

VERBAL INFLECTIONAL MORPHOLOGY IN BROCA'S APHASIA

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ABSTRACT

The present study aims to explore the nature of agrammatism, the main symptom of Broca's aphasia, by seeking to clarify if some of its characteristic grammatical errors are a consequence of selective impairment of functional categories. To examine this question, it focuses on the inflectional domain, i.e. Tense and Agreement in the verbal production of Catalan, English and Spanish agrammatic subjects. This issue is analysed within the theoretical framework of generative grammar. Pollock's (1989) Split Inflection Hypothesis together with Friedmann and Grodzinsky's (1997) Tree-Pruning Hypothesis will be the main hypotheses considered to analyse the data.

Agrammatic speech is characterized by the omission or substitution of two main types of functional elements: inflectional morphemes and 'free-standing function words' (prepositions, determiners, auxiliaries and complementizers), which are selectively impaired. For bound morphemes, assuming that patients respect rules of lexical well-formedness (as established by Grodzinsky 1984, 1990), the grammatical properties of the language used mark in which cases omissions are impossible and substitutions take place. While in languages where inflection is attached to words (e.g. English), omissions are expected to occur, for languages which attach inflection to stems (e.g. Catalan or Spanish), substitutions are expected.

The analysis of inflection in terms of a series of functional categories follows, within the framework of Principles and Parameters, from Pollock's (1989) Split Inflection Hypothesis. Based on a study of inflected verbs in French and English, Pollock proposed the division of INFL into two separate functional nodes. Following

the order of the functional nodes marked by Pollock [CP [TP [Neg P [Agr P [VP]]]]], Friedmann and Grodzinsky (1997) proposed the Tree-Pruning Hypothesis (TPH) to account for a pattern of selective impairment based on the degree of severity of agrammatism. This hypothesis states that either C(omplementizer), T(ense) or Agr(eement) is underspecified in agrammatic speech and that an impaired node cannot project any higher. As a result, impairment in Agr implies also T and C impairment and impairment in T implies that C will also be damaged.

Partially replicating Friedmann and Grodzinsky (1997), two experimental tasks were designed (repetition and completion of given sentences) to examine the behavior of tense and agreement morphology in both Catalan and Spanish. These results are compared with those documented in the literature for English to corroborate that functional categories are selectively impaired in agrammatism and that the impairment follows the pattern predicted by the Tree-Pruning Hypothesis. The results show that there is a clear tense-agreement dissociation in Catalan, English and Spanish and that Tense is more severely impaired than Agreement in the three languages. Subjects are classified in different groups depending on the degree of severity of agrammatism: 1) those with impaired T and Agr, 2) those with spared T and Agr and 3) those with T impaired and Agr spared. With respect to the nature of the errors observed in the tasks, while Catalan and Spanish agrammatic subjects substituted a member of the same paradigm for T and Agr markers, English subjects tended to omit them.

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1 INTRODUCTION

The linguistic study of Broca's aphasia is relatively recent in the history of linguistics and is virtually unexplored for many languages. The present study aims to examine whether grammatical errors produced by Broca's aphasics are a consequence of a selective impairment of functional categories. It focuses on the inflectional domain: tense and agreement in verbal production. This issue is analyzed within the theoretical framework of Principles and Parameters (Chomsky 1981). Pollock's (1989) Split Inflection Hypothesis together with Friedmann and Grodzinsky's (1997) Tree-Pruning Hypothesis are the main hypotheses considered to analyze the data.

1.1 Aphasia

It has been widely documented that lesions affecting the left hemisphere may damage language performance, leaving other activities unaffected (Zurif 1990; Obler and Gjerlow 1999; among others). In 1864, Armand Trousseau introduced the term aphasia, 'lack of communication by means of language' (*a-* 'lack' + *phasia* 'word'), to describe an acquired language impairment caused by damage to the brain in the hemisphere responsible for communication. This regressive pathology consists in the complete or partial loss of the language faculty in subjects previously having normally functioning language systems while intelligence and the vocal tract are intact.

Aphasia is a consequence of diseases and strokes (e.g. clots in the brain, tumors, infection, thrombosis or dementia) or traumatic injuries such as hemorrhages or wounds. This syndrome affects both comprehension and production in all modalities (speaking, writing, reading, understanding and gesturing) to a different extent depending on the location and the size of the affected area. Goodglass and Kaplan (1983) provide a severity rating scale for measuring communicative ability in aphasics in a systematic way. This scale rates from 0, the total absence of production and

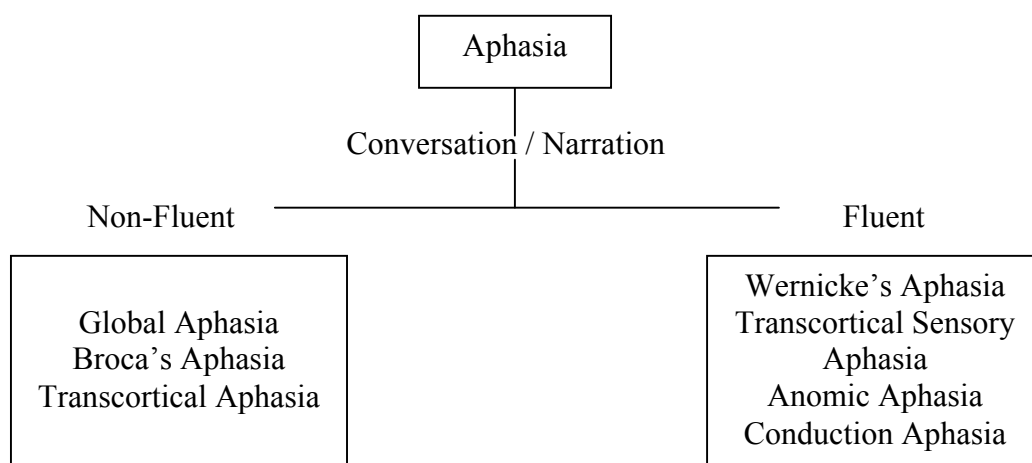
auditory comprehension, to 5 when no overt difficulties are observed. In linguistic works, the classification of subjects as ‘mild’, ‘moderate’ or ‘severe’ depending on the degree of impairment is more widely spread.

Dealing with the pattern of recovery, there is an observable cross-subject variation. While some patients may recover completely, others may have permanent speech and language difficulties of varying degree. For bilingual and multilingual subjects, Paradis (1977) identified four patterns of recovery based on the review of 138 cases reported in the literature: synergistic recovery, antagonistic recovery, successive recovery and selective recovery. When recovery in one language is accompanied by recovery in the other languages, Paradis uses the term synergistic recovery. This pattern may have two forms: parallel (all languages are similarly impaired and recovered) and differential (each language is differently impaired and the degree of recovery can be different or similar but occurs at the same rate in all languages). Paradis (1977) also observes cases of antagonistic recovery, the first-recovered language regresses as a consequence of the improvement in another language, or successive recovery, which refers to the improvement of languages in a one-by-one sequence. After one language is recovered in full, improvements in the following one start to be perceptible. The last pattern described by Paradis (1977) has to do with a process of selection. Selective recovery is produced when one or more languages are not recovered or remain severely impaired. The degree of use of a particular language prior to brain damage, the patient’s psychological state and the language used in the therapy are determinant conditionings of language recovery.

According to the classification adopted by the National Aphasia Association of North America (NAA), aphasic syndromes can be classified into two main categories: fluent aphasia and non-fluent aphasia. Subjects with fluent aphasia present major

problems in comprehension of both spoken and written language. The most representative member of this group is what is known as posterior or Wernicke's aphasia. Non-fluent aphasias are classified in the second group. Subjects with these syndromes have major difficulties in production (oral and written) while comprehension is, in general, better maintained. The most representative member of this group is the so-called motor, anterior, or Broca's aphasia. Global aphasia, the most severe type of aphasia, is also classified within the non-fluent category. It affects oral and written modalities in both comprehension and production. The NAA classification is represented in figure 1:

FIGURE 1: Classification of Aphasia. From Helm-Estabrooks, N. & Albert, M. L. (1994: 42).



1.2 Broca's area

Broca's area, named after the French neurologist Paul Pierre Broca (1824-1880), is located in the posterior part of the 3rd frontal convolution on the left hemisphere, near the specialized area for speech movements (Brodmann's areas 44 and 45). A representation of this area has been included in figure 2. Damage in Broca's area and its subjacent structures (operculum, insula and white matter) is called expressive, anterior,

motor or Broca's aphasia and it is generally accompanied by hemiplegia (paralysis of one side of the body) or hemiparesis (weakness of one side of the body).

FIGURE 2: Broca's Area. From Helm-Estabrooks & Albert (1994).



Derived from the idea that language is a distinct entity organized in modules (in line with Chomsky's conception of 'modularity'), the role of Broca's area in language processing stands as a controversial point. Although many proposals, especially until the 1970's when controlled experiments began to be carried out, attribute Broca's area with a general role in syntactic processing (Zurif and Caramazza 1976) and the codification of the message (Crystal 1980), the experimental results seem to point out that this cerebral area has a highly specific role. Even though syntax is said to be completely located in the left hemisphere¹, it is supported by more than one piece of tissue and not all of it is represented in Broca's area and its surroundings (Grodzinsky 2000). Basic syntactic operations and semantic abilities are spared in patients with lesions in this area. In fact, Broca's area and its vicinity only control highly structured syntactic abilities, among them, the receptive mechanisms involved in the connection between 'transformationally moved phrasal constituents and their extraction sites' (Grodzinsky 2000: 2). Broca's aphasics have problems with the hierarchically highest structures.

¹ Not all language functions are completely lateralized. Interpretative functions and lexical representation together with some aspects of speech perception are distributed in both hemispheres (Garrett 2003). The right hemisphere has an important role in communication abilities but has no syntactic nor morphological role.

Based mostly on functional neuroimaging, some authors point out that Broca's area is not only involved in the above-mentioned processes but also in phonological processing (Cappa, Moro, Perani and Piattelli-Palmarini 2000; Friederici and von Cranon 2000; Ullman and Izvorski 2000) or lexical access (Cappa *et al.* 2000; Dick and Bates 2000; Dronkers 2000; Müller 2000). In order to cope with the criticism received, Grodzinsky (2000) proposes a distinction between 'critical involvement and mere participation'. While only critically involved in highly structured syntactic abilities and transformational operations, Broca's area may participate in or be related to other processes such as phonological or lexical processes.

As mentioned above, Broca's aphasia was traditionally associated with difficulties in speaking while comprehension was assumed to be intact. Much controversy dealing with this issue can be found in the literature. Until the 1970's, the comprehension deficit had been ignored or not noticed. Since the 1970's, when Zurif, Caramazza and Myerson (1972) gave evidence of 'agrammatic comprehension', researchers in the field of linguistics tend to assume that the competence underlying both comprehension and production of language is the same (McCaffrey, McColl, Blackmon and Boone 2001) or only partially distinct (Grodzinsky 2000), suggesting anatomical proximity between the neural tissues involved in comprehension and production. Therefore, both modalities are affected by a non-fluent aphasia. However, it may be easier for the patient to understand than to produce due to the comprehension of key words and non-verbal cues. The observed patterns of impairment indicate extensive variation across subjects.

1.3 Agrammatism

The main symptom of Broca's aphasia is agrammatism. This term was used for the first time by Jakobson (1941) to refer to an effortful, non-fluent, hesitating and telegraphic

speech with lost patterns of rhythm observed in some subjects after brain damage to fronto-temporal areas. The speech is marked by the omission or reduced use of certain grammatical classes. Due to their difficulties in word finding, patients with this syndrome produce brief utterances commonly repeating parts of the discourse or individual words. In traditional accounts, this is given as reason for their avoidance of the use of embedded structures or wh- questions. The capacity of repeating given utterances can be also altered. These characteristics of oral production are also observed in writing where, due to related motor problems, the impairment is more severe (Goodglass and Berko 1960, Goodglass 1968, Zurif and Caramazza 1976).

The idea of attributing agrammatic deviations to a failure in syntax is far from new. Hughlings (1884) already proposed that aphasic syndromes are a reflection of the breakdown in the patients' capacity to 'propositionalize', i.e. a failure to create complete grammatical sentences. Syntactic simplification patterns are very similar across languages but allow for individual differences in severity (Menn and Obler 1990). While severe agrammatic subjects are speechless or preserve a labored, persevering speech, mild agrammatics show only a frequent associated anomia (inability to name objects) or paraphasia (deformation or substitution of words).

Refinements in the syntactic framework allow us to link this characterization to functional categories (FCs). According to Grodzinsky (1984, 1990, 1991, 2000), agrammatism is directly related with the loss of internal feature specification in the syntactic representation of functional categories (FCs). For a long time, agrammatism has been defined as a syntactic deficit in the production of FCs, where the language used is mainly reduced to content words (e.g. adverbs, adjectives, nouns, verbs) and even the search for these words is effortful and leads to frequent errors in pronunciation (Grodzinsky 1984, Ouhalla 1993). Therefore, the assumption was that FCs were omitted

in agrammatic speech. An example of production of an English-speaking agrammatic subject is provided in (1).

