semelfactives., which are [+punctual]. We use *for*-tests to distinguish them by using expressions like in *He reads a book for an hour*. If semelfactives represent very short duration, they can be used with these expressions.
- The sixth test identifies telic verbs: those verbs whose meaning implies a terminal point. Only accomplishments and active accomplishments are telic, so only them can be used with *in*-tests like in *He reads a book in an hour*.
- The seventh test distinguishes between achievements and semelfactives, since these are the only two Aktionsarten that are [+punctual]. In this case, we make use of the stative modifier, because semelfactives have no result state and thus cannot be used with this modifier. An example is *The shattered vase*, but we cannot say **The flashed light*.
- The eighth test is not a linguistic test *per se*, but it is useful to know whether the semantic structure of a verb is causative. We can paraphrase the original sentence to identify the causativity of verbs, although we need to bear in mind that it only makes sense if the verb has two or more arguments. In this way, we can paraphrase *Pat gives the book to Chris* with 'Pat causes Chris to come to have the book', but we cannot paraphrase a sentence like *John sleeps*, i.e., it is not appropriate to say 'John causes himself to sleep'.

A way to formalize meaning consists in the use of logical structures, adapted from formal semantics (Van Valin, 2005: 45). Every verb class is assigned to one logical structure, where predicates are represented by constants with a prime (**predicate'**) and arguments are seen as variables (*x*, *y*, *z*...); if we find an argument that is not sufficiently specified, the symbol Ø is used (Pavey, 2010: 114). From states and activities, we can derive the rest of logical structures by adding operators like BECOME or CAUSE. If we are to express dynamicity, we add **do'** to the logical structure, so that an example like *The cat popped the balloon* would be transcribed as [**do'** (cat, Ø)] CAUSE [INGR **popped'** (balloon)] (taken from Pavey, 2010: 114), where **do'** has an unknown second argument. Observe that constants and operators are in English, but this semantic metalanguage is universal (Van Valin, 2005: 45). We offer examples for each logical structure both in Spanish and English in (1)-(7), adapted from Van Valin (2005: 46-47) and from Cortés Rodríguez, González Vergara and Jiménez Briones (2012: 62):

(1) States:
Pat is a fool.
be' (Pat, [**fool'**])
El niño tenía un perro.
have' (niño, perro)

(2) Activities:
The children cried.
do' (children, [**cry'** (children)])
Mi padre barría.
do' (padre, [**sweep'** (padre)])

(3) Achievements:
The balloon popped.
INGR **popped'** (balloon)
El jarrón se hizo añicos.
INGR **shattered'** (jarrón)

(4) Semelfactives:
Dana glimpsed the picture.
SEML **see'** (Dana, picture])
Antonio tose.
SEML **do'** (Antonio, [**cough'** (Antonio)])

(5) Accomplishments:
The snow melted.
BECOME **melted'** (snow)
Ana recibió una carta.
BECOME **have'** (Ana, carta)

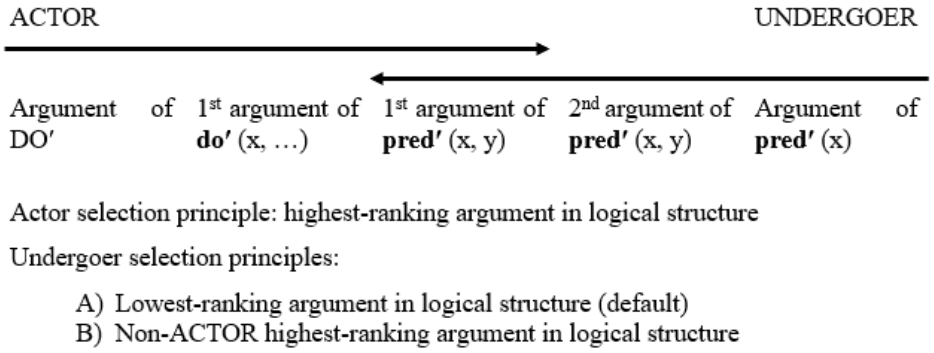
(6) Active accomplishments:
Chris ran to the park.
do' (Chris, [**run'** (Chris)]) & INGR **be-at'** (park, Chris)
Jorge paseaba hasta el museo.
do' (Jorge, [**walk'** (Jorge)]) & INGR **be-at'** (museo, Jorge)

(7) Causatives: The dog scared the boy.
[**do'** (dog, Ø)] CAUSE [**feel'** (boy, [**afraid'**])]]
Félix ha matado a su perro.
[**do'** (Félix, Ø)] CAUSE [BECOME **dead'** (perro)]]

For each logical structure, we assign at least one of the two macroroles that RRG posits to generalize the traditional ones: the ACTOR encompasses roles such as agent or experiencer, whereas the UNDERGOER includes roles like patient or theme (Van Valin, 2005: 53). When we assign these macroroles, we have to consider the following hierarchy: in dynamic predicates, the first argument is assigned ACTOR, but in stative predicates, the first argument receives UNDERGOER (Van Valin, 2005: 60). This is best captured in Figure 3, where the arrows represent an increasing degree of markedness. The hierarchy is complemented with two principles that ensure the right assignment of macroroles to arguments (adapted from Van Valin, 2005: 63):

(a) The number of arguments in the logical structure is greater than or equal to the number of macroroles that the predicate takes. In addition, if a predicate has two or more arguments, it will take two macroroles, but if the predicate has one argument, it can only take one macrorole.
(b) For those predicates that take one macrorole, they either take ACTOR if there is an activity predicate, or they take UNDERGOER if there is a stative predicate.