- (1) B.L.: Wife is dry dishes. Water down! Oh boy! Okay. Awright. Okay
... Cookie is down... fall, and girl, okay, girl... boy... um
Examiner: What is the boy doing?
B.L.: Cookie is... um... catch
Examiner: Who is getting the cookies?
B.L.: Girl, girl!
Examiner: Who is about to fall down?
B.L.: Boy... fall down!

(Avrutin 2001)

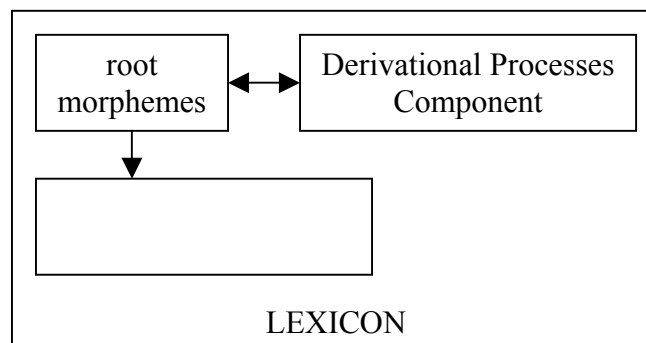
In the light of current research, this characterization, mainly based in the study of English severe agrammatic subjects, is problematic, as it can not account for all the recent results in the field. Menn and Obler (1990) highlight the fact that two forms widely used in agrammatism to substitute for inflected forms, the infinitive of verbs and the singular form of nouns, are morphologically unmarked in English. The zero marker makes it impossible to set apart omissions from possible substitutions. It was this impossibility together with the high degree of severity of the patients studied that led linguists to define agrammatism as the general omission of FCs. In addition, even though very severe cases of agrammatism in many languages provide empirical support for this characterization, recent studies of mild and moderate agrammatic patients in languages different from English reveal that not all functional elements are necessarily equally involved, as retained functional elements are present in the production of subjects with lower degrees of impairment and even severe patients can preserve some FCs.

More specifically then, agrammatic speech is characterized by the omission or substitution of two main types of functional elements: inflectional morphemes and ‘free-standing function words (prepositions, determiners, auxiliaries and

complementizers)’ (Grodzinsky 1990: 59), which are selectively impaired. Omissions are to be understood as the deletion of functional elements while substitutions refer to the use of another member of the paradigm to fill the position of the functional element.

It is important at this point to introduce an observation about morphology. Inflectional affixation and derivational affixation may be considered two differentiated processes. Miceli and Caramazza’s (1988) study of FS (an Italian agrammatic speaker) shows a dissociation between derivational and inflectional morphology in word repetition. The patient showed spared derivation but impaired inflection. This dissociation is represented in figure 3:

FIGURE 3: Miceli and Caramazza’s (1988) split morphology



Equally, support for this claim can be found in Goodglass and Berko (1960). In this study, the authors observe the behavior of 21 English agrammatic subjects in the production of the suffix {-s}. The results show that there is a dissociation in the rate of omissions when the suffix functions as a marker of 3rd person singular present tense or as the possessive marker or as a mark of plural. For these inflectional affixes, the rates of omission were higher than for derivational affixes. These results were corroborated by another group of 28 subjects with fluent and non-fluent aphasia showing that there are differences in the processing of these two types of affixes, invariable across different types of aphasia.

This distinction between inflectional and derivational morphology is consistent with a syntactic characterization of agrammatic phenomena, since affixes without syntactic role, i.e. derivational affixes, are spared. While the syntactic role of inflection will be central to the development of this dissertation, derivational morphology will be outside of its scope.

2 FRAMEWORK

The best tool for investigating language loss is linguistic theory, since a proper account of aphasic linguistic processes should be an impaired version of the normal speakers' model. Data from the field of language pathologies also contribute to theoretical linguistics:

‘Cerebral lesions provide a unique ground for linguistic claims. If language knowledge and use are taken to be biologically supported, then a theory of linguistic representation and use must be compatible with patterns of language breakdown’

(Grodzinsky 2000: 18)

In particular, research in the field of language pathology, and more specifically in agrammatism, has attracted the attention of linguists because of its relevance for the Modularity Hypothesis. Agrammatic impairment affects language capacities while general cognitive abilities are preserved. In line with Chomsky's ideas, this phenomenon supports the claim that language is an independent system governed by its own rules and principles. The Autonomy of Syntax, related to the architecture of grammar, has also been a source of interest for agrammatism. Generative grammar and the Principles and Parameters view will be assumed as framework for the present study since Friedmann and Grodzinsky's (1997) Tree-Pruning hypothesis, as well as Pollock's (1989) Split-INFL hypothesis, the two hypotheses that will be taken as the linguistic basis for characterizing and discussing the impairment of the FCs Tense and Agreement are framed within the Principles and Parameters model.

2.1 Universal Grammar and Principles and Parameters

Generative grammar assumes that knowledge of language is a component of the human mind. In Chomsky's words:

“I have in mind certain biological properties, the most significant of these being properties that are genetically-determined and characteristic of the human species, which I will assume, for the purposes of this discussion, to be genetically uniform, a further idealization. These properties determine the kinds of cognitive systems, language among them, that can develop in the human mind. In the case of language, I will use the term “universal grammar” to refer to these properties of human biological endowment.”
(Chomsky 1980: 28)

Universal Grammar (UG) is a set of universal principles common to all human languages. In order to account for cross-linguistic variation, some of these principles are said to be parameterized by available options determined by UG. Such a conception of language directly allows us to provide a characterization of the human linguistic capacity that is both descriptively and explanatorily adequate. In other words, differences across languages can be described and accounted for in a principled way by assuming that parameters have binary values that can be set in one direction or another, thus leading languages to differ to some extent, but not in their underlying mechanisms. Moreover, the Principles and Parameters (Chomsky 1981) framework also addresses the problem of language acquisition by considering it to consist in fixing the parameters to their relevant values on the basis of exposure to linguistic input.

Parametric variation is now regarded as residing in functional categories (FCs) (Chomsky 1988, Ouhalla 1991), considered in depth in section 2.2. The features of FCs trigger syntactic operations, such as Move- α , that result in crosslinguistic word-order differences. Therefore, in such a theoretical framework, the study of crosslinguistic patterns of violations observed in the speech of agrammatic subjects in relation to FCs, which is closely linked to the aim of the present dissertation, is particularly relevant.

2.2 Functional Categories

Within the Principles and Parameters model, a distinction must be made between lexical and functional categories. While the former are part of a universal lexicon, the later are subject to parametric variation (Chomsky 1988, Ouhalla 1991): ‘If substantive elements (verbs, nouns, etc.) are drawn from an invariant universal vocabulary, then only functional elements will be parametrised’ (Chomsky 1988: 2). Within this theoretical framework, the set of functional categories necessary to describe language adequately is a matter of debate but some of the proposed categories included in this group are C(omplementizer), T(ense), Neg(ation) and Agr(eement).

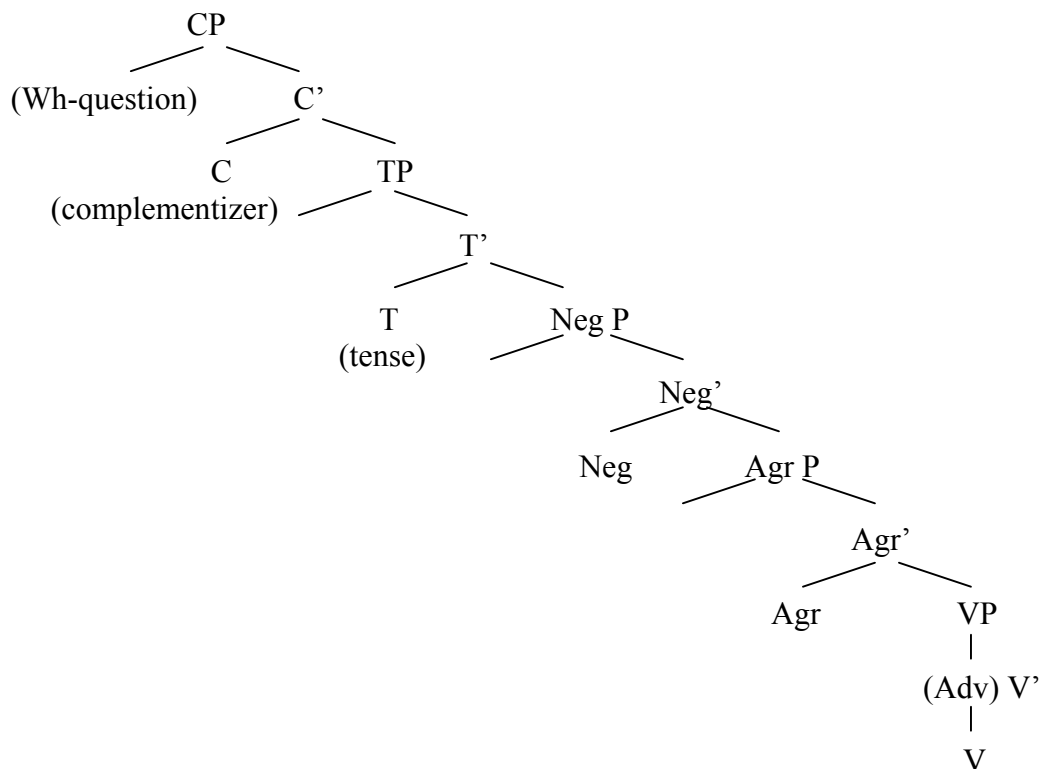
Ouhalla (1991) provides an account of the inventory and properties of FCs. In contrast with lexical elements, FCs are characterized as a closed class of heads which may be phonologically dependent. They often correspond to affixes and, when they appear as free standing morphemes, they are usually unstressed. Functional categories may thus have morphological selectional (m-selectional) properties which specify if the category is affixal and the elements it can attach to. Functional elements do not assign thematic roles, they lack semantic selectional (s-selectional) properties, but they are specified for categorial selection (c-selection). These functional elements have grammatical features and are involved in movement operations (for a summary, see Llinàs 1997). Adopting the terminology of the Minimalist version of Principles and Parameters (Chomsky 1998), FCs with a feature specified as [-interpretable] (a strong feature in earlier versions) trigger movement by attracting an element with the same feature specified as [+ interpretable].

2.3 The Split-Inflection Hypothesis

Generative theories have traditionally considered INFL as a head with its own projection, i.e. IP, including tense and agreement features. This node was represented in

the phrase marker as dominating VP. Based on the study of verbs in French and English, Pollock (1989) proposes the Split-Inflection Hypothesis, the division of INFL into two separate functional nodes with structural differences. The position of verbs with respect to adverbs, negation and quantifiers differs in these two languages due to internal differences in the properties of FCs. While Agr in French is strong and attracts the verb, making it move, in English Agr is weak and does not force verb movement. Thus, Pollock proposes that there are two positions which the verb may occupy, one closer to VP and one beyond NegP. To capture these two possibilities, INFL, the node in charge of controlling verb movement, is decomposed into T(ense) and Agr(eement), each with its own projections and properties.

FIGURE 4: Pollock (1989) Split-INFL Hypothesis



Pollock's initial insight has been taken up by other authors: Belletti (1990), Chomsky (1992), Cinque (2000). These proposals develop Pollock's work deviating

from it in some points such as the hierarchy established. As represented in the phrase marker included in figure 4, Pollock's (1989) proposal marks a hierarchical order for the syntactic tree where Agr is closer to VP and T beyond NegP. On the other hand, Belletti (1990), Chomsky (1992) and Cinque (2000) consider that Agr is located in a node higher than T. Chomsky (1992) develops the idea of the Split-INFL hypothesis. His proposal differs from Pollock's: Chomsky (1992) adds the distinction of two Agr nodes, i.e. Agr_s (subject agreement) and Agr_o (object agreement). Agr_s is checked in a higher position than TP (breaking Pollock's [CP [TP [NegP [AgrP [...]]]]] hierarchy). Another important difference with respect to Pollock's proposal is that, while for Pollock the verb comes from the lexicon uninflected and undergoes a syntactic process of affixation in order to acquire the features of tense and agreement, for Chomsky the verb is already inflected and movement is motivated by checking requirements (Checking theory). For the sake of clarity and to avoid these issues, which are not critical for our account, Pollock's proposal is adopted in this dissertation.

3 PROPOSALS AND HYPOTHESIS

The core of this study is built upon two main issues: (i) the morphological well-formedness of lexical items (section 3.1) and (ii) the syntactic disruption of functional elements, fully developed in section 3.2. In the first section, 3.1, Grodzinsky's (1984, 1990, 1991 & 2000) proposal and the work reported in Radford, Atkinson, Britain, Clahsen and Spencer's (1999) about the preserved abilities relating to lexical well-formedness in agrammatic subjects are presented. Section 3.2 provides an account of Friedmann (1994) and Friedmann and Grodzinsky's (1997) Tree-Pruning Hypothesis. Section 3.3 gives an overview of agrammatic data from different languages supporting both Pollock's (1989) Split-INFL hypothesis and Friedmann and Grodzinsky's (1997) Tree-Pruning Hypothesis. Section 3.4 includes the presentation of the hypothesis and predictions central to the current piece of research.

3.1 Pattern of Omissions and Substitutions in agrammatic subjects

By definition, agrammatism is said to affect two main types of elements, free-standing function words and inflectional morphemes. Most types of free grammatical morphemes are liable to be omitted. As Menn and Obler (1990) conclude through the observation of language disruption in 14 languages, for severe agrammatic patients the percentage of omission is higher than for moderate and mild agrammatics. Substitution errors (typical paragrammatic errors) of these types of morphemes are also documented, especially in the lower degrees of severity.

For bound morphemes, the range of errors found in agrammatic production is 'restricted and narrowly constrained' (Radford *et al.* 1999: 246). Agrammatic subjects are found to respect the properties of word-structure of their native language. The distinction between stem-based and word-based morphology is preserved in agrammatism. Categorical features of bound morphemes, i.e. knowledge of the

categories affixes can attach to, are also retained. More specifically, Radford *et al.* (1999) report that inflectional paradigms are intact. Even though agrammatics randomly choose affixes when features are underspecified, the available options must be members of the same paradigm.

As patients respect rules of lexical well-formedness (Grodzinsky 1990), the grammatical properties of the language used mark in which cases omissions are impossible and thus substitutions take place. While omissions may occur in languages where bare stems can function as independent lexical items (e.g. English, Japanese), for languages where bare stems are not generally allowed (e.g. Hebrew, Italian, Spanish) substitutions are expected in order to avoid the use of a non-word. Some examples are included in (2):

- (2) a. *inorimasu (correct: inorimasushita) (Japanese)
I pray (I-prayed)
- b. *Cappucetto rossa andava (Italian)
little Ridinghood + masc red+ fem went
 (Grodzinsky 2000)

These findings are consistent with Bates, Friederici and Wulfeck's (1987) idea that in languages with rich agreement systems, inflection tends to be maintained. Miceli, Silveri, Romani and Caramazza's (1989) study of 20 Italian agrammatic subjects reveal that all the errors in production of bound grammatical morphemes (n = 434) were substitution and not omission errors. Individual results are included in table 1:

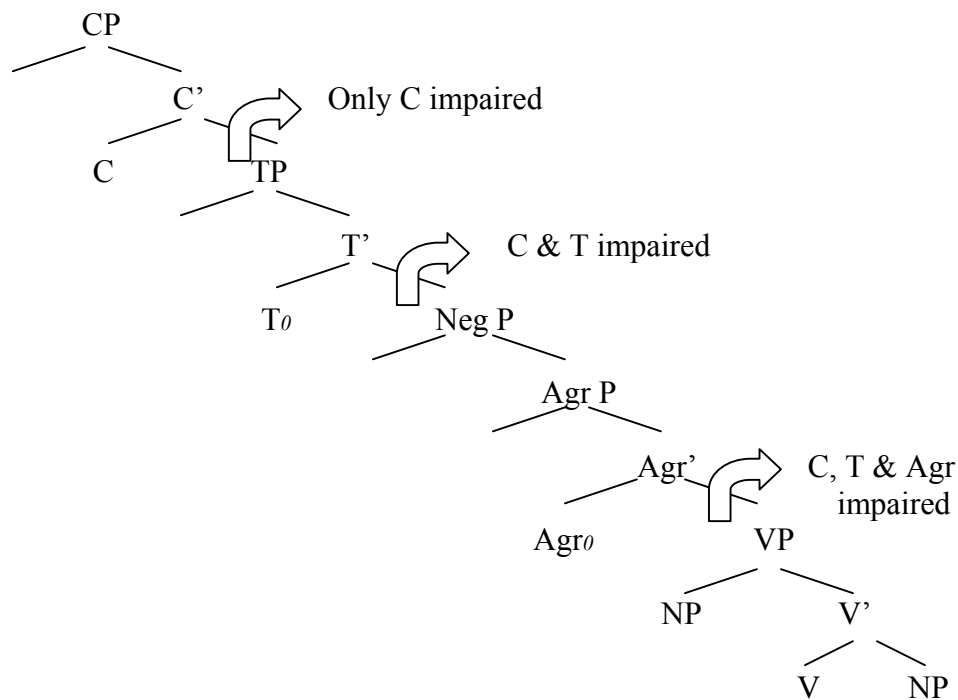
TABLE 1: Substitution errors in Italian bound morphemes. From Miceli *et al.* (1989: 465).

Subject	Bound Grammatical Morphemes:
	Substitution errors (%)
A.A.	9.6
F.A.	9.9
F.B.	1.7
C.D.	5.8
F.D.	5.7
C.D.A.	5.7
G.D.C.	15.3
E.D.U.	8.6
G.F.	24.2
T.F.	21.1
F.G.	0.8
G.G.	4.7
M.L.	3.7
A.M.	6.5
M.M.	4.1
B.P.	17.8
C.S.	3.4
F.S.	20.4
L.S.	7.3
M.U.	8.4

3.2 The Tree-Pruning Hypothesis

To give a syntactic account of agrammatic data, Friedmann (1994) and Friedmann and Grodzinsky (1997) propose the Tree-Pruning Hypothesis (TPH). According to this hypothesis, the proper description of agrammatic speech has to be stated over trees and not elements. The phrase marker proposed by Friedmann and Grodzinsky is based on Pollock's (1989) Split-INFL Hypothesis. Friedmann and Grodzinsky (1997) claim that the syntactic tree of agrammatic aphasics is pruned at a level that varies depending on the degree of severity of the deficit: C(omplementizer), T(ense) or Agr(eement) are impaired in agrammatic speech. The representation of the resulting agrammatic phrase marker is included in figure 5:

FIGURE 5: Friedmann and Grodzinsky's (1997) agrammatic phrase marker



Friedmann and Grodzinsky (1997) argue that an impaired node cannot project higher and, as a result, impairment in Agr means also T and C impairment and impairment in T means that C will also be damaged. According to the TPH, agrammatics frequently fail to project the syntactic tree up to the higher nodes: nodes such as CP are harder for agrammatics to access. This proposal, derived from Friedmann's (1994) findings, coincides with Hagiwara's (1995) idea that the lower the position of a projection with a functional head, the more accessible it is to an agrammatic speaker. The evidence available supports Grodzinsky's (2000) claim that Broca's area is involved in the construction of higher parts of the syntactic tree.

As mentioned in the previous section, Chomsky (1992) proposes a different structure of the phrase marker with two nodes for agreement: [... [_{Agrs} [_T [_{Agr_o} [...]]]]]. Friedmann and Grodzinsky (1997), in their study of one Hebrew agrammatic subject with intact Agreement and impaired Tense, find problems in accounting for the results

in the light of the Minimalist proposal. The authors provide two possible analyses: (i) Agrs is below T in Hebrew (which is completely undesirable in a model which assumes that the order of nodes is fixed) or (ii) Agro suffices to check subject agreement. To avoid these issues, which are not central for the analysis of the data in this dissertation, the Minimalist proposal will not be considered².

Friedmann and Grodzinsky (1997, 2000) present the case of Hebrew and Palestinian Arabic agrammatic speakers who performed normally for Agreement while Tense was severely impaired. An example is given in (3):

- (3) * Maxar dani haya ba-yam (Past instead of Future tense)
tomorrow Danny was in-the-sea Intact agreement
 (Friedmann and Grodzinsky 2000: 91)

Not only tense inflection in main verbs and copulas but the whole T node was impaired. The results of the production tasks they use show examples of copula omissions, errors in negation of copular constructions and subject pronoun omissions in mandatory contexts as a consequence of an impaired T node. The results for one Hebrew agrammatic speaker in repetition and completion tasks discussed in Friedmann and Grodzinsky (1997) have been included in table 2.

TABLE 2: Results for a Hebrew agrammatic subject in repetition and completion tasks. From Friedmann and Grodzinsky (1997).

Hebrew	Tense errors	Agreement errors
Completion	38%	3.2%
Repetition	23%	0%

Friedmann's (2001) study of 12 Hebrew and 2 Palestinian Arabic agrammatic subjects corroborate these findings (29% errors in T vs. 2% errors in Agr). The results across tasks are displayed in table 3:

² A proper account in Minimalist terms is left for further research.

TABLE 3: Results for Hebrew and Palestinian Arabic in repetition and completion tasks. From Friedmann (2001).

Hebrew	Tense errors	Agreement errors
Completion	41%	4%
Repetition	16%	0%

Arabic	Tense errors	Agreement errors
Completion	69%	9%

At the individual level, the results show that, while questions and embeddings (i.e. phenomena residing in the CP node) are impaired in all subjects, lower nodes are spared in mild agrammatic subjects (0% agreement and around 10% tense impairment). For severe patients, both TP and CP turn out to be problematic.

3.3 Further evidence

Although few studies related to agrammatism have examined inflection through programmed tasks, the analysis of the results seems to support that Tense and Agreement behave as two separate functional categories. Research on Romance languages shows results in the same direction. Further evidence for the dissociation between Tense and Agreement can be found in Benedet, Christiansen and Goodglass's (1998) study comparing the behavior of Spanish and English agrammatic subjects both in production and comprehension. To collect the Spanish data, an adapted version of Goodglass, Christiansen and Gallagher's (1993) Morphosyntax Battery in English was run with 6 Spanish subjects. Completion of given sentences and one-sentence descriptions of target pictures were the oral production tasks used. The results for the production and comprehension of T and Agr in Spanish were significantly different: 36% Agr errors vs. 94.5% T errors. The main error in verbal agreement was substitution of the inflection. The results of this study will be detailed in section 6.

The data in Nespoulous, Dordain, Perron, Ska, Bub, Caplan, Mehler, and Lecours (1988) and Nespoulous, Dordain, Perron, Jarema and Chazal (1990) confirm this pattern with mild French agrammatic patients. T and higher nodes are impaired while agreement stays intact. Mr. Clermont had only tense errors while agreement remained intact. He avoided the use of complex tenses and omitted copulas and auxiliaries in 50% of the mandatory contexts. Mrs. Auvergne produced 96% of main verbs correctly, while the percentage of right answers for auxiliaries only reaches 77%. The results of Nespoulous *et al.* (1990), as summarized in Gavarró (2003), appear in table 4:

TABLE 4: Mr. Clermont's and Mrs. Auvergne's results for verb production.
From Gavarró (2003: 236-7).

	Correct	Incorrect	Omission
Mr. Clermont			
main V	92% (120)	3% (4)	5% (7)
have / be V	50% (7)	0% (0)	50% (7)
auxiliaries	50% (10)	5% (1)	45% (9)
Mrs. Auvergne			
main V	96% (92)	4% (4)	0% (0)
have / be V	96% (22)	0% (0)	4% (1)
auxiliaries	77% (27)	14% (5)	9% (3)

As Gavarró (2003) points out, the data in table 4 support the predictions of the TPH, since auxiliaries are assumed to reside in higher nodes of the syntactic tree than main verbs. An example of tense error observed in the tasks is included in (4):

- (4) * et j'ai encore étouffais
and I have (aux. Pres.) still suffocate (Impf.)
 (Nespoulous *et al.* 1990: 700)

Further evidence on Romance languages can be found in Miceli, Silvery, Romani and Caramazza's (1989) and in De Bleser and Luzzati's (1994) studies of Italian. Miceli *et al.*'s. (1989) study of 20 Italian agrammatic speakers also follows this

pattern. Subjects can be classified in three groups: those with T and Agr impaired, those with intact T and Agr and those with T impairment and intact Agr. No cases of Agr impairment without T impairment are observed. Four subjects showed tense impairment with almost normal agreement while another group showed impairment in neither, C being the only affected node. A third group presented impairment of both categories. Individual scores have been presented in table 1. De Bleser and Luzzati (1994) findings of two patients with agrammatic speech reveal the mastery of general principles of agreement. Only 8% of incorrect agreement responses were recorded in simple sentences with past participle suffixes. In these constructions, when subject agreement was required, number was better preserved than gender.

The picture for the Germanic languages confirms the validity of the cross-linguistic tense-agreement dissociation. Wenzlaff and Clahsen (2002) provide evidence from 7 agrammatic and 7 control German subjects in sentence completion and grammaticality judgment tasks. The findings suggest a deficit in tense but not agreement features. While subject-verb agreement appeared almost intact, the results for tense were significantly worse than those of the control group (Wilcoxon test³: $Z = -2.37$, $p < 0.05$). Table 5 summarizes the individual scores in the sentence completion task:

³ The Wilcoxon test is a non-parametric test generally used, when the observations are paired and do not meet the assumption of normality, to test the null hypothesis that the population median of the paired differences of the samples is zero (Hollander and Wolfe 1973).

TABLE 5: Results 7 German agrammatic speakers in the sentence completion task. From Wenzlaff and Clahsen (2002: 32).