Figure 3. Actor-Undergoer Hierarchy (adapted from Van Valin, 2005: 126).

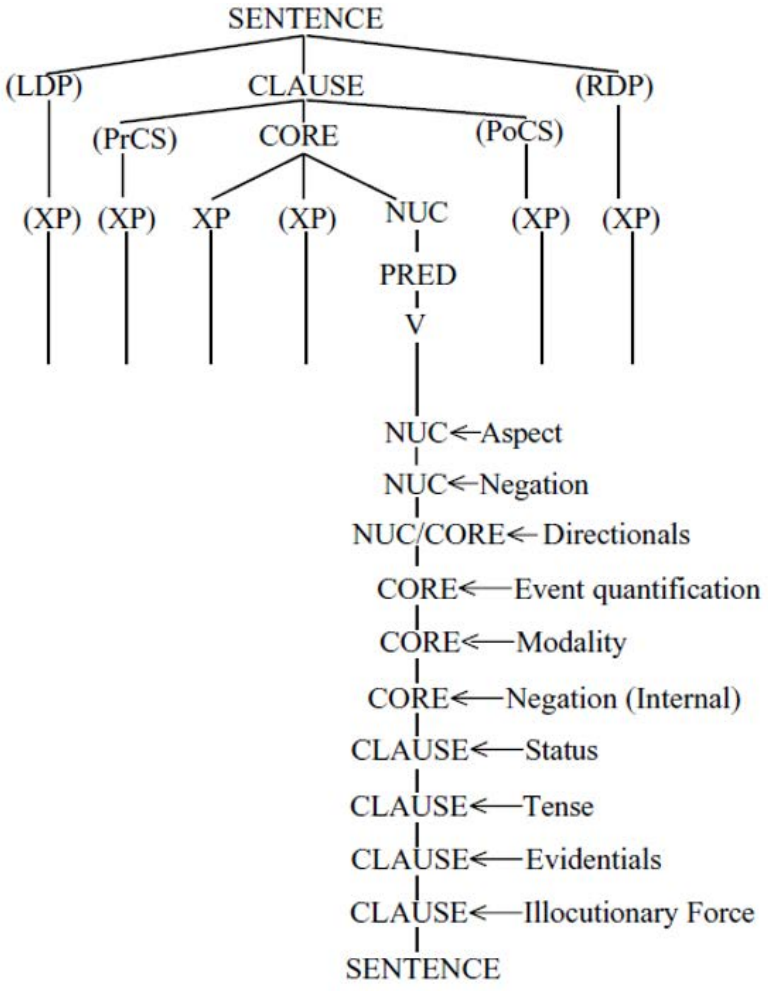


The syntactic representation in RRG does not follow abstract derivations, but it assumes a sole level of analysis in which syntax, semantics and pragmatics are encapsulated. In this sense, RRG posits a layered structure of the clause, where the syntactic units are defined semantically (Van Valin, 2005: 4). This means that the clause is built on the semantic content of the predicate, its arguments and its non-arguments (adjuncts; Pavey, 2010: 53), but from a syntactic viewpoint, the predicate constitutes a NUCLEUS; the predicate and its arguments form the CORE, and the non-arguments form the PERIPHERY. In this way, the CLAUSE in simple sentences is built gathering these three syntactic components.

The layered structure of the clause is represented in a constituent projection, where we can also find other syntactic positions that are language specific and are usually pragmatically motivated: the left-detached position (LDP), the right-detached position (RDP), the precore slot (PrCS) and the postcore slot (PoCS). In English and Spanish, there are no PoCs, in contrast to languages such as Japanese or Dhivehi (South Asia), where the predicate is placed towards the end of the sentence (Van Valin, 2005: 5-6). At the same time, RRG considers tense, illocutionary force or modality to be operators, and so they are represented in a separate projection connected to the constituents by the NUCLEUS (Van Valin, 2005: 12). There are three types of operators affecting each of the three constituent levels — nuclear, core and clause, but they are not evenly distributed (see Figure 4). In fact, the only operator that can be found in the three levels is negation (Van Valin, 2005: 9).

Given the fact that RRG is not based on abstract derivations, it offers syntactic templates as a way to acknowledge language variety. These templates are stored in a syntactic inventory and they need to follow a «selection principle», where the number of syntactic arguments and semantic arguments must coincide (Van Valin, 2005: 130). Thus, as stated before, syntactic structure is viewed in RRG as specific to the language, whereas the semantic content can be applied to any language, i.e., it is universal (Van Valin, 2005: 128).

Figure 4. Layered structure of the clause (adapted from Van Valin, 2005: 12).



As for complex sentences, subordination and coordination are not enough to account for the variety of nexus relations, so RRG offers cosubordination to better understand the behavior of these relations (Van Valin, 2005: 187; Van Valin, 2021). Cosubordinate clauses can be viewed as coordinate clauses that have some kind of subordination — usually operator dependence —, as in *Sam sat playing the piano* (Van Valin, 2005: 198). These nexus relations include what is called «junctures», where «the nature of [syntactic] units being linked» is considered (Van Valin, 2005: 188). The lowest-level juncture is the nuclear juncture, in which we find two or more nuclei within a core; an example may be *Kim painted the table red* (Van Valin, 2005: 190). The following level is the core juncture, where several cores are found under a single clause, as in *Chris forced Diana to leave the party* (Van Valin, 2005: 188). Finally, the clause juncture is defined to contain several clauses within a sentence, e.g., *Dana jogged through the park, and Kim waved to him* (Van Valin, 2005: 228). In Spanish, we can also find examples for the three types of juncture: *Luis hizo llorar a su padre* is a nuclear juncture, *Álex vio a Pedro hablando con María* is a core juncture and *María le regaló un libro y Luis le trajo bombones* is a clause juncture (examples taken from Conti Jiménez, 2012: 271-272).

Finally, the most salient aspect of RRG is its linking algorithm, defined as a series of sequential steps that connect the semantic content of any language and its syntactic structure, and vice versa (Van Valin & LaPolla, 1997: 317-318; Van Valin, 2005: 129). Discourse-pragmatics interaction with the linking algorithm depends on each language (Van Valin, 2005: 1). Furthermore, language production and language comprehension are related by this bi-directional connection (Van Valin, 2005: 129), and it is subject to a «completeness restriction»: the number of syntactic arguments needs to be the same as the number of semantic arguments in the core (Van Valin, 2005: 129-130). We offer a simplification of the linking algorithm in (1) and (2), taken from Suárez Rodríguez (2021).

(1) Linking algorithm: semantics → syntax (language production)
1. Construct the semantic representation (logical structures).
2. Assign macroroles according to hierarchy.
3. Determine the morpho-syntactic codification of arguments (PSA, grammatical case, agreement).
4. Select suitable syntactic templates.
5. Assign arguments to syntactic positions.

(2) Linking algorithm: syntax → semantics (language comprehension)
1. Determine the macroroles and other core arguments.
2. Assign the macroroles to the logical structure, according to hierarchy.
3. Link the core arguments from 1 and 2.
4. In non-subordinate core junctures, link the arguments of the main core with argument positions of the subordinate logical structure.
5. Assign the adjuncts to the periphery (core or clause) in the logical structure.
6. If they exist, assign the elements of the pre- or post-core positions.

With this theoretical background, we have analyzed three corpora by applying the linking algorithm provided by RRG. In section 3, we provide a brief description of each corpora, the method we have followed to analyze them and, finally, the method we have followed in this paper.

3. Corpora and method

The three corpora that we have analyzed are the PerLA corpus (Pérez Mantero, 2014), the corpus compiled by Peraita & Grasso (2010) and the Pitt corpus (Becker et al., 1994). In this section, we will first provide a brief description of each of the three corpora, followed by a brief description of the method we have used in each paper to analyze them and finally we will explain the method we use in this very paper to compare them. Moreover, we have analyzed only the verbal predicates due to two reasons: first, RRG is based on the verbal predicate as noted in section 2 and, second, because there is evidence that verbs can be regarded as the central point around which lexical access is impaired (Davis et al., 2010; Paek, Murray & Newman, 2020; De Almeida et al., 2021). All three corpora were analyzed by applying the full version of the linking algorithm shown at the end of section 2.

The first corpus is the PerLA corpus, whose data are part of the Clinical Linguistics PERLACH corpus and contributed to TalkBank by the PerLA Research Group on Clinical Linguistics, thanks to funding provided by the University of Valencia and the Spanish Ministries with competences in Science (MINECO Ref. FFI2012-39325-C03-01). The corpus attempts to study several neuro-psychological disorders, such as Alzheimer's disease, from a discourse-pragmatic point of view, where patients have conversations with the researcher and a patient's close person, not a guided interview with the doctor (Pérez Mantero, 2014: 103). This corpus has 27 transcriptions from conversations with 21 patients between 2012 and 2014, during which several patients were interviewed twice. Pérez Mantero (2014: 101-103) makes use of the Global Deterioration Scale to classify the cognitive deficits of the patients: 10 patients are diagnosed in the early stage of the disease (GDS4), 6 patients are in the intermediate stage (GDS5) and 5 patients are in the late stage (GDS6). During the conversations, Pérez Mantero (2014: 106) uses pairs of questions and answers in order to identify speech deficits in which patients show their ability to acknowledge the presence of another person. In these interviews, Pérez Mantero (2014: 106) poses four types of questions — polar, confirmation, repetition and open — which are mapped to four types of answers: vague, ungrammatical, incorrect and no answer.