Aphasic subjects	Agreement (% correct)	Tense (% correct)
DB	95.2	70.0
EL	83.3	82.5
KM	90.5	72.5
MH	97.6	67.5
HM	92.9	75.0
WH	85.7	62.5
OP	100.0	47.5

Höhle (1995) examined 10 German-speaking agrammatics in an oral sentence completion task. In this study, Höhle found significantly more tense errors than agreement errors (29% vs. 9%). No default form was observed in the substitution errors. Further evidence for Japanese can be found in Hagiwara (1995). No Japanese agrammatic speaker performed correctly on sentences with C-related conditions if T was impaired.

3.4 The present study

The present study aims to examine whether morphological well-formedness is preserved in agrammatism and whether the grammatical errors produced by Broca's aphasics are a consequence of a selective impairment of functional categories through the observation of the behavior of verbal inflection in the linguistic productions of Catalan, English and Spanish agrammatic speakers. A syntactic account is proposed to analyze the data since lexical accounts of agrammatic phenomena (Zurif *et al.* 1972; Zurif and Caramazza 1976) fail to predict some of the patterns observed in previous research such as spared abilities at the single-word level, deficits related to the T node and the impossibility of having access to higher nodes of the syntactic tree (Menn and Obler, 1990).

According to the hypotheses mentioned above, two outcomes (one morphological and one syntactic) may be expected: firstly, following Grodzinsky's (1984, 1990) assumption, inflectional morphology in agrammatism may result in different patterns of errors depending on the properties of the language used. When the lexical item permits it, inflection may be omitted (even though substitution is not excluded). If omission is impossible, inflection must be substituted. Verbs in Spanish and Catalan do not generally allow for the omission of inflection because this is added to a stem and not to an independent word. Therefore, substitutions by another member of the paradigm are expected. In English, bare forms of the verb are allowed and omissions of bound morphemes are expected to occur.

Secondly, following the TPH, three groups of subjects can be found depending on the degree of severity of agrammatism: a) those with intact tense and agreement⁴; b) those with agreement intact and a deficit in tense production and c) those with both tense and agreement damaged. Following the hierarchical order of FCs, deficits in Agreement would imply deficits in Tense, and thus the prediction is that no patient should present impaired Agreement and spared Tense.

Data from Catalan, English and Spanish are analyzed to see whether the Tree-Pruning Hypothesis is supported. The nature of the grammatical errors (the degree of omission and substitution found in the three languages) is also analyzed to check whether Grodzinsky's proposal, which sets languages with word-based morphology and languages with stem-based morphology apart, is corroborated.

⁴ For these subjects, the deficit would affect only CP.

4 DATA AND RESULTS

4.1 Data

There are two main sources of data analyzed in the development of this dissertation. The results for English, discussed in section 4.2, are taken from previous research. While some of these studies are based on spontaneous speech, others rely on structured tasks. Specifications of the method of data collection are included for each study individually as differences in this respect may have implications for the results. Partially replicating Friedmann and Grodzinsky (1997), Spanish and Catalan data are obtained by means of two experimental tasks: delayed repetition and sentence completion, as further detailed in section 4.3. The results for these two languages are presented in section 4.4.

4.2 English data

4.2.1 Omissions vs. Substitutions

Three studies of agrammatic phenomena have been revised to check the distribution of omission vs. substitution errors in English: De Villiers (1978), Nadeau and Rothi (1992) and Menn (1990). Omissions of bound morphemes are frequent due to the occurrence of stems which function as independent words. An example is included in (5):

- (5) ... my mother pass away
(Grodzinsky 1990: 52)

De Villiers' (1978) study of spontaneous speech data from 8 non-fluent English-speaking aphasics shows high omission rates in the production of finite verbal forms. The results are included in table 6:

TABLE 6: Omission errors in the production of 8 English agrammatic subjects.
From De Villiers (1978).

3rd pers. sing. present {-s}	past tense {-ed}
35.1%	28.2%

A more recent study by Nadeau & Rothi (1992) which analyzes the case of one agrammatic English subject in story completion tasks gives evidence of the frequent use of omissions vis-à-vis occasional incorrect uses of Tense and Agreement. The results are parallel to those obtained by the subject in the Cloze test of inflectional morphology (based on Goodglass and Berko 1960) as well as in spontaneous speech. The results for the use of verbs in spontaneous speech are included in table 7:

TABLE 7: Verb production in the spontaneous speech of one English agrammatic subject. From Nadeau and Rothi (1992: 648).

Morpheme	Number of omissions / %
Auxiliaries	16/73 (22%)
Copula (<i>be/have</i>)	20/56 (36%)
Main Verb	11/158 (7%)

Morpheme	Number of substitutions / %
Tense violation	17/100 (17%)
Lack of person agreement	2/100 (2%)

Further evidence confirming omission in English can be found in Menn's (1990) study of two English-speaking agrammatics. The first subject, coded as Mr. Franklin, omitted 33% of the 3rd person singular present tense marker and 22% of the past tense marker. The results for Mr. Eastman, the second agrammatic subject who was more severely impaired, show only one case of substitution that could be argued to be an omission of an auxiliary verb. The distribution of responses as right answers and omission or substitution errors for these subjects is included in table 8:

TABLE 8: Verb production of two English agrammatic speakers. From Menn (1990: 122, 125).

	Correctly supplied (%)	Substitutions (%)	Omissions (%)
Mr. Franklin			
Verb past-tense markers	7 (78%)	0 (0%)	2 (22%)
-ing progressive markers	24 (92%)	0 (0%)	2 (8%)
-s 3 rd -singular markers	7 (58%)	1 (8%)	4 (33%)
Mr. Eastman			
Verb past-tense markers	5 (56%)	0 (0%)	4 (44%)
-ing progressive markers	1 (33%)	0 (0%)	2 (67%)
-s 3 rd -singular markers	24 (92%)	0 (0%)	2 (8%)

4.2.2 Tense vs. Agreement

To analyze the behavior of Tense and Agreement in English agrammatic subjects, three studies have been revised: Goodglass and Berko (1960), De Villiers (1978) and Nadeau and Rothi (1992). Nadeau and Rothi (1992) analyze the case of a 71-year-old, right-handed, agrammatic English subject. This study reveals that T is more severely impaired than Agr. As shown in table 7, Agr violations were just 2% of the total while T violations reached 17%. Across tasks, Agr is almost intact in the story completion Test while in the Cloze test of inflectional morphology (Goodglass & Berko 1960), the patient failed to produce 20% of past and present tense endings. The results for the story completion task are included in table 9:

TABLE 9: Percentages of incorrect answers in story completion task of one English agrammatic speaker. From Nadeau and Rothi (1992).

Present [-z]	Present [-↔z]	Past [-d]
50%	33%	33%

Present [-ɛz]⁵ was the most problematic form while past [-d] together with present [-ɛz] were correctly produced in 67% of the total number of responses. A total

⁵ Nadeau and Rothi (1992) approached the issue from a phonological point of view observing the behavior of the different realizations of {-s}.

number of 18 inflectional errors were observed in the Cloze test. These results are comparable with Goodglass and Berko (1960) findings with 21 aphasic patients where the mean of errors in inflection (T and Agr together) was 22.8%.

The results presented in De Villiers (1978) are slightly different. She found similar mean omission rates for 3rd person singular {-s} and past tense {-ed} (35.1% vs. 28.2%). However, in English Tense and Agreement are difficult to set apart. The {-s} marks both present tense and 3rd person singular agreement, therefore, it is not clear in this case if the omission rates have to be attributed to difficulties in T, in Agr or if they are due to difficulties in both.

4.3 Spanish and Catalan data

Due to the reduced amount of research carried out to observe the behavior of Tense and Agreement in Spanish agrammatic subjects and the inexistence of previous studies based on structured tasks for Catalan, data for these two languages have been obtained by means of two experimental tasks fully developed in section 4.3.1, 4.3.2 and 4.3.3: a complete account of the subjects involved in the experiment is included in 4.3.1; section 4.3.2 includes the design of the two proposed tasks and the way errors have been computed; section 4.3.3 summarizes the procedure followed during the development of the tasks.

4.3.1 Subjects

7 Catalan and 7 Spanish mild agrammatic patients in stable neurological condition from the Associació Sant Pau of Language Disorders in Barcelona were tested. Subjects were all right-handed bilinguals or nearly-bilinguals from the metropolitan area of Barcelona where Spanish and Catalan co-exist. The time when the lesion took place ranged from 3 to 20 years prior to testing. For the Catalan experimental group, the age of the subjects

ranged from 62 to 82 (mean age 70). For the Spanish experimental group the age ranged from 35 to 80 (mean age 56). Catalan agrammatic subjects were identified with the capital letter ‘C’ as opposed to ‘S’, which was used for Spanish-speaking agrammatic subjects.

TABLE 10: Background information on subjects

Subject	Age	Education	TPO	Hand	Etiology	Related disorders
Catalan						
CA	62	3	3	R	CVA Embolic	Memory and attention disorders
CB	65	1	3	R	CVA	*
CC	82	1	5	R	*	*
CD	68	1	6	R	*	*
CE	69	1	4,5	R	*	*
CF	69	3	6	R	CVA	Memory disorders
CG	81	1	4	R	*	*
Spanish						
SA	63	1	7	R	*	*
SB	50	2	5	R	Angioma	Memory, balance and orientation disorders
SC	60	3	10	R	CVA	Memory disorders
SD	80	1	4	R	*	*
SE	50	1	10	R	*	*
SF	54	2	20	R	*	*
SG	35	2	5	R	CVA	*

1 = Primary education; 2 = Secondary education; 3 = University studies; TPO = Time post-onset (in years); R = Right-handed (even though, due to hemiplegia, subjects presented a varying degree of use of their right hand); CVA = Cerebrovascular accident; * = No data available

The experiment was replicated with 7 Catalan and 7 Spanish control subjects matched in age, gender and education. Catalan control subjects were recruited in the center of Catalonia, in Vic and Manlleu. They were all right-handed bilingual speakers (Catalan - Spanish) with an age ranging from 45 to 80 years old (mean age 52). Spanish

control subjects were recruited in the area of Pontevedra. Subjects were all right-handed bilingual speakers (Spanish - Galician). The age ranged from 38 to 54 (mean age 50).

Even though all the subjects involved in the tasks were bilingual or nearly bilingual, Catalan – Spanish or Galician – Spanish, the degree of proficiency in other languages was variable. While the experimental subjects reported in informal conversation a great loss in their mastery of communicative abilities in other languages after the stroke, control subjects reported low to high levels of proficiency in, at least, L3.

4.3.2 Design

In order to give a detailed account of errors, Catalan and Spanish subjects were tested through structured tasks. As Friedmann and Grodzinsky (2000) state, in spontaneous speech, tense errors may not be evident due to difficulties in determining the target tense. Moreover, patients can avoid the use of problematic structures. Partially replicating Friedmann and Grodzinsky (1997), two simple tasks focused on production were proposed: repetition and completion of given sentences with alternating tense and person specifications. The system of verb inflection in Spanish and Catalan is very rich, with specific forms for each person and number. As none of the inflected verbs are constructed with a null inflection, there are no forms equivalent to the verb stem as in English.

Two tenses in indicative were chosen for each language. In Spanish, the Present and the Preterite were the selected forms. The six possible forms available for agreement were included in the tasks providing 12 variables. A model of the conjugation of the Present and the Preterite in Spanish appears in table 11:

TABLE 11: Conjugation of the Present and the Preterite in Spanish

Corr – er // To run	Present	Preterite
1 st person singular	Corr – o ‘run’	Corr – í ‘ran’
2 nd person singular	Corr – es ‘run’	Corr – iste ‘ran’
3 rd person singular	Corr – e ‘runs’	Corr – ió ‘ran’
1 st person plural	Corr – emos ‘run’	Corr – imos ‘ran’
2 nd person plural	Corr – eis ‘run’	Corr – isteis ‘ran’
3 rd person plural	Corr – en ‘run’	Corr – ieron ‘ran’

For Catalan, the chosen tenses were the Present and the Imperfect. As shown in (6), the Preterite in Catalan has two possible forms: a synthetic form (6b), which is archaic in the Catalan varieties considered, and the analytical form currently used in these varieties (6c).

- (6) a. En Pere compra pomes.
det Pere buys apples
- b. En Pere comprà pomes. (archaic form)
det Pere bought apples
- c. En Pere va comprar pomes. (common use)
det Pere aux- past-3rd sing. buy-INF apples

To avoid the use of the auxiliary required for the conjugation of this second form (possibly involving another FC), the Preterite is replaced by the Imperfect. The 12 variables were included in the tasks: six for the Present and six for the Imperfect. A model of the conjugation of the Present and the Imperfect in Catalan appears in table 12:

TABLE 12: Conjugation of the Present and the Imperfect in Catalan

E.g. Tém – er	Present	Imperfect
1 st person singular	Tem – o ‘fear’	Tem – ia ‘feared’
2 nd person singular	Tem – s ‘fear’	Tem – ies ‘feared’
3 rd person singular	Tem ‘fears’	Tem – ia ‘feared’
1 st person plural	Tem – em ‘fear’	Tem – íem ‘feared’
2 nd person plural	Tem – eu ‘fear’	Tem – íeu ‘feared’
3 rd person plural	Tem – en ‘fear’	Tem – ien ‘feared’

Confounding forms, which could lead to misinterpretation, were avoided when possible (e.g. 1st person plural in Spanish verbs of the first conjugation {-ar}: *cantamos* (1st person plural, Present) and *cantamos* (1st person plural, Preterite)). To allow for a quantitative analysis of the data, each task included 50 critical sentences (see Appendix I). Sentences were simple and contained a reduced number of words. Negative forms were not included in the experiment as it is assumed that Neg is a FC heading its own projection.