In Suárez Rodríguez (2021), we selected a subsample of only 2 patients from the early stage and 58 verbal predicates to test the linking algorithm of RRG in the PerLA corpus. Since then, we have revised and updated the assigning and counting of verbal predicates for the individuals in the early stage present in Suárez Rodríguez (2021), so the total number of verbal predicates is now 5795, instead of the initial 4224 elements. Because RRG is based on the semantic representation of verbs, we only analyzed the verbal predicates of the samples. Although we dealt with a sample of two patients in Suárez Rodríguez (2021), in this paper we will include the results for all patients in the early stage. The analysis of the early stage will enable a future study of the differences between diagnosed patients and healthy individuals. We have applied statistical methods to obtain a representative sample of verbal predicates considering a 95% confidence interval and given a population of 5795 predicates. As a result, we obtained 360 predicates for the early stage subcorpus, which means that we had to analyze at least 30 predicates per patient. In each patient, we have analyzed the first predicates in order to avoid biases. Finally, we followed the full version of the syntax-semantics linking algorithm of RRG shown in section 2, although we have not analyzed the information structure, which is related to discourse-pragmatics.

The second corpus in Spanish was compiled by Peraita & Grasso (2010) based on a neuropsychological research that dealt with how semantic categories are represented in the mind (Peraita & Grasso, 2010: 204). From the 211 individuals, 107 are control and 104 are patients. A score from the Mini-Mental State Examination (MMSE; Folstein, Folstein & McHugh, 1975) was assigned to many patients, but not all of them. The research aimed to study the lexical-semantic deficits of patients from Argentina and Spain by means of semantic categories defined either as living things — dog, apple, tree — or non-living things — car, trousers, chair (Peraita & Grasso, 2010: 204-206). By using the semantic categories, the structure and organization of semantic memory can be contrasted with other theories (Peraita & Grasso, 2010: 205). The degree of impairment in each semantic category is determined by the assignment to one of the eleven conceptual blocks that the authors establish: functional, classifying, evaluative, recipient... (Peraita & Grasso, 2010: 206). These semantic categories were then analyzed with a vector model that allows to create a network of semantic features (Peraita & Grasso, 2010: 208-211)..

Since there are patients from both countries, we aimed to avoid cultural differences by only selecting the Spanish patients. At the same time, in Suárez Rodríguez (2022), we analyzed only those patients in the early stage that had a tag for the MMSE, and had a score between 19 and 24 points in it. Thus, we analyzed 16 patients from the Spanish subcorpus. Following the same method as with the PerLA corpus, there were 1089

verbal predicates, so we took a representative sample of at least 285 predicates that fall within a 95% confidence interval. By the same token, we analyzed 18 predicates per patient and because there are 6 semantic categories, we analyzed the first 3 verbs per semantic category and per patient to avoid biases. As before, we applied the syntax-semantics interface of RRG, leaving aside the analysis of the pragmatic content.

The third corpus is the Pitt corpus, which was part of the Alzheimer Research Program at the University of Pittsburgh (USA), supported by the National Institute of Aging grants AG03705 and AG05133. This study is now part of DementiaBank, «a shared database of multimedia interactions for the study of communication in dementia,» which is also part of TalkBank (Lanzi, Saylor, Fromm, Liu, MacWhinney, & Cohen, 2023). The researchers recruited 319 volunteers and 181 individuals were diagnosed with «probable or definite patients with AD» (Becker et al, 1994: 585-586). Patients were over 71 years old on average and most of them were women (Becker et al., 1994: 587). As with the Peraita & Grasso corpus, patients in the Pitt corpus were assigned a score from the MMSE. The corpus is based on the distribution of four tasks to patients: the cookie test, the fluency test, the recall test and the sentence test. There are 1047 transcriptions distributed among the tasks: 309 in the cookie test, 238 in fluency, 262 in recall and 238 in sentence.

The transcriptions show that there exist 6646 verbal predicates, most of them in the cookie test (2632 verbs), and by eliminating the fluency test, we obtain 5660 verbal predicates for our analysis. In Suárez Rodríguez (2024), we stated that the fluency task is an entity-naming test where predicates are fewer in number, most are isolated predicates and most are nouns. Therefore, we have not analyzed the predicates in the fluency test. The early stage for this corpus contains 2833 predicates: 1353 in the cookie test, 972 in the recall and 508 in the sentence test. Given that the Pitt corpus makes use of the MMSE test, we only analyzed those patients that scored more than 19 points but less than 24 points in the test and that had the «probable AD» tag in their transcriptions. When samples were taken following the same statistical methods as the PerLA and Peraita & Grasso corpora, results indicated that in order to work with a representative sample, we should analyze 300 predicates from the cookie test, 276 predicates from the recall test and 231 predicates from the sentence test, which amounts to 807 predicates. Thus, we analyzed between 3 and 4 predicates per patient. Again, we only applied the syntax-semantics interface, without including the discourse-pragmatic aspects.

Finally, in this paper, we aim to present a comparison of the corpora we have just described (see Table 1 for a summary). We will show the results for each corpus and then compare the realization of several syntactic phenomena from an RRG point of view as shown in the three papers we have just mentioned, i.e., the results for the type of sentences, the type of clauses, the number of LDP and RDP, the type of junctures. We will also highlight the main lexical-semantic anomalies that we have found in the corpora and that may correspond to the typical signs of the disease, and we will see that pragmatics plays a larger role than expected at first. As can be seen, the two corpora in Spanish have samples of 360 predicates (PerLa corpus) and 285 predicates (Peraita & Grasso corpus), which amounts to 645 predicates, and the Pitt corpus has 807 predicates. We selected two corpora in Spanish to have a similar quantity of predicates in the sample as in the English corpus. This comparison will enable us to also verify whether there exist the same syntactic and semantic phenomena in both languages from an RRG perspective.

Table 1. Summary of the corpora

	PerLA	**Peraita & Grasso**	**Pitt**
No. of individuals	21	211	319
No. of patients	21	104	181
Methodology	GDS and casual conversations	MMSE and semantic categories	MMSE and four tasks
Levels of dementia	Early, intermediate and late stages	Early and intermediate stages	Early, intermediate and late stages
No. of verbs	5795	1089	5660 (no fluency test)
Sample (95% conf. int.)	360	285	807

4. Results and discussion

This section presents the results of the analyses of the three corpora according to the linking algorithm of RRG. For each of the corpora, we will first present the analysis of the corpus followed by a brief discussion. After this, we will discuss the comparison of the results from the three corpora. Notice that we do not provide all the logical structures for the examples.

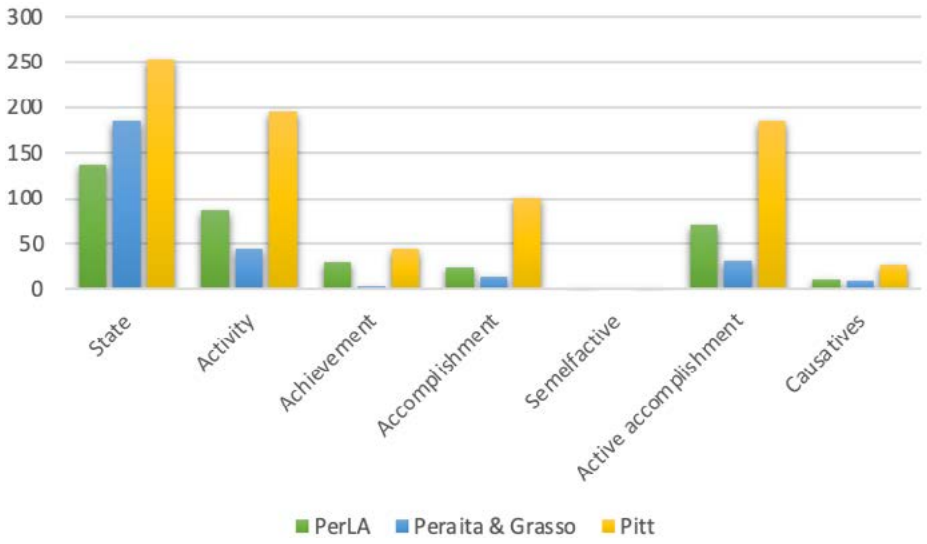
In Table 2 and in Figure 5, we offer the frequency of Aktionsarten in the three corpora — the PerLA and Peraita & Grasso corpora in Spanish and the Pitt corpus in English. As can be seen, states are the most uttered Aktionsarten in each corpus. In the PerLA corpus, activities are the second most common type of verb, followed by active accomplishments, achievements and accomplishments, but there are no semelfactives; in

the causative verbs, causative active accomplishments are used the most with 5 cases. In the Peraita & Grasso corpus, activities are again the second most uttered Aktionsart, followed by active accomplishments, accomplishments, causative active accomplishments (8 cases among all causative verbs), achievements and there exists 1 semelfactive. Finally, the sample from the Pitt corpus shows that activities are the second Aktionsart, followed by active accomplishments, accomplishments, achievements and the causatives, where causative active accomplishments are the most used with 26 instances. An explanation for the consequences of these results are beyond the scope of this paper and will be explored in a future study.

Table 2. Aktionsarten for the three corpora.

Aktionsart	PerLA	Per&Gra	Pitt
State	138	185	253
Activity	87	44	195
Achievement	30	4	45
Accomplishment	24	14	101
Semelfactive	0	1	0
Active accomp.	71	31	186
Causatives	10	9	27
Total	**360**	**288**	**807**