As mentioned earlier in this dissertation, two tasks, based on Friedmann and Grodzinsky (1997) have been designed⁶: delayed repetition of sentences and sentence completion. Examples of these tasks are presented in (7) and (8) – (9) respectively.

Task 1. - Delayed repetition of sentences: Subjects are exposed to a sentence. Then, they are asked to count up to 3 for “articulatory suppression”⁷ and reproduce the given sentence.

⁶ Video-recorded materials and answer sheets are available upon request provided the patient’s consent.

⁷ Friedmann and Grodzinsky (1997, 2000) use this technique of delayed repetition based on Baddeley (1986, 1990) to block phonological “echoing”.

- (7) a. Spanish: El niño come manzanas.
(1, 2, 3...)
-

- b. Catalan: El nen menja pomes.
(1, 2, 3...)
-

Task 2. - Completion of sentences: Subjects are exposed to a complete sentence with a clause initial temporal adverbial and then to an incomplete sentence. The incomplete sentence is a partial repetition of the previous one but with a change in the temporal marker (in order to trigger a change in tense) or the subject (in order to trigger a change in agreement: number and person). Subjects are asked to fill in the gap in the sentence, the verbal form, to test their ability to inflect for tense or agreement.

- (8) Spanish:
a. Ayer,⁸ el niño estuvo triste.
yesterday, the child was sad.
Ayer, ellos _____ .
yesterday, they _____

- b. Ayer, el niño estuvo triste.
today, the child was sad.
Hoy, el niño _____ .
today, the child _____

- (9) Catalan:
a. Avui, la Maria pinta un quadre.
today, det Mary paints a picture
Ahir, la Maria _____ .
yesterday, det Mary _____
b. Ahir, jo saltava les tanques.
yesterday, I jump-Imperfect the fences
Ahir, ells _____ .
yesterday, they _____

⁸ Commas have been added to indicate a marked pause after the temporal marker, intended to help subjects to create expectations on Tense.

With regard to tense responses, one point must be made. The empty position in (8b) can be filled by the Present, the Present Perfect or the Future to produce a grammatical sentence in Spanish. As the tokens were designed to trigger a change of tense, if this change was produced, the three possibilities were accepted as right responses. Errors in verbal inflection were classified as tense or agreement errors, keeping apart omissions from substitutions. Examples of these types of errors have been included in (10):

- | | | | |
|------|----|--|-----------------|
| (10) | a. | *Ayer yo voy al parque.
<i>yesterday I go to the park</i> | Tense error |
| | b. | *Ahir jo menjo pomes.
<i>yesterday I eat apples</i> | Tense error |
| | c. | *Ayer yo fuiste al parque.
<i>yesterday I went– 2nd pers. sing. to the park</i> | Agreement error |
| | d. | * Ahir jo saltàvem les tanques.
<i>yesterday I jump–Imperfect Past–3rd pers. plur. the fences</i> | Agreement error |

A quantitative analysis of the data was carried out. The percentages of errors in Tense and Agreement were calculated and the results of the experimental and the control groups were contrasted to observe if there were significant differences. The percentage of omission and substitution errors was also calculated. Errors that were immediately corrected by the subject were counted as right answers and false starts were not considered in the statistical analysis.

To complete the information provided by the tasks, the sessions with the experimental groups were fully video-recorded including explanations, comments by the subjects and the experimenter, repetitions, false starts and conversations during the pauses. Naturalistic data, when relevant, was analyzed and contrasted with the results obtained in Task 1 and Task 2.

4.3.3 Procedure

At the beginning of the session, relevant background information was collected. Data such as age, gender, education, hand, site and time of the lesion was registered for each subject in the experimental group. The experiment was run in a one-hour session in a quiet room. Sentence repetition was the first task. A 5-minute optional pause was inserted after the first 25 items. Task 2, sentence completion, was carried out following the same scheme. Tokens in both tasks were read aloud by the experimenter at a normal reading speed. When necessary, tokens were repeated. The total duration of the two tasks was 20 – 40 minutes depending on the severity of the aphasia.

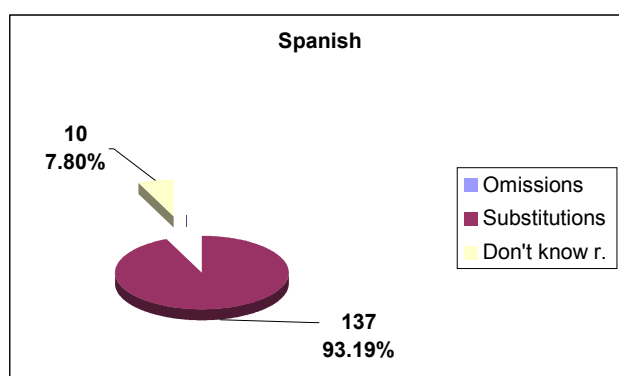
After analyzing the experimental data, the test was carried out with two groups of control subjects. Relevant background information was collected. Replicating the same steps followed with the experimental groups, the tasks were run in a quiet place in twenty-minute individual sessions.

4.4 Spanish and Catalan results

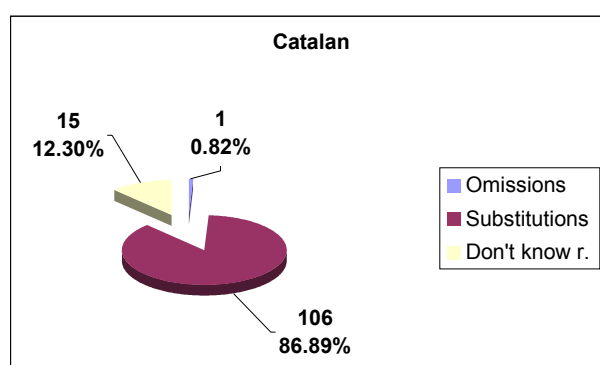
4.4.1 Omissions vs. Substitutions

The distribution of errors as omissions or substitutions of the inflection and “don’t know” responses in the delayed repetition task and the completion task was calculated for Spanish and Catalan subjects and is displayed in graph 1 and 2 respectively.

GRAPH 1: Distribution of errors and ‘don't know’ responses in Spanish



GRAPH 2: Distribution of errors and 'don't know' responses in Catalan



The observation of errors in verbal morphology shows that the 14 experimental subjects have a clear tendency to substitute tense and agreement markers instead of omitting them. While substitution in both languages reaches 90.33%, there is only one example of omission in the data. CB⁹, experimental Catalan subject, omitted part of a main verb in the delayed repetition task, as shown in example (11).

- (11) Target: Nosaltres sabem anglès
 we know-1st plur English
 CB Response: Nosaltres ***sem** anglès
 *we *kn-w-1st plur English*

4.4.2 Tense vs. Agreement

The percentage of errors in both repetition and completion tasks was calculated for each subject in the Spanish and the Catalan experimental groups. The results are displayed in table 13 and graph 3.

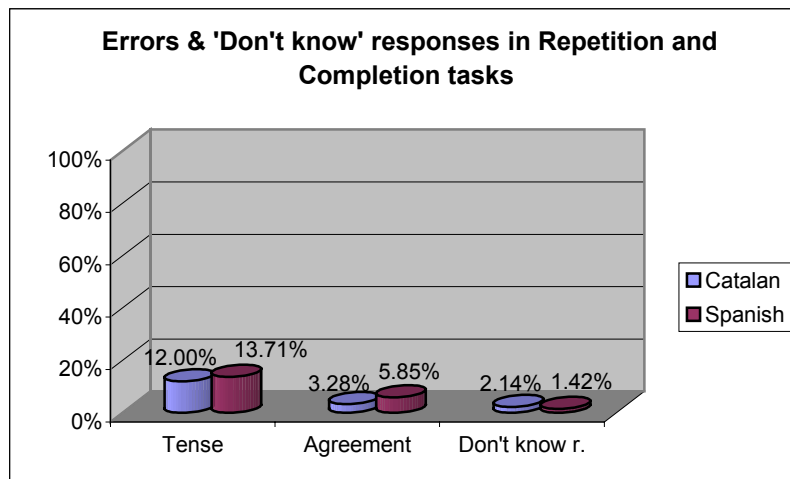
⁹ As stated in the method section, CB corresponds to the coding that was given to Catalan subject (C) number 2 (B).

TABLE 13: Percentage of errors in repetition and completion tasks.

Spanish								
	Tense				Agreement			
	Repetition		Completion		Repetition		Completion	
SA	2%	(1/50)	4%	(2/50)	0%	(0/50)	2%	(1/50)
SB	4%	(2/50)	32%	(16/50)	2%	(1/50)	26%	(13/50)
SC	2%	(1/50)	30%	(15/50)	0%	(0/50)	18%	(9/50)
SD	2%	(1/50)	14%	(7/50)	0%	(0/50)	10%	(5/50)
SE	0%	(0/50)	16%	(8/50)	0%	(0/50)	0%	(0/50)
SF	2%	(1/50)	50%	(25/50)	4%	(2/50)	12%	(6/50)
SG	2%	(1/50)	32%	(17/50)	0%	(0/50)	8%	(4/50)

Catalan								
Tense				Agreement				
	Repetition		Completion		Repetition		Completion	
CA	2%	(1/50)	20%	(10/50)	0%	(0/50)	10%	(5/50)
CB	24%	(12/50)	26%	(13/50)	8%	(4/50)	6%	(3/50)
CC	2%	(1/50)	18%	(9/50)	0%	(0/50)	0%	(0/50)
CD	0%	(0/50)	10%	(5/50)	0%	(0/50)	2%	(1/50)
CE	6%	(3/50)	28%	(14/50)	2%	(1/50)	12%	(6/50)
CF	8%	(4/50)	14%	(7/50)	0%	(0/50)	6%	(3/50)
CG	0%	(0/50)	10%	(5/50)	0%	(0/50)	0%	(0/50)

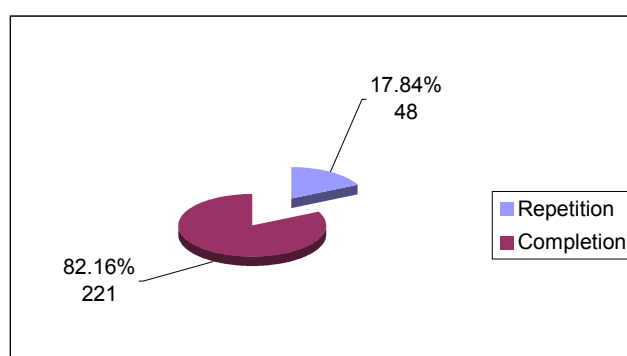
GRAPH 3: Experimental results: errors and 'don't know' responses in repetition and completion tasks



A two-way ANOVA showed significant differences between Tense and Agreement at a level of $p < 0.01$ ($p = 0.00125585$). At the individual level, subjects reported more correct responses for agreement in both the delayed repetition task and the completion task. Three subjects (CC, CG and SE) showed no agreement errors across the test and two more (SA and CD) reached only 1%, the mean obtained by the control subjects¹⁰.

Across tasks, the sentence completion exercise was harder than the delayed repetition exercise. Of 269 errors, 48 were repetition errors and 221 were completion errors, as can be seen in graph 4. Control subjects also displayed this pattern: out of 21 errors produced by the 14 controls, only 1 was found in delayed repetition.

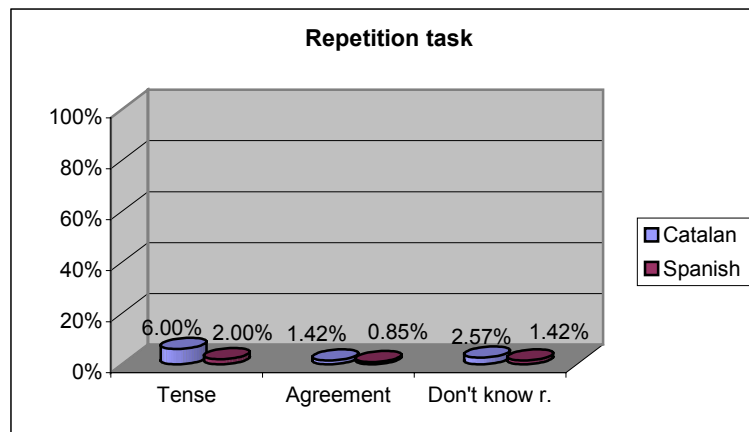
GRAPH 4: Distribution of errors and ‘don’t know’ responses across tasks



Graphs 5 and 6 illustrate the results of the experimental subjects in the two tasks. Graph 5 summarizes the results for the delayed repetition task. For the Catalan experimental group, Tense impairment reaches 6% while agreement appears almost intact, as shown by the 1.42% of errors of this kind. The Spanish error percentages, which are lower than those of their Catalan counterparts, reach 2% for T errors and 0.85% for Agr errors.