Figure 5. Aktionsarten per corpus

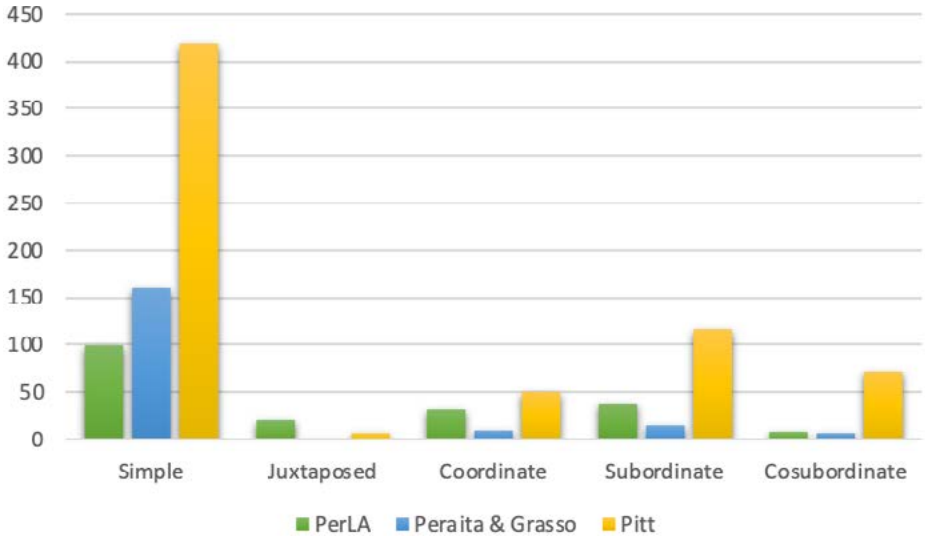


In Table 3 and in Figure 6, we show the differences in the type of sentences for the two corpora in Spanish and the one in English and we discuss the results for the three of them afterwards.

Table 3. Types of sentences for the three corpora.

Type of sentence	PerLA	Per&Gra	Pitt
Simple	99	160	419
Juxtaposed	20	2	7
Coordinate	31	10	50
Subordinate	38	15	117
Cosubordinate	8	7	72
Total	**196**	**194**	**665**

Figure 6. Type of sentence per corpus.



Since we have revised and updated the data from the PerLA corpus, they show that the 360 verbal predicates constitute 196 sentences, where 23 of them are unfinished. Some of the examples are taken from Suárez Rodríguez (2021: 124-125). More than half are simple sentences (99 cases out of 196; 50,51%), like in example 1, followed by subordinate sentences (19.38%), coordinate sentences (15.82%) and juxtaposed sentences (10.20%); cosubordinate sentences (0.40%) are the least used by patients in this corpus. Clauses are mainly realized as simple clauses (108 instance out of 358; 30.17%), but we can find many instances where subordination (28.49%) is found in the three levels —nucleus, core (as in example 2) and clause. Moreover, junctures are found generally in the clause level (90 cases out of 166; 24.22%). As for the extra-clausal elements, left-detached positions are the most used positions (49 cases; 81.67%) in this sample, although 11 right-detached positions (18.33%) can also be found, as in example 3, where we observe a tag question. Also in example 4, we see the repetition of the pragmatically-motivated «venga» as an LDP and as an RDP. Intra-clausal elements, i.e., pre-core slots and post-core slots, are less used and there are 26 PrCS but no PoCS; in example 4, the PrCS is part of a direct question. The symbols shown in the logical structures stem from formal logic: «&» stands for «and then», «∨» refers to «or» and «⊃» has to do with inclusion. Other symbols we use are «+» to signal unexpressed temporal relation between states of affairs.

(1) Tengo dos hijos, Juan y Mireia. (C.G.S.)
have' (x = 1sg, y = dos hijos, Juan y Mireia)
(2) Si necesitas que te laven o que te peinen o te... (J.A.C.)
[**need'** (x = 2sg, y = [[[**do'** (z = 3pl, [**wash'** (z, t = te)])] & INGR **cleaned'** (t)] ∨ [**do'** (z, [**comb'** (z, t)])] & INGR **brushed'** (t)] ∨ ...])] ⊃ [Ø]
(3) Cojo la patata, ¿no? (L. M. L.)
(4) Venga, ¿qué dice tu nieto?, venga. (D. G. N.)

Patients of the PerLA corpus use simple sentences as the default choice but we notice how they first utter a simple sentence like example 1 and then utter a coordinate sentence with subordinate clauses like example 2. As noted in Suárez Rodríguez (2021: 127), this may be a consequence of the upcoming symptoms of Alzheimer's disease, such as loss of cognitive control, and it may be explained by how semantic content is realized in the syntactic phenomena, parallel to the use of context as support to balance their loss of capabilities. All syntactic positions of arguments are filled, although we can find many instances where arguments are realized as part of the verb conjugation, as in example 1 («Tengo») and 2 («necesitas», «laven», «peinen»). In the same vein, all macroroles are set in their unmarked positions.

In a similar fashion, the sample from the Peraita & Grasso corpus has 288 predicates distributed in 194 sentences, a large part of them (160 out of 194; 82.47%) realized as simple sentences. Some of the examples that we show are taken from Suárez Rodríguez (2022: 165-166). Subordinate sentences, coordinate sentences and cosubordinate sentences complete the sample, as there are no instances of sentence parataxis. By the same token, in example 5 we observe an instance of simple clauses, which account for most of the clauses in the corpus (189 out of 309; 61.16%), although there are subordinate clauses (26.21%) and coordinate clauses (10.68%; example 6), as well as 6 cosubordinate clauses and 2 cases of clause parataxis. In contrast to the PerLA corpus, junctures are mostly realized as nuclear junctures (41 cases out of 92; 44.57%), like the example 8, followed by core junctures (29.35%) and clause junctures (26.09%). Example 8 shows those cases where the juncture corresponds to a clause that is part of an ad-nuclear periphery. Finally, there are 19 extra-clausal elements (17 LDPs and 2 RDPs) and we also find 25 PrCS; in example 5, we observe both the PrCS «Qué» and the RDP «hijo». Also, in example 5, we use the logical structure from Van Valin & LaPolla (1997:116-118) to generalize the formalization of *verba dicendi*.

(5) ¿Qué te voy a decir, hijo? (E55, pine)
[**do'** (x = 1sg, [**express(α).to(β).in.language(γ)'** (x, y = qué, z = te)])], where y = α, z = β y γ = Spanish
(6) Me gustan, pero que no me acuerdo de los nombres. (E37, dog)
[**like'** (x = 1sg, y = 3pl)] [MR1] + [**remember'** (x, z = de los nombres]
(7) Yo sé que es un animal. (E56, dog)
(8) Ese que, cuando vinimos a ver a ese niño, un jovencito iba con un coche así rojo y descapotable. (E48, car)

As with the PerLA corpus, simple sentences are the most used type of sentences, which may account for the impact of the first symptoms of the disease. The pragmatic content turns out to be important in the syntactic realization, since interviews are guided tasks. In this way, patients depend on the situational context to partially mask their cognitive deficits. Patients in this corpus manifest their lack of knowledge or remembrance (example 6), or they even ask the interviewer directly, like in example 5, in order to not lose the thread of the conversation or to hide that they do not remember the word or concept. First arguments are mostly realized as part of the conjugation, but second arguments are mostly in their canonical positions, i.e., explicitly realized after the verb. In specific predicates, there are third arguments realized mainly as proclitic pronouns, like «te» in example 5. As before, all macroroles are set in their unmarked positions.

Last, from the Pitt corpus we took a sample of 807 predicates that renders 665 sentences: 419 are simple, 117 are subordinate, 72 are cosubordinate, 50 are coordinate and only 7 are juxtaposed. Junctures are mostly realized at the core level as shown in example 9, where a core cosubordination is shown («like to write»), but we also find nuclear junctures. Clause junctures can be found in coordinate sentences like example 10. As for extra-clausal elements, we find that LDPs are the most common ones, although RDPs also exist in this sample («I guess» in example 11). In example 11, the constant **PREDICATE'** represents a class of verbs (jussive, reason, propositional attitude...), while **predicate'** represents the meaning of a verb (**have'**, **know'**, **believe'**, etc.).The use of PrCS is primarily realized as direct questions («What» in example 12). Some examples are all taken from Suárez Rodríguez (2024: 213-216).

(9) I like to ride the... write with a pencil. (sentence test, 051-2)
do' (x = I, [**write'** (x)]) ^ **do'** (x, [**use'** (x, y = a green pencil)])
(10) I'll read a little more, but I don't know about this uncle of his. (recall test, 134-1)
[**more'** (**do'** (x = I, [**read'** (x)]))] + [**know'** (x, y = about this uncle of his)]
(11) Last year, we had a cold winter, I guess. (sentence test, 357-0)
BELIEVE' (z = I, [**last.year'** (**have'** (x = we, y = a cold winter))])
(12) What do you want here? (cookie test, 470-1)

As before, patients tend to rely on simple sentences to produce the semantic content of the state of affairs they intend to express. Given that patients are limited by the tasks, they need to depend on the context to ensure that they answer the questions or requirements. Moreover, since English syntax is stricter than in Spanish, a slight deviation in the syntactic positions is immediately identified and in some cases self-corrected (example 5), unless patients intend a formal way of uttering or to put emphasis on some words or phrases ((Suárez Rodríguez, 2024: 216)). We see once again how the discourse-pragmatic content is more important than expected at first. Moreover, we observe that macroroles are aligned with their unmarked positions, just as in the previous analyses.

When we compare the results for the PerLA and Peraita & Grasso corpora and the Pitt corpus, there are no major syntactic differences, in spite of the fact that Spanish is more flexible regarding argument and periphery positions than English. This means that what in Spanish may seem, e.g., an irregular syntactic position of arguments can be explained by the colloquial register that patients utilize or simply that the grammatical configuration of Spanish allows for the non-canonical assignment of arguments. In English, it is known that this flexibility is only allowed in certain situations (emphasis, formality, literary texts...). However, semantic anomalies are more common than syntactic ones in both languages, as can be seen in examples 13 and 14. In example 13, we see how a patient does not utter the proper word (*jar*, instead of *stool*; in most cases, patients produce *step* or *chair*, which is a word from the same semantic domain). On the other hand, example 14 shows the difficulty patients express to remember the name of an object; in this case, the patient refers to her lack of knowledge about a type of apple.

(13) Wowie, the boy's going up on a cookie jar to get cookies and he's falling off the jar [...]. (cookie test, 010-0)
(14) Y no sé si hay otra, pero no sé cómo se llama. (E69, apple)

Lexical semantics is the obvious approach to understanding the linguistic loss in these patients (Pérez Cabello de Alba, 2018; Pérez Cabello de Alba & Teomiro García, 2018; Ivanova et al, 2020) and examples 6, 9, 13 and 14 show the lack of knowledge that patients express. Nonetheless, the semantic perspective may be better understood if we focus on the Aktionsarten. Although a deeper analysis may provide a better understanding of this preference, we can venture that patients seem to require less cognitive effort when uttering states of affairs that are static, given that states are the preferred Aktionsart in each corpus (see Table 2). In the sentence test of the Pitt corpus, active accomplishments (like example 15) are the lexical aspect that patients utter the most, in contrast to what we obtain in the rest of subcorpora, be it in English (cookie and

recall tests) or in Spanish, like in examples 16 and 17. The consequences for these results are not part of the aims of this paper and they will be addressed in a future study.