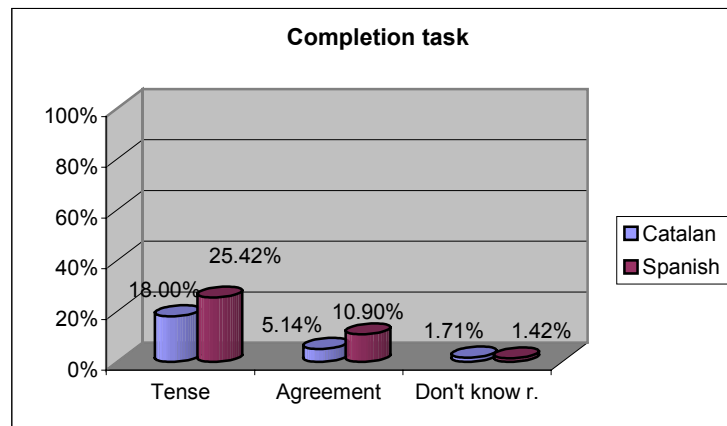
¹⁰ See Appendix II for a detailed account of the results for control subjects.

GRAPH 5: Experimental results for the repetition task



Graph 6 summarizes the results for the sentence completion task. In this task, T impairment reaches 18% for Catalan and 25.42% for Spanish. As expected, the rate of agreement errors is lower: 5.14% in Catalan and 10.90% in Spanish.

GRAPH 6: Experimental results for the completion task



Even though the percentages of error are reasonably low due to the mildness of the speakers' aphasia and the simplicity of the target sentences (Menn and Obler, 1990), the results obtained from the experimental and the control subjects present significant differences both in Spanish and Catalan, i.e. $p < 0.01$ in a Two-way ANOVA ($p = 6,3501E - 06$ for Spanish subjects and $p = 0,000234$ for Catalan

subjects). Statistical between-group comparisons showed that differences between the behavior of Spanish and Catalan agrammatic subjects are not significant.

5 DISCUSSION

As specified in previous sections, from the theoretical assumptions made, two main outcomes are predicted: (i) one morphological and (ii) one syntactic, derived from the idea of selective impairment. Omission vs. substitution patterns of errors are presented in section 5.1. Section 5.2 includes the discussion on the behavior of Tense and Agreement. A summary of findings has been included in section 5.3.

5.1 Omissions vs. Substitutions

As mentioned in section 3.1, for a morphological analysis of agrammatism, it is important to highlight a clear distinction between languages with stem-based morphology and languages with word-based morphology. Romance languages such as French or Italian are characterized by a stem-based morphology. This means that Inflection is attached to a stem and not to a complete word (e.g. *cant-* + *-a*: 3rd pers. sing., Present tense), i.e. zero inflection is generally¹¹ not possible. Conversely, languages with a word-based morphology such as English, attach inflection to an existing word (e.g. *sing* + *-s*: 3rd pers. sing., Present tense), i.e. the possibility of zero morphology is generally available in these languages. This distinction plays a fundamental role in the range of grammatical errors allowed in agrammatism.

When FCs lose their internal feature specification (Grodzinsky 1990), the possible outcomes are either omissions or substitutions. While free-standing function words tend to be omitted, for bound morphemes both types of errors (omissions and substitutions) coexist. As mechanisms in charge of lexical structure are located outside Broca's area (Grodzinsky 2000), lexical retrieval is unimpaired in agrammatism. Grodzinsky's (1984) claim that agrammatic subjects will not omit inflection if omission results in a non-word leads to the following prediction: when the lexical item permits

¹¹ There are some zero affixes in Catalan and other Romance languages, e.g. *l'amic*. This definite article has Ø person and number markers.

zero morphology, the inflection may be generally omitted. If omission is impossible, i.e. if words cannot have zero morphology, inflection is substituted. Spanish and Catalan verb stems cannot stand alone in any form either finite or non-finite. The deletion of inflection, which would make the inflected verb equivalent to the verb stem, is not allowed. Therefore, substitutions by another member of the paradigm are expected (as reported in Radford *et al.* 1999). In English, as bare forms of the verb are allowed, omissions of bound morphemes are expected.

The results introduced in the previous section support this prediction. While omissions of inflection in English are widely documented in the literature, for Spanish and Catalan the experimental results confirm that languages with stem-based morphology do not allow the omission of inflection. Out of the 1400 responses elicited for Spanish and Catalan in the delayed repetition task and the completion task, only one omission error has been documented: the production of the main verb **sem* instead of the expected form *sabem* ‘to know’. The omission of {-ab-} in Catalan is quite problematic but it can be accounted for in the light of current linguistic research in agrammatism. The example displayed in (11), which would imply the break of rules of lexical well-formedness, can be an example of the use of a dialectal form or follow from a problem in the motor organs of speech related to aphasia. Examples of pure Broca’s aphasia are rare: adjacent areas are commonly affected. Neural tissues involved in the control of the muscles serving speech lie in front of Broca’s area, therefore, motor problems are very common among patients. This may influence the pronunciation of certain sounds that appear in the morphemes under study.

Therefore, as expected, the results fulfill the prediction that Spanish and Catalan subjects produce substitution and not omission errors in agrammatism due to an internal property of the morphology of these languages, i.e. due to the fact that morphology is

stem-based in these languages. Substitution errors consist mainly in the wrong selection from the correct paradigm, which is expected under the assumption that inflectional paradigms are respected in agrammatism, an idea expressed in Radford *et al.* (1999).

Even though not directly comparable due to differences in data collection methods, the results of previous research in Romance languages seem to point in the same direction. Benedet, Christiansen and Goodglass's (1998) results for 6 Spanish agrammatic subjects in oral production tasks reveal that the main error in verbal agreement was substitution of the verb inflection. No percentages summarizing these results are available. Miceli *et al.*'s (1989) study of 20 Italian agrammatic subjects shows that all the errors in the production of bound morphemes, a total of 434 errors, were substitution errors. The individual rates of substitution for these subjects are included in table 1.

In sum, the results for Catalan, English and Spanish verbal morphology provide evidence in favor of the fact that agrammatic speakers respect rules of lexical well-formedness (Grodzinsky 1984, 1990, 1991, 2000). In Spanish and Catalan, where inflection is attached to stems, substitution errors are frequent while in English, which attaches inflection to existing words, the omission of bound morphemes is the preferred option. In addition, no examples of substitutions by a member of an incorrect paradigm are observed.

5.2 INFL: Tense and Agreement

The second result of this investigation relates to the syntactic production of sentences. Inflectional elements are impaired depending on the structural position to which they relate. Following the Tree-Pruning Hypothesis (Friedmann & Grodzinsky 1997), three groups of subjects can be found depending on the degree of severity of their impairment: a) those with intact Tense and Agreement; b) those with Agreement intact

and a deficit in Tense production and c) those with both Tense and Agreement damaged. Following the hierarchical order of FCs proposed by Friedmann and Grodzinsky (1997), deficits in T would not affect Agr production while deficits in Agr would imply deficits in T.

An important observation has to be made at this point with respect to the English data available in the literature. The interpretation of tense and agreement errors in English can be controversial. The examples presented in (12) can be classed as either omission or substitution errors of the agreement marker.

- (12) a. The dog *chase...
b. She *want to hear the news
(Nadeau & Rothi 1992: 651)

The sentence in (12a) can be interpreted as the substitution of the required 3rd person singular form by the infinitive or by a wrong person, e.g. 2nd person singular. Another possible interpretation is that the missing marker has been omitted. When the context is missing, failure to produce the grammatical form can also be attributed to the omission of the past tense marker. Even though Menn and Obler (1990) claim that the interpretation of errors as substitutions of elements by forms with zero endings is the most desirable interpretation, errors will be considered as examples of omission in this study due to the lack of evidence for a zero morpheme. The role of the context in giving a suitable interpretation of the data is crucial in the case of English.

Even with these difficulties for the analysis of data, a review of the literature (Goodglass and Berko 1960, De Villiers 1978 and Nadeu and Rothi 1992) is consistent with the predictions of the TPH, i.e. Tense is more severely impaired than Agreement in the production of English agrammatic speakers. No examples of Agreement impairment with spared or better preserved Tense have been documented.

As advanced in section 3.3, further evidence comparing the behavior of Spanish and English agrammatism both in production and comprehension can be found in Benedet *et al.* (1998). For Spanish, tense production was more severely impaired than agreement production. A table showing the individual production scores on the Morphosyntax Battery is displayed in table 14:

TABLE 14: Percentages of right answers on the Morphosyntax Battery. Adapted from Benedet *et al.* (1998: 326).

	Agreement	Tense	Low-Content verbs
Spanish			
Subject 1	60–69%	0–9%	0–9%
Subject 2	50–59%	0–9%	10–19%
Subject 3	60–69%	0–9%	0–9%
Subject 4	80–89%	0–9%	40–49%
Subject 5	80–89%	30–39%	80–89%
Subject 6	30–39%	0–9%	0–9%
English			
Subject a	*	20–29%	30–39%
Subject b	30–39%	0–9%	0–9%
Subject c	30–39%	20–29%	60–69%
Subject d	60–69%	0–9%	10–19%
Subject e	60–69%	10–19%	30–39%
Subject f	10–19%	20–29%	0–9%
Subject g	30–39%	0–9%	30–39%

* No percentage available.

While 36% of Agr impairment was observed, the percentage of errors in T reaches 94.5%. The cross-linguistic comparison revealed that Agr was more severely impaired in English than in Spanish (58% vs. 36%), while the results for T were similar in both languages (94.5% errors in Spanish vs. 85% in English).

Dealing with the results of the experimental tasks proposed in this dissertation for Spanish and Catalan, there is a remarkable Tense-Agreement dissociation in the agrammatic production of the two languages. Agr is more largely preserved than T (64 agreement vs. 180 tense errors). The fact that tense is more severely impaired takes special relevance if 25 out of the 64 agreement errors found for both languages are

attributed to misinterpretations in the use of pronouns and not to errors of inflection itself. The deictic nature of subject pronouns, together with the fact that the tasks were run out orally, led subjects to personalize the target sentences by exchanging the 1st and 2nd person subject pronouns. An example of this phenomenon is illustrated in (13).

- (13) Abans, tu endevinaves coses.
before, you guessed – 2nd sing things
 Avui, tu **endevino coses**¹².
today, you guess – 1st sing things
 (CA)

As in Miceli *et al.* (1989), sentences where the new pronoun was present and matched with agreement were counted as right answers. Nevertheless, there are also cases where the exchanged pronoun is not explicit and Spanish and Catalan both being pro-drop languages, it is not possible to determine in which cases the results show a failure in the inflection or a change of the subject pronoun. This phenomenon was also observed in the control subjects: 13 out of the 14 agreement errors found in the control data were examples of ‘personalization’ of the target sentences.

Observing the results for Spanish and Catalan as a unique group, the percentage of Agr impairment for agrammatic subjects in this study reaches the mean of 4.57%. If sentences where the new pronoun was not present had been counted as right answers, the percentage of Agr errors would have decreased to 2.78%, very close to the values for control subjects. This new percentage would make the difference between T and Agr even more striking.

In addition, some further examples of tense impairment with intact agreement were found in the naturalistic data recorded in informal conversation during the tasks. Some examples are included in (14):

¹² The bold-typed part of the sentence belongs to the tested subject, while normal case words were uttered by the experimenter.

- (14) a. Ayer yo *toco el piano...
yesterday I play-1st sing-pres the piano
 (SA)
- b. Cuando *he estado trabajando...
when (I) have been working (instead of the Simple Past form)
 (SF)

As mentioned in the previous section, the percentages of error in the delayed repetition task are lower than those found in the sentence completion task. Differences across tasks have been also documented in Nadeau and Rothi (1992). The English-speaking subject that was studied reported 22% omission in inflectional grammatical morphemes on the Cloze test of inflectional morphology (Goodglass & Berko 1960) but only 3% in repetition. In addition, in Nespoulous *et al.*'s (1988) study of French agrammatic speakers, differences between sentence-based tasks and repetition tasks were reported. The authors attributed these differences to psycholinguistic factors. According to them, in sentence-based tasks, inflectional morphemes would be elicited via the syntactic representation, while in repetition tasks, the phonological representation substitutes for the syntactic representation. In my view, however, despite the use of delayed repetition to avoid phonological echoing in the repetition task, the results suggest that phonological retrieval may have played a role in the results, although the syntactic representation is still at play to account for the differences between tense and agreement.