(15) My neighbor hadta take his child to the hospital. (sentence test, 010-1)
do' (x = my neighbor, [**take'** (x, y = his child)]) & INGR **be-at'** (z = the hospital, y)
(16) Yes, there's a few accidents. (cookie test, 610-0)
(17) Hay más niñas que niños. (A. L. G.)

As for the pragmatic aspects, examples 5, 6, 7, 10, 12 and 14 represent those cases where patients express their lack of knowledge, which is linked to their loss of memory — a typical symptom of Alzheimer's disease — or the tendency to repeat answers or even the questions the researcher asks, perhaps as a way of masking their memory loss. This is a recurring aspect in the three corpora, where the use of sentences that make no sense is also present: in examples 18 and 19, the utterances have no relation to the previous nor the following piece of text. It seems as if patients want to express more of a situation or an idea than they are capable of and they attempt to hide this impossibility by relying on the context, referring to the same semantic domain or uttering fillers or pauses to enlarge the time they can process information (Pistono et al., 2019).

(18) A cosas nada más, en la comida y en sus cosas que estén todas ordenadas. (J.A.C.)
(19) I sit in the chair and for the doctor. (sentence test, 310-0)

We have shown that there are specific instances in the three corpora related to the utilization of discourse-pragmatics. Researchers such as Ivanova (2020), Pistono et al. (2018) and Paulino et al. (2020) have shown that discourse is a linguistic marker in the diagnose of Alzheimer's disease. We stated in Suárez Rodríguez (2021), Suárez Rodríguez (2022) and Suárez Rodríguez (in press) that we searched for a description of the disease by means of the syntax-semantics interface of RRG. We have also shown that this approach has resulted in the need for the third leg of this functional grammar: information structure. Information structure is very much related to the pragmatic content of utterances (see Figure 1 in section 2), and so an RRG analysis that incorporates the discursive aspects and how information is distributed in the sentences may be a better approach to Alzheimer's disease. That is to say, the analyses we compare in this paper are should be complemented with a discourse-pragmatic approach, although our line of research seems to acknowledge the specificities found in, at least, these corpora from the point of view of the syntax-semantics interface. Furthermore, our analysis agrees with the research that has been conducted in different aspects of the disease and it helps widen the scope of the studies from a linguistic-theoretical point of view.

Finally, regarding the aims of this paper, we have compared the three corpora and we can assert that there are no major differences in Spanish and English when dealing with Alzheimer's disease from a syntactic point of view. The PerLA corpus provides a pragmatically-driven approach that the Peraita & Grasso corpus lack, despite the fact that results are very similar. At the same time, the Pitt corpus follows a similar approach when compared to the Peraita & Grasso corpus, i.e., the MMSE test and directed tasks approach. However, results parallel the ones found in the PerLA-Peraita comparison. The differences that we obtain in the three corpora from the syntax-semantics point of view are related to the specifics of the language, especially the phonetic-phonological and the lexical-semantic parts. In other words, we have no evidence that Alzheimer's disease behaves differently in the two languages from a syntax-semantics perspective, despite their distinct features as separate languages. The results we have obtained are based on these corpora; therefore, future studies that account for the distribution of information in sentences, in particular from an RRG perspective and its syntax-semantics-pragmatics interface, may have a deeper approach that may shed some light on the relationship of the disease and how language is produced and understood by these patients.

5. Conclusions

We have compared the results of samples taken from three different corpora that deal with Alzheimer's disease in the early stage, in both Spanish and English. These three corpora have been analyzed by applying the syntax-semantics interface of Role and Reference Grammar. In our comparison, we find that states are the default Aktionsart in the three corpora and that simple sentences are the preferred way of expressing ideas, concepts or situations. In addition, we verify that patients in the three corpora begin to lose memory or that their lexical access is restricted, as part of the symptoms of the disease in its early stage. Moreover, patients try to avoid this memory loss and access restriction by referring to contextual cues in each corpus, which leads us to realize that an analysis of sentence information is needed in order to have a complete picture.

The main objective of this paper has been to verify if this neurodegenerative disease can be understood from a cross-linguistic perspective by comparing the results of applying the syntax-semantics interface of RRG. In other words, we wanted to show if Alzheimer's disease has specific traits in two major languages (Spanish and English) so that we can better understand the behavior of the disease from a functional-conceptual perspective. In doing so, we have found that both languages respond in similar ways to the disease in syntactic terms (argument and periphery positions) and semantic terms (anomia, distribution of lexical aspect). Furthermore, patients of each language rely more on aspects related to the pragmatic content, especially the use of pauses, fillers and reestablishing questions. In this sense, we propose that further research needs to be carried out to account for the discursive and pragmatic aspects from an RRG viewpoint that we have not considered in this paper nor in the results under comparison.

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