Therefore, as expected, the structural position of inflectional elements in the syntactic tree accounts for which items are impaired and which are preserved. Agreement, located in the lower node in the syntactic framework assumed in this dissertation, is better preserved than Tense in all cases. Taking the results of the control group as the basis, i.e. impairment rates lower than 1%, experimental subjects can be divided in two groups. While 5 subjects showed intact agreement with impaired tense, 9

reported problems both in Agr and T. No patient showed better preserved T than Agr, as predicted.

In sum, the results in Catalan, English and Spanish agrammatic production of inflectional morphology provide evidence for the selective impairment of FCs. The distinction between T and Agr established by the Split-INFL Hypothesis (Pollock 1989) contributes to a straightforward account of the pattern of disruption. Agr inflection, represented in the lower part of the syntactic tree, is produced correctly by most agrammatic subjects, while T inflection, which requires higher parts of the syntactic tree, is more severely impaired as a consequence of the agrammatics' inability to project complete syntactic trees. Different degrees of severity in agrammatism can be distinguished by observing the level at which the syntactic tree is pruned. These findings corroborate Friedmann and Grodzinsky's (1997) Tree-Pruning Hypothesis.

5.3 Summary of findings

- a) There is a clear Tense-Agreement dissociation in the production of agrammatic speakers of Catalan, English and Spanish.
- b) Tense is more severely impaired than Agreement in the three languages.
- c) Subjects can be classified in different groups depending on the degree of severity of agrammatism: 1) those with impaired T and Agr, 2) those with spared T and Agr and 3) those with T impaired and Agr spared.
- d) While Spanish and Catalan agrammatic subjects substitute a member of the same paradigm for the correct T and Agr markers, English subjects tend to omit them.

6 ISSUES FOR FURTHER RESEARCH

6.1 The behavior of TP and CP in Spanish and Catalan agrammatic subjects

The TPH has implications for a wider range of linguistic phenomena than has been considered in this dissertation. Impairment in the T node has implications for Nominative case assignment, the use of copulas (cf. 6.2) and word order. Higher nodes of the syntactic tree are also affected by the impairment of T: these nodes are harder for agrammatics to access and as a result CP is generally impaired in agrammatic speakers.

Evidence confirming these predictions can be found in the literature mentioned in this study for languages such as English, French, German, Hebrew, Italian, Japanese, Spanish or Palestinian Arabic. The experimental tasks proposed in section 4.3.2 were especially designed to check the behavior of Tense and Agreement and tasks for other categories can be designed for Spanish and Catalan, which constitute an issue for further research.

6.2 The behavior of copulas and main verbs

The behavior of copulas in comparison to main verbs is an interesting issue in agrammatism. Deficits in the production of copulas are related to the T node. As this node is impaired in many agrammatic subjects, the Tree-Pruning Hypothesis (Friedmann and Grodzinsky 1997) predicts frequent disruptions of the copula. Nadeau and Rothi (1992) analyze the case of one agrammatic English subject: a dissociation between the results for copulas and main verbs is observed in the spontaneous speech of the studied subject (see table 7, repeated below for convenience). The patient omitted 36% of *be/have* verbs while only 7% of main verb omissions were attested.

TABLE 7: Verb production in the spontaneous speech of one English agrammatic subject. From Nadeau and Rothi (1992: 648).

Morpheme	Number of omissions / %
Auxiliaries	16/73 (22%)
Copula (<i>be/have</i>)	20/56 (36%)
Main Verb	11/158 (7%)

Morpheme	Number of substitutions / %
Tense violation	17/100 (17%)
Lack of person agreement	2/100 (2%)

A deficit in copula production is reported for many other languages in the literature. The results from a Hebrew-speaking patient (Friedmann & Grodzinsky 2000) show that the ability to use copulas properly is seriously impaired. Data from Dutch, Swedish, French, Finnish and Japanese (Menn & Obler 1990) show that agrammatics omit the copula from 36% to 60% in mandatory contexts. Benedet *et al.* (1998) calculate the percentage of omission errors in Spanish low-content verbs: wrong responses were 50% of the total (see table 14).

Dealing with omissions, after observing the behavior of 14 languages, Menn and Obler (1990) claim that the rate of omission in low-content main verbs is higher than in lexical main verbs. In the present study, which was not especially designed to observe the distinction between copulas and main verbs, the omission of two verbal forms in the Spanish tests (the copula *estar*, ‘to be’ and the main verb *trabajar*, ‘to work’) has been documented. Although the data available are insufficient from a quantitative point of view (only 3 out of 100 verb forms provided in the tasks were copular verbs), the results show higher degrees of impairment for copulas than for full verbs, as predicted by the TPH. In fact, for the 7 Spanish experimental subjects, full lexical verbs are unimpaired, as shown by the low percentage of omissions displayed in table 15. For Catalan, both

copulas and full verbs seem to be spared, since no examples of omission have been documented.

TABLE 15: Omissions of verbs in Spanish

% of omission for copular verbs	% of omission for full verbs
4.46% (1/21)	0.15% (1/679)

Further evidence confirming these results can be found in Gavarró (2003). Based on the results of Miceli and Mazzucchi (1990) with 2 Italian agrammatic subjects, she claims that the behavior observed for *be/have* verbs indicates that these verbs implicate higher parts of the syntactic tree than full lexical verbs do, though further research in this topic is needed. The results for Italian are displayed in table 16:

TABLE 16: Omissions of verbs in Italian. From Gavarró (2003).

	Omissions (%)
Mr. Rossi	
Main V	21 (17%)
<i>Be / Have</i> V	17 (57%)
Mr. Verdi	
Main V	3 (3%)
<i>Be / Have</i> V	2 (8%)

Evidence for French has been previously included in table 4. No experimental work has been carried out for Catalan or Spanish – a topic for further research.

6.3 Production of non-finite verb forms

Despite the observations reported in Radford *et al.* (1999) and Friedmann & Grodzinsky's (2000) claim that agrammatic subjects tend to produce non-finite verb forms such as the infinitive, as in example (15), no examples of this kind were attested in the results of the delayed repetition and completion tasks in Spanish and Catalan.

- (15) andare ospedale. Non credere parola
go-INF hospital. Not believe-INF word
(Radford *et al.* 1999: 246)

Friedmann (2001) makes the same observation in her study of 12 Hebrew-speaking agrammatic patients in a completion task with half infinitives and half finite verbs: only 2% of the substitutions were infinitive forms of the verb while the vast majority of errors occurred within the finite paradigm. Why this crosslinguistic contrast emerges is a topic for future research.

6.4 Cross-linguistic differences in agrammatism: a comparison between English and Spanish.

Benedet *et al.* (1998) compare the linguistic behavior of English and Spanish agrammatic speakers and, as stated in section 5.2.2, the cross-linguistic comparison revealed a more severe impairment of Agr in English than in Spanish (58% vs. 36%), while the results for tense were similar in the two languages (94.5% of errors in Spanish vs. 85% in English). English has a unique form of agreement inflection (3rd pers sing Simple Present); hence, null forms occupy Agr position in the rest of the Simple Present paradigm and in all other tenses. The situation is different in Spanish: it has a unique form for each person and number. Further research on this issue is still needed but internal differences in the morphological systems of these two languages may be the reason for differences to come up (in line with Benedet *et al.* (1998)).

Even though the Catalan data presented in this paper are not directly comparable to the English data for methodological reasons, the fact that Catalan shares many morphological features with Spanish makes us expect that agreement will also be better preserved in Catalan than in English. The results do indeed show that, for Spanish and Catalan, the experimental tasks proposed in this study elicited no significant differences between the two languages.

6.5 Comprehension in Agrammatism

The present dissertation has focused on the field of production. An interesting issue for further research would be the examination of comprehension in the 14 subjects to check whether there are observable differences.

Benedet *et al.* (1998) looked at comprehension for Spanish and English agrammatic subjects. The English agrammatic speakers performed better than the Spanish speakers. These differences are especially relevant in the case of Agreement: while the scores for Spanish agrammatics reach approximately 40% of right answers, the scores for English increase up to 65%. The individual scores are displayed in table 17:

TABLE 17: Percentages of right answers in comprehension. Adapted from Benedet *et al.* (1998: 326).

	Agreement	Tense	Low-Content verbs
Spanish			
Subject 1	68–75%	100%	68–75%
Subject 2	43–50%	59–67%	43–50%
Subject 3	84–92%	100%	68–75%
Subject 4	84–92%	76–83%	76–83%
Subject 5	51–58%	51–58%	34–42%
Subject 6	68–75%	100%	76–83%
English			
Subject a	34–42%	84–92%	68–75%
Subject b	43–50%	100%	84–92%
Subject c	34–42%	84–92%	76–83%
Subject d	68–75%	84–92%	84–92%
Subject e	76–83%	76–83%	59–67%
Subject f	68–75%	84–92%	43–50%
Subject g	76–83%	100%	84–92%

A comparison between the Spanish results for production (table 14) and comprehension reveals that the percentages of impairment are higher in production. While the scores of 5 subjects reach 100% in the comprehension of tense, in production the higher scores for tense are between 30% and 39%. These results are in line with

Zurif (1990) who claims that despite across-subject variation, the comprehension problem is milder than the production problem in subjects with Broca's aphasia. Such an issue needs to be further investigated.

7 THE TREATMENT OF AGRAMMATISM

The results presented in the previous section have important implications for the design of therapy exercises for agrammatic subjects. As Friedmann, Wenkert-Olenik and Gil (2000) show, treatment to recuperate higher nodes of the syntactic tree results in better access to the lower ones. This claim derives from the ideas presented in the Tree-Pruning Hypothesis (Friedmann and Grodzinsky 1997) according to which spared higher nodes imply the preservation of lower nodes, while impaired higher nodes may involve either spared or impaired lower nodes.

To reach this conclusion, Friedmann *et al.* (2000) provided Wh-question therapy to a Hebrew-speaking agrammatic subject and tested his ability in sentence embedding and tense inflection. Data suggest not only an improvement in the higher nodes themselves but also an improvement in the production of the lower nodes. These findings fit with the more general claim by Thomson, Ballard and Shapiro (1998) that training in the production of syntactically complex structures results in general improvements in less complex structures that share common properties with treated structures. Thomson *et al.* (1998) also observed that linguistic improvement increased when the direction of treatment was from more complex to less complex structures.

In short, and somehow contrary to the general belief, the suitable treatment for agrammatic aphasia should put special emphasis in the more complex structures of language, i.e. those which imply higher nodes of the syntactic tree, rather than in simple structures, as improvement of hierarchically lower items will follow as a consequence of the improvement of hierarchically higher items.

8 CONCLUSION

The analysis of data from language pathologies has two main goals. First, knowledge about these phenomena is necessary in order to treat them. Second, these data provide insight into the human language faculty and the way normal grammars work.

The results for sentence repetition and sentence completion with Catalan and Spanish mild agrammatic subjects demonstrate a selective deficit in the syntactic domain. That is, functional categories are selectively impaired in agrammatism. The data are consistent with previous findings on agrammatic production and provide support for the cross-linguistic validity of a Tense-Agreement dissociation in agrammatism. Pollock's (1989) Split Inflection Hypothesis, which posits the division of INFL into T and Agr, as well as the assignment of other functions to T, namely that of being the site for copulas and Nominative case assignment position, receives support in the present study. Friedmann and Grodzinsky's (1997) Tree-Pruning Hypothesis is also corroborated with further evidence from two Romance languages.

The results also show that the range of errors produced by agrammatic speakers is constrained by the morphological properties of the language used. Grodzinsky's (1984, 1990, 1991, 2000) assumption that rules of lexical well-formedness are respected in agrammatism is confirmed for Catalan, English and Spanish. Additionally, in line with the work reported in Radford *et al.* (1999), categorial features and inflectional paradigms are maintained.

A syntactic account of agrammatism is necessary to characterize the linguistic phenomena that can be observed in the speech of Broca's aphasics. Such an account, however, has to consider the morphological differences that exist across languages, as these have been proved to play a crucial role in the type of errors (omissions vs. substitutions) that occur in agrammatic speech. The present dissertation has provided a

syntactic account of the linguistic productions of Broca's aphasics taking into account some morphosyntactic aspects. This analysis, which is not only relevant for the study of language disorders, but also for syntactic theory and the research on functional categories, constitutes a further step in the pursuit of an accurate picture of the grammatical characterisation of Broca's aphasia and agrammatism.

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ANSWER SHEETS FOR REPETITION AND COMPLETION TASKS

TS/AGR

EX: Ellos corren mucho (1, 2, 3, ...) Ellos corren mucho.

- 62

25. Nosotros cosimos la blusa. ☐

36. Sandra creó una empresa. ☐

37. Nosotros corrimos 3 kilómetros. ☐

Pausa de 5 minutos.

38. Vosotros aconsejáis a todo el mundo. ☐

26. Tú entendiste el guión. ☐

39. Yo pinto acuarelas. ☐

27. Los pollitos nacieron ayer. ☐

40. Él coció la pasta. ☐

28. Nosotros conducimos a menudo. ☐

41. Tú alcanzaste tu objetivo. ☐

29. Ana ama a Mario. ☐

42. Yo rompí la valla. ☐

30. Los hermanos esperaron el autobús. ☐

43. Nosotros creímos en ti. ☐

31. Vosotros obtuvisteis el premio. ☐

44. Carlos vende apartamentos. ☐

32. Sara temió perderse. ☐

45. Vosotros fumáis demasiado. ☐

33. Yo toqué el piano. ☐

46. Ana pintó su casa. ☐

34. Los compañeros hicieron un homenaje. ☐

47. Yo respiro profundamente. ☐

35. Tú mientes mucho. ☐

48. Vosotros fregáis los platos. ☐

49. Las nubes desaparecieron. ☐

50. Yo añoro a Pedro. ☐

TS/AGR

TAREA 2: COMPLETAR CON PRESENTE SIMPLE Y PASADO SIMPLE.-

EX: Hoy, María pinta un cuadro.
Ayer, María pintó un cuadro.

Ayer, yo rompí la valla.
Ayer, ellos rompieron la valla.

1. Hoy, yo como manzanas.
Ayer, yo _____.

4. Ayer, nosotros fuimos a la playa.
Hoy, nosotros _____.

2. Ayer, vosotros fuisteis al supermercado.
Ayer, yo _____.

5. Hoy, el perro ladra mucho.
Ayer, el perro _____.

3. Hoy, los niños bailaron.
Hoy, María _____.

6. Ayer, tú bailaste mucho.
Ayer, las chicas _____.

- 7 Hoy, tú haces gimnasia.
Ayer, tú _____ .
- 8 Ayer, Carlos cerró el acuerdo.
Hoy, Carlos _____ .
- 9 Hoy, yo toco el piano.
Hoy, los niños _____ .
- 10 Ayer, Juan coció la pasta.
Hoy, Juan _____ .
- 11 Hoy, nosotros vemos la televisión.
Ayer, nosotros _____ .
- 12 Ayer, yo dormí poco.
Ayer, vosotros _____ .
- 13 Hoy, la niña friega los platos.
Ayer, la niña _____ .
- 14 Hoy, vosotros obtenéis resultados.
Hoy, tú _____ .
- 15 Ayer, los carpinteros llegaron tarde.
Hoy, los carpinteros _____ .
- 16 Ayer, María compró pasteles.
Hoy, María _____ .
- 17 Hoy, mi jefe sale temprano.
Hoy, mis compañeros _____ .
- 18 Ayer, vosotros leísteis un libro.
Hoy, vosotros _____ .
- 19 Ayer, María vio una película.
Ayer, yo _____ .
- 20 Hoy, los pescadores van al mar.
Ayer, los pescadores _____ .

- 21 Ayer, tú adivinaste cosas.
Hoy, tú _____ .
- 22 Hoy, vosotros coméis peras.
Hoy, Juan _____ .
- 23 Ayer, nosotros estudiamos inglés.
Ayer, tú _____ .
- 24 Hoy, yo sirvo la cena.
Ayer, yo _____ .
- 25 Hoy, el agua hierve rápido.
Ayer, el agua _____ .

Pausa de 5 minutos.

- 26 Ayer, María vendió su casa.
Ayer, mis vecinos _____ .
- 27 Hoy, vosotros sentís pena.
Ayer, vosotros _____ .
- 28 Hoy, Ana trabaja todo el día.
Ayer, Ana _____ .
- 29 Ayer, nosotros tuvimos una cena.
Hoy, yo _____ .
- 30 Hoy, tú escribes una carta.
Ayer, tú _____ .
- 31 Hoy, los jefes firman el contrato.
Ayer, los jefes _____ .
- 32 Ayer, Juan pescó dos carpas.
Ayer, mis hijos _____ .
- 33 Hoy, tú sorprendes a todo el mundo.

- Hoy, vosotros _____ .
- 34 Ayer, Andrés creyó en mí.
Hoy, Andrés _____ .
- 35 Hoy, nosotros perdemos el tiempo.
Ayer, nosotros _____ .
- 36 Hoy, yo bailo mucho.
Ayer, yo _____ .
- 37 Ayer, las chicas comieron demasiado.
Hoy, las chicas _____ .
- 38 Ayer, tú estudiaste mucho.
Ayer, mis primos _____ .
- 39 Hoy, Sara escucha música.
Hoy, vosotros _____ .
- 40 Hoy, nosotros hacemos una fiesta.
Ayer, nosotros _____ .
- 41 Hoy, yo voy a una conferencia.
Ayer, yo _____ .
- 42 Ayer, los niños leyeron el periódico.
Hoy, los niños _____ .
- 43 Hoy, María está contenta.
Hoy, los niños _____ .
- 44 Ayer, tú preparaste un examen.
Ayer, vosotros _____ .
- 45 Hoy, yo juego al ajedrez.
Ayer, yo _____ .
- 46 Hoy, vosotros vais al cine.
Ayer, vosotros _____ .
- 47 Ayer, mi perro saltó un muro.
Ayer, mis perros _____ .
- 48 Hoy, tú tienes clase.
Ayer, tú _____ .
- 49 Ayer, mis primos fueron de compras.
Hoy, mis primos _____ .
- 50 Hoy, la música suena muy alta.
Ayer, la música _____ .

Subjecte:

Edat:

Educació:

Mà d'escriptura:

Llengua materna:

Coneixement d'altres llengües:

→

→

Lloc de la lesió:

Temps de la lesió:

TS/AGR

TASCA 1: REPETIR.-

EX: Ells corren molt (1, 2, 3, ...) Ells corren molt.

- [illegible]

- | | | | |
|---|--------------------------|--|--------------------------|
| 29. L'Anna estima en Pere. | <input type="checkbox"/> | 40. Ell coïa la pasta. | <input type="checkbox"/> |
| 30. Els germans esperaven l'autobús. | <input type="checkbox"/> | 41. Tu vas aconseguir el teu objectiu. | <input type="checkbox"/> |
| 31. Vosaltres teníeu un gos. | <input type="checkbox"/> | 42. Jo saltava molt alt. | <input type="checkbox"/> |
| 32. La Sara temia perdre's. | <input type="checkbox"/> | 43. Nosaltres crèiem en tu. | <input type="checkbox"/> |
| 33. Jo tocava el piano. | <input type="checkbox"/> | 44. En Carles ven apartaments. | <input type="checkbox"/> |
| 34. Els companys sortien molt. | <input type="checkbox"/> | 45. Vosaltres fumeu massa. | <input type="checkbox"/> |
| 35. Tu dius una poesia. | <input type="checkbox"/> | 46. L' Anna pintava casa seva. | <input type="checkbox"/> |
| 36. La Sandra escrivia contes. | <input type="checkbox"/> | 47. Jo respiro profundament. | <input type="checkbox"/> |
| 37. Nosaltres vam córrer 3 quilòmetres. | <input type="checkbox"/> | 48. Vosaltres renteu els plats. | <input type="checkbox"/> |
| 38. Vosaltres aconselleu a tothom. | <input type="checkbox"/> | 49. Els núvols desapareixien. | <input type="checkbox"/> |
| 39. Jo pinto aquarel·les. | <input type="checkbox"/> | 50. Jo enyoro en Pere. | <input type="checkbox"/> |

TS/AGR

TASCA 2: COMPLETAR AMB PRESENT SIMPLE I PRETÈRIT IMPERFET.-

EX: Avui, la Maria pinta un quadre.
Ahir, la Maria pintava un quadre.

Ahir, jo saltava les tanques.
Ahir, ells saltaven les tanques.

- | | |
|--|--|
| 1. Avui, jo menjo pomes.
Ahir, jo _____ . | Ahir, les noies _____ . |
| 2. Abans, vosaltres anàveu al supermercat.
Abans, jo _____ . | 7. Avui, tu fas gimnàstica.
Ahir, tu _____ . |
| 3. Ahir, els nens ballaven.
Avui, la Maria _____ . | 8. Ahir, en Carles tancava l' acord.
Avui, en Carles _____ . |
| 4. Abans, nosaltres anàvem a la platja.
Avui, nosaltres _____ . | 9. Avui, jo toco el piano.
Avui, els nens _____ . |
| 5. Avui, el gos borda molt.
Ahir, el gos _____ . | 10. Ahir, en Joan coïa la pasta.
Avui, en Joan _____ . |
| 6. Ahir, tu ballaves molt. | 11. Avui, nosaltres mirem la televisió.
Ahir, nosaltres _____ . |

12. Abans jo dormia poc.
Abans, vosaltres _____ .
13. Avui, la nena renta els plats.
Ahir, la nena _____ .
14. Avui, vosaltres obteniu resultats.
Avui, tu _____ .
15. Abans, els fusters arribaven tard.
Avui, els fusters _____ .
16. Abans, la Maria comprava pastissos.
Avui, la Maria _____ .
17. Avui, el meu cap surt d'hora.
Avui, els meus companys _____ .
18. Ahir, vosaltres llegíeu un llibre.
Avui, vosaltres _____ .
19. Ahir, la Maria mirava una pel·lícula.
Ahir, jo _____ .
20. Avui, els pescadors van al mar.
Ahir, els pescadors _____ .
21. Abans, tu endevinaves coses.
Avui, tu _____ .
22. Avui, vosaltres mengeu peres.
Avui, en Joan _____ .
23. Abans, nosaltres estudiàvem anglès.
Abans, tu _____ .
24. Avui, jo serveixo el sopar.
Ahir, jo _____ .
25. Avui, l'aigua bull ràpid.
Ahir, l'aigua _____ .

Pausa de 5 minuts.

26. Ahir, la Maria venia casa seva.
Ahir, els meus veïns _____ .
27. Avui, vosaltres sentiu llàstima.
Ahir, vosaltres _____ .
28. Avui, l'Anna treballa tot el dia.
Ahir, l'Anna _____ .
29. Ahir, nosaltres teníem un sopar.
Avui, jo _____ .
30. Avui, tu escrius una carta.
Ahir, tu _____ .
31. Avui, els caps signen el contracte.
Ahir, els caps _____ .
32. Abans, en Joan pescava sardines.
Abans, els meus fills _____ .
33. Avui, tu sorprens a tothom.
Avui, vosaltres _____ .
34. Ahir, l'Andreu creia en mi.
Avui, l'Andreu _____ .
35. Avui, nosaltres perdem el temps.
Ahir, nosaltres _____ .
36. Avui, jo ballo molt.
Ahir, jo _____ .
37. Abans, les noies menjaven massa.
Avui, les noies _____ .
38. Abans, tu estudiaves molt.
Abans, els meus cosins _____ .
39. Avui, la Sara escolta música.
Avui, vosaltres _____ .
40. Avui, nosaltres fem una festa.
Ahir, nosaltres _____ .

41. Avui, jo vaig a una conferència.
Ahir, jo _____.

42. Ahir, els nens llegien el diari.
Avui, els nens _____.

43. Avui, la Maria està contenta.
Avui, els nens _____.

44. Ahir, tu preparaves un examen.
Ahir, vosaltres _____.

45. Avui, jo jugo a escacs.
Ahir, jo _____.

46. Avui, vosaltres aneu al cine.
Ahir, vosaltres _____.

47. Abans, el meu gos saltava
tàpies.
Abans, els meus gossos _____.

48. Avui, tu tens classe.
Ahir, tu _____.

49. Ahir, els meus cosins anaven de
compres.
Avui, els meus cosins
_____.

50. Avui, la música sona molt alta.
Ahir, la música _____.

APPENDIX II

CONTROL DATA

Percentage of errors in repetition and completion tasks.

Spanish

	Tense				Agreement			
	Repetition		Completion		Repetition		Completion	
PA	0%	(0/50)	0%	(0/50)	0%	(0/50)	2%	(1/50)
PB	0%	(0/50)	0%	(0/50)	0%	(0/50)	0%	(0/50)
PC	0%	(0/50)	0%	(0/50)	0%	(0/50)	4%	(2/50)
PD	0%	(0/50)	0%	(0/50)	0%	(0/50)	0%	(0/50)
PE	0%	(0/50)	8%	(4/50)	0%	(0/50)	0%	(0/50)
PF	0%	(0/50)	0%	(0/50)	0%	(0/50)	2%	(1/50)
PG	0%	(0/50)	0%	(0/50)	0%	(0/50)	2%	(1/50)

Catalan

	Tense				Agreement			
	Repetition		Completion		Repetition		Completion	
TA	0%	(0/50)	2%	(1/50)	0%	(0/50)	0%	(0/50)
TB	0%	(0/50)	0%	(0/50)	0%	(0/50)	0%	(0/50)
TC	0%	(0/50)	0%	(0/50)	0%	(0/50)	0%	(0/50)
TD	2%	(1/50)	0%	(0/50)	0%	(0/50)	18%	(9/50)
TE	0%	(0/50)	0%	(0/50)	0%	(0/50)	0%	(0/50)
TF	0%	(0/50)	2%	(1/50)	0%	(0/50)	0%	(0/50)
TG	0%	(0/50)	0%	(0/50)	0%	(0/50)	0%	(0/50)

SUMMARY OF RESULTS – CONTROL GROUPS:

