

# Functional Categories in Agrammatic Speech\*

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## 1 Introduction

The speech of individuals with agrammatism is generally characterized by omission or substitution of grammatical morphemes, a high noun-to-verb ratio and a lack of complex sentence structures. It is generally agreed upon that agrammatic speakers show a highly selective pattern of impairment of functional categories (Arabatzi & Edwards 2000, 2002; Bastiaanse 1995; Bastiaanse & Thompson 2003; Friedman & Grodzinsky 1997; Hagiwara 1995; Lee 2003; Miceli & Caramazza 1988; Thompson, Fix, & Gitelman 2002). For example, Miceli and Caramazza (1988) observed a dissociation between derivational and inflectional morpheme production in the speech of an Italian agrammatic patient, suggesting that different processes are involved in affixation of derivational and inflectional morphology. Bastiaanse (1995) also reported a case study in which a patient with Broca's aphasia shifted her speech spontaneously between two different patterns. In one pattern, the patient showed non-telegraphic speech with mild syntactic errors, while in the other the patient's speech was telegraphic with severe morphological and syntactic errors such as omission of verbs, tense, aspect and agreement markers. Bastiaanse suggested that the underlying deficits can involve both phrase structure and morphosyntactic processes, or solely the former.

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While these selective patterns of deficits have been broadly agreed upon, few theoretical accounts have been put forward to accommodate the patterns. One of the most recent accounts is based on the syntactic tree and its hierarchical branching structure. (Hagiwara 1995; Freidman & Grodzinsky 1997; Freidman 2001, 2002). Based on Japanese, Italian, and French, Hagiwara (1995) presented a syntactic tree structure-based account for the production of functional categories in agrammatic speech. The agrammatic speakers demonstrated more difficulty with structures higher in the tree than those lower in the tree. She suggested that the structures within the Inflectional Phrase (IP) are easier to access than those outside IP. In other words, without successful projection of the IP, material in the Complementizer Phrase (CP), which is located at higher nodes, could not be projected.

Following Hagiwara (1995), Freidman & Grodzinsky (1997) proposed the Tree Pruning Hypothesis (hereafter TPH). Under the TPH, selective patterns of dissociation are attributed to an agrammatic speaker's inability to access higher nodes in the syntactic tree. Specifically, "when a node is impaired, the tree is pruned from this node upward; in other words, when a node is inaccessible, all nodes above it are also inaccessible" (Friedmann 2002: 162). This hypothesis was supported by a Hebrew speaking agrammatic patient, who showed preserved agreement inflection, while tense inflection, use of copula and embedded clauses were impaired (Friedman & Grodzinsky 1997). In Freidmann (2002), *wh*-question and *yes/no* question formation were examined in 13 agrammatic aphasic Hebrew speakers, 2 Palestinian Arabic speakers, and 1 English speaker. It was shown that the highest node of the syntactic tree, which is required for *wh*-questions in Hebrew, Arabic, and English, and for *yes/no* questions in English, was impaired in the agrammatic speakers.

However, there is some cross-linguistic evidence that raises questions about the TPH (Arabatzis & Edwards 2000, 2002; Bastiaanse & Thompson 2003; Lee 2003; Thompson, Fix, & Gitelmann 2002), and alternative accounts have been proposed. In Bastiaanse and Thompson (2003), which is based on English and Dutch data, it was argued that verb movement is a crucial factor in the production deficits in agrammatism, not the position that a structure occupies in the syntactic tree. Nine Dutch agrammatic patients exhibited more difficulty with finite verb production in the matrix clause as compared to the embedded clause, because the former involves movement in Dutch. In English, the six agrammatic patients did not show differences in the production of finite verbs in matrix versus embedded clauses, since in both cases no movement is involved. However, the English patients showed difficulty with auxiliary and verb movement in question formation. Lee (2003), in her case study of a Korean aphasic with agrammatism, examined production of complementizers, mood, and tense, and found that mood is more impaired when it is placed in the embedded clause as compared to the

matrix clause. Lee explained this pattern of impairment in terms of the linear position of a functional element rather than hierarchical order; the nearer the position of a functional element is to the end of the clause the more likely it is to be preserved.

In another study, Arabatzi and Edwards (2000, 2002) examined verb inflection errors in a group of eight English-speaking agrammatic aphasics in both declarative and negative sentences. Various error patterns were observed, including omission and substitution, leading the authors to attribute the patients' deficits to faulty implementation of syntactic processing such as feature checking, not to the "loss" of grammar. Further, their data did not pattern as would be predicted by the TPH. Finally, Thompson et al. (2002) examined production data from an English patient who showed no difficulty producing complex sentential structures. Her free morphology, such as auxiliaries, verbs, and determiners, was intact, while she made errors with affixes. Thompson et al. (2002) explained the dissociation between free and bound morphemes in the context of Distributed Morphology (Halle & Marantz 1993). Their patient showed impaired ability to translate feature information into morphological material, a process that occurs after sentence construction. This account is similar to that of Arabatzi and Edwards (2000, 2002) except that Thompson et al. (2002) considered morphological rule application as a post-structural process, while the former did not make a clear statement about this point. However, both studies raise questions regarding the validity of the TPH, in that CP, the highest structure in the syntactic tree, was relatively unimpaired, while linguistic structures associated with nodes lower in the tree were impaired.

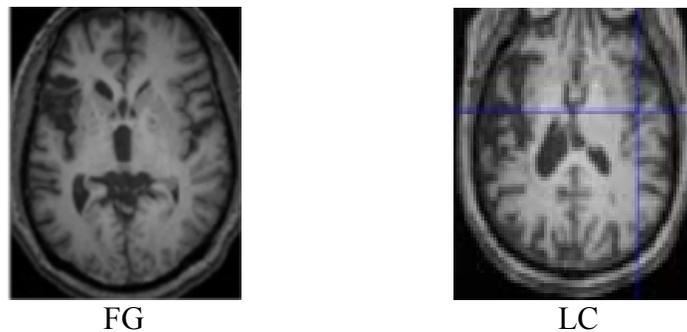
The purpose of this study is a) to examine complementizers, tense, and agreement within the framework of the TPH based on English production data of two agrammatic patients, and b) to propose an alternative hypothesis for their selective deficits of functional categories. Two experiments were carried out. In the first experiment, production of complementizers (*if*, *whether*, and *that*) and verb inflections (*-s* and *-ed*) were elicited. The second experiment examined production of third person singular present (*-s*), present plural (bare verb stem) and past tense (*-ed*) in order to elucidate the patients' ability to distinguish subject and verb agreement in third person singular and plural subjects. The second patient was excluded from the second experiment because he was unable to complete the task.

## 2 Method

### 2.1 Participants

Two male patients with Broca’s aphasia, FG and LC, participated in this study. FG was a 48 year-old Spanish-English bilingual with right-handedness. He suffered a left hemisphere cerebrovascular accident 42 months prior to participation in the study. LC was a 56 year-old English monolingual with right-handedness. He also suffered a left hemisphere cerebrovascular accident that occurred 39 months prior to the study (see Figure 1 showing the participants’ MRI scans). Neither of the participants had experienced language disorders or neurological disorders prior to their stroke. Both had normal hearing and vision. Participants’ demographic data are given in Table 1. The diagnosis of Broca’s aphasia was made based on their performance on the Western Aphasia Battery (Kertesz, 1982).

**Figure 1: Structural MRI images showing participants’ brain lesions.**



**Table 1: Participants’ demographic information**

Participants	FG	LC
Age	48	56
Gender	M	M
Language	Spanish-English bilingual	English monolingual
Education (degree)	M.A.	B.A.
Handedness	Right	Right
Etiology	CVA (stroke)	CVA (stroke)
Post-onset	42 months	39 months
Diagnosis	Mild Broca’s aphasia	Moderate Broca’s aphasia
WAB(AQ)	84.2	66.8
Other disorders	None	None
Hearing/Vision	Normal	Normal

## **2.2 Experiment 1**

### **2.2.1 Stimuli**

In order to examine the production of complementizers and verb inflections, two sets of stimuli were developed. For the complementizer production task, a set of matrix verbs that take CP complements (such as *care*, *ask*, *see*, and *wonder*) and a group of 10 imageable regular transitive verbs for the embedded clauses were selected (see Appendix 1 for a list of the verbs). The verbs were controlled in terms of frequency and word length. Picture stimuli depicting the action of each verb were developed for both the matrix clause and the embedded clause. Target verbs were written on the picture stimuli. A sample set of picture stimuli is provided in Appendix 2. Each embedded action card was used twice, resulting in 20 items in total. The order of presentation of items was randomized.

The stimuli for the second task, verb inflection production, were developed in a similar way. The same ten transitive verbs and pictures were used (see Appendix 1). Instead of using a matrix verb action picture, cue word cards were prepared; *yesterday* was chosen for the past tense (V+*-ed*) and *nowadays* for the present tense (V+*-s*). Each verb was used twice in each tense, resulting in 20 items for each past and present tense. The order of items was randomized. A sample set of stimuli is presented in Appendix 3. A group of normal university students reliably produced target responses for both the complementizer and verb inflection stimuli.

### **2.2.2 Procedure**

#### *Complementizer production task*

In this task, the participants were asked to produce 20 embedded sentences using *if*, *whether*, or *that* when presented with a picture stimulus set. First, the matrix verb was presented and the examiner said, "In this picture, they wonder...." Second, the embedded clause picture was presented and the examiner said "This picture has a man and a woman. The action is *cover*." The relevant nouns (e.g. *the man* and *the woman*) were provided by the examiner in order to eliminate any confounding effect of word retrieval problems in sentence production. After presenting the pictures, the examiner instructed the patient to produce a sentence, saying "Make a sentence using these two cards." The expected target sentence was "They wonder if/whether the man is covering the woman." For each item, 10 seconds was allowed for a response. When the patient did not provide a response within the first 10 seconds, the examiner repeated the above procedure before proceeding to the next item. Throughout the procedure, general encouragement

(e.g. “You are doing fine”) was provided, but no specific feedback as to the accuracy of the responses. Two practice items were provided prior to the task.

#### *Verb inflection production task*

The second task was developed to elicit two verb inflection forms, third person present singular *-s* and past tense *-ed*. Prior to presentation of the stimuli, pre-training of verb production was carried out to verify that the patients could produce all verb stems. A trained examiner presented each verb and named them one by one, and then the patient was asked to name them. If 75 percent of phonemes of a verb were produced correctly by the patient, the examiner advanced to next verb. Otherwise, the patient was corrected and asked to name the verb again. Pre-training of temporal adverbs was also carried out (*yesterday* and *nowadays*). By using a calendar, the patient was asked to point to ‘today,’ ‘yesterday,’ and ‘nowadays.’ This was repeated until the patient showed 100% correct response.

The patient was asked to produce a sentence by using a set of verb inflection stimuli. The examiner first placed a picture card on the table in front of the participant and identified the actors and action by saying “This picture has a man and a woman. The action is *cover*.” Second, the cue word card was presented and the examiner said “This card says *nowadays/yesterday*. Make a sentence with these two cards.” The expected response was “Nowadays the man covers the woman” or “Yesterday the man covered the woman.” The procedure was repeated once if the patient did not provide a response within 10 seconds. Only general feedback was provided. Two practice items were presented before the test stimuli. The order of presentation of all items was counterbalanced for each subject.

### **2.2.3 Data Analysis**

All responses were transcribed on-line. The sessions were also tape-recorded for analysis of inter-rater agreement. Only quantitative analysis was done for complementizer production, but both quantitative and error analyses were conducted for verb inflections. Responses were scored as ‘correct’ if the patient produced a complementizer in the complementizer condition. The appropriate verb inflections, *V+-s* and *V+-ed* for *nowadays* and *yesterday*, respectively, were scored ‘correct’ for the verb inflection condition. Substitution of an incorrect inflectional morpheme, production of a bare verb stem, and unintelligible productions were all scored as ‘incorrect.’ The errors in verb inflections were also analyzed. The errors were categorized into *-s* substitution for *-ed*, *-ed* substitution for *-s*, no inflection, and other, which included unintelligible responses.

## **2.3 Experiment 2**

### **2.3.1 Stimuli**

A set of 30 intransitive and transitive verbs including both 15 regular and 15 irregular verbs were selected (see Appendix 4). The verbs were controlled in terms of frequency and word length. For each item of each inflection category, a picture card was developed. Under the picture of the action, a sentence was written with the verb missing (e.g. *Last week the dog \_\_\_\_\_ the cat.*). Each verb was tested with three inflections, third person singular present tense, present plural, and past tense, making a total of 90 stimuli.

### **2.3.2 Procedure**

A picture stimulus was presented and the subject was asked to complete the sentence by providing the correct form of the verb. A sample set of sentences is exemplified in (1) for the three different verb inflection categories. In third person singular present tense, the obligatory context for the target form was provided by the cue word, *nowadays*, and a third person singular subject (e.g. *the boy*). In the present plural category, the plural subject (e.g. *the boys*) was used without a cue word. The cue word, *last week*, was used with a third person singular subject for the past tense category. A set of practice items preceded the actual production test. During the procedure, only general feedback was given and all the responses were transcribed on-line by both the examiner and the reliability scorer.

- (1) Nowadays the boy \_\_\_\_\_ home. (Third person present singular: *walks*)  
The boys \_\_\_\_\_ home. (Present plural: *walk*)  
Last week the boy \_\_\_\_\_ home. (Past tense: *walked*)

### **2.3.3 Data Analysis**

Each item was scored as ‘correct’ if a correct form of the verb was provided. The number of different morpheme types produced was also analyzed. For example, the number of affixations of the morpheme *-s* were counted across all categories.

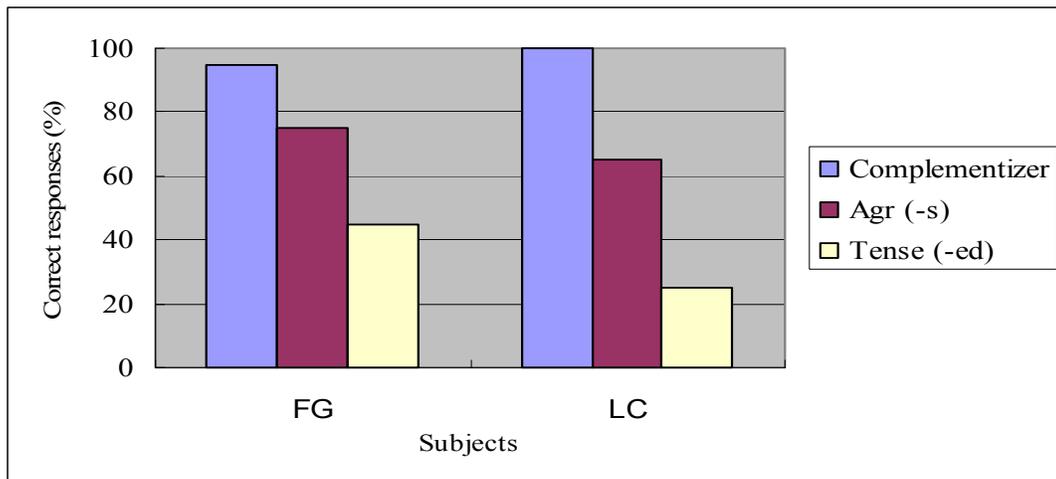
## **3 Results**

### **3.1 Results from Experiment 1**

A total 40 tokens of complementizers and 80 tokens of verb inflections were analyzed. First, both FG and LC showed intact complementizer production, while

their tense and agreement were impaired as shown in Figure 2. Out of 20 items in the complementizer task, FG produced 19 correct responses (95%) and LC produced all of them correctly (100%). Within IP, both patients showed higher scores in agreement than in tense. FG produced 15 correct responses (75%) for agreement while he showed 9 correct responses (45%) for tense out of 20 items for each category. LC showed 13 (65%) and 5 (25%) correct production out of 20 total items for agreement and tense, respectively.

**Figure 2: Production of complementizers and verb inflections (n=20/type)**



The error analysis is presented in Table 2. Two interesting patterns are noticeable here. First, the subjects made more substitution errors than omission errors. Both FG and LC showed high rates of occurrence of verb inflections, although incorrect. FG produced a verb stem in only 2 cases and LC in 4 cases. FG made 13 substitution errors out of a total of 16 (81%), and LC substituted an incorrect morpheme in 16 cases out of a total of 22 errors (72%). The second interesting pattern in the error analysis was that within substitution, *-s* was frequently substituted for *-ed* as in (2). When the two patients made errors in inflection by attaching an incorrect inflectional morpheme, this pattern was dominant; 8 cases out of a total of 16 errors (50%) for FG, and 11 cases out of a total of 22 errors (55%) for LC.

- (2) Yesterday a man calls a woman.  
Yesterday a boy tickle~~s~~ a girl.

The past tense marker *-ed* was substituted for *-s* as exemplified in (3). This pattern of substitution was observed much less frequently. FG made this type of

error in 5 cases out of 16 total errors (31%), and LC had only 1 case out of 22 total errors (4%).

- (3) *Nowadays the child painted the woman.*  
*Nowadays a man saved the woman.*

Other types of errors included variant forms of the verb (e.g. *the action is to cover*), mazes (e.g. *now the hmmm...*), non-sentences (e.g. *the save*) and unintelligible utterances.

**Table 2: Summary of error analysis: the number of errors in four types of errors**

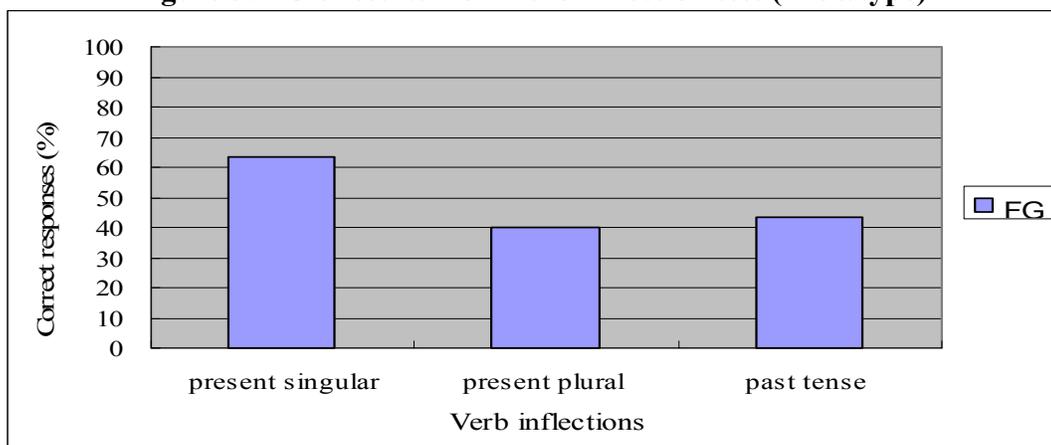
Error types	FG	LC
-s substitution for -ed	8	11
-ed substitution for -s	5	1
no inflection (verb stem)	2	4
others	1	6
total	16	22

To summarize, in experiment 1, FG and LC showed two interesting patterns of impairment. First, both patients showed intact complementizer production, while their agreement and tense were impaired. Second, the error analysis shows that significantly more substitution occurred than omission of an inflectional marker, and this substitution was dominated by -s rather than -ed.

### 3.2 Results from Experiment 2

In the second experiment, a total of 90 tokens of items were analyzed (30 tokens for each category). FG's rates of correct responses for the three forms of verb inflection are given in Figure 3. He produced 19 correct responses out of 30 in third person present singular -s (63%), 12 in present plural (40%) and 13 in past tense -ed (43%). Based on only these percentile results, FG appeared to perform slightly better in present singular than the other two.

**Figure 3: FG's results from verb inflection test (n=30/type)**



Again, as in experiment 1, a qualitative analysis of FG's verb inflections was done. For each item, the inflectional morpheme type produced was counted in terms of *-s*, *-ed*, verb stem, and other inflectional markers such as *-ing* and *-en*. The results are provided in Table 3 below.

**Table 3: Morpheme type analysis in FG's verb inflections**

Types of responses	Present singular	Present plural	Past tense
V+ <i>-s</i>	19*	9	13
V+ <i>-ed</i>	4	6	13* <sup>1</sup>
Verb stem	2	12*	2
Other inflections	5	3	2
Total	30	30	30

Note: \* indicates correct forms of inflections

The data show two noticeable patterns in the use of inflectional markers by FG. First, he overused *-s* across all three categories. He used *-s* in 19 cases out of 30 (63%) in present singular, resulting in 19 correct responses. The V+*-s* form occurred in 9 cases (30%) in present plural, where a bare stem is required, and in 13 cases (43%) in past tense, where either a regular past tense form (V+*-ed*) or an irregular past tense form is required. Second, he rarely produced a bare stem when

<sup>1</sup>The 13 correct responses included five correct past tense forms for 15 irregular verbs (e.g. *rode*, *slept*, *blew*, *sat*, and *swung*). For the other 10 irregular verbs, FG produced various incorrect responses.

an inflected form was required. While he produced 12 bare stems in the present plural category, he produced only two bare stems for each of the other categories.

In sum, the second experiment with FG showed that he overused the *-s* morpheme across all the contexts.

## **4 Discussion**

This section examines whether or not the data from the above two experiments can be explained within the framework of the TPH. We conclude that it cannot, and propose an alternative account for the findings.

Under the TPH, when it comes to the selective deficits of complementizers, agreement, and tense, predictions are made as follows: first, the highest node, CP, is always impaired to some degree. Second, material at higher nodes should be more impaired than material at lower nodes, but not vice versa. For example, CP should be more impaired than IP (where IP includes both tense and agreement), and within IP, tense should be more impaired than agreement, since tense is placed at a higher node than agreement according to the syntactic tree of the TPH (Freidman & Grodzinsky 1997). Hence, an agrammatic patient would produce those three categories in the order of CP, tense, and agreement, from the most impaired to the least impaired.

The TPH's prediction of CP being more impaired than IP is not borne out in our data. Neither FG or LC exhibited any difficulty projecting CP, the uppermost node of the syntactic tree, but material within IP was impaired. These data indicate that the hierarchical position of the syntactic tree is not a crucial factor in agrammatic speech. While both FG and LC produced almost perfect embedded sentences, their verb inflections within IP were disturbed. Although there was variation between agreement and tense, that is, both patients performed slightly better in agreement than in tense, the TPH's prediction of IP being less impaired than CP is not supported by our data. This pattern of deficits reversed from that predicted by the TPH was also reported in Arabatzi & Edwards (2000) and Thompson et al. (2002). Both studies reported that material within IP was affected while CP was preserved in the speech of their agrammatic patients. In Arabatzi & Edwards (2000), it was shown that elements in the IP (e.g. tense markers and auxiliaries) were omitted more frequently than *wh*-words in CP. Thompson et al. (2002) showed that while their patient's production of embedded structures was preserved, various levels of impairment occurred with elements within IP.

While the TPH's prediction for CP and IP is not borne out in our data, what about the structures within IP? Is agreement less impaired than tense? Based on both patients' higher score in agreement and more frequent substitution of *-s* for *-ed*, the TPH could be supported within IP because our patients' agreement

seemed to be more intact than tense. However, FG's production patterns in the second experiment suggest that agreement was impaired as well. First of all, FG overused *-s* for every category in experiment 2. He used *-s* in 19 cases, 9 cases, and 13 cases for present singular, present plural, and past tense, respectively. This may explain the higher scores for agreement in comparison to tense as found in experiment 1. That is, his overuse of *-s* may have inflated his agreement data. Furthermore, FG's frequent use of *-s* in present plural tense further supports the conclusion that his agreement was impaired. As pointed out earlier, FG affixed *-s* to verb stems of 9 items in the present plural tense category where the target form was a verb stem, indicating that FG did not have knowledge that *-s* marks that the subject is third person singular, distinguishing it from the plural subject. We would need LC's data in the verb inflection task in order to determine if his agreement was impaired as well.

Regardless of the question whether or not agreement is less impaired than tense, one problem with the syntactic tree-based account of the TPH concerns the lack of agreement on the ordering of nodes within IP. Although in the TPH, the agreement phrase is placed below tense phrase following Pollock's (1989) split IP hypothesis, different structures have also been proposed in recent literature within the GB/Principles and Parameters framework. With regard to the subject agreement phrase and tense phrase in English, two general assumptions have been agreed upon: either the subject agreement phrase dominates tense phrase, or subject agreement is not associated with a separate projection but a feature checked on tense under I (Infl). For example, as illustrated in Thompson et al. (2002), both Ouhalla (1990) and Chomsky (1993) placed the subject agreement phrase above tense phrase. Chomsky (1993, as cited in Thompson et al., 2002) further differentiated the subject agreement phrase (AgrSP) from the object agreement phrase (AgrOP), placing tense lower than subject agreement and higher than object agreement, while Ouhalla (1990, as cited in Thompson et al. 2002) suggested a common agreement phrase to be placed above tense phrase. On the other hand, Bobaljik and Thrainsson (1998) argued that English has an unsplit IP, according to which agreement and tense phrases are collected under I (Infl). Therefore agreement is not separately projected but checked on tense concurrently. At first glance, impairment of both agreement and tense found in the present study seems to support Bobaljik and Thrainsson (1998). However, this conclusion awaits further analysis of the relation between tense and agreement errors. Nevertheless, the lack of agreement regarding the IP structure in English makes it difficult to know what predictions the syntactic tree-based account makes for agrammatism.

The next question to be raised is how the observed selective deficits in the speech of our patients can be explained. We propose that it is the implementation of morphological rules (e.g. verb inflection) that is impaired, as suggested by

Arabatzi & Edwards (2000, 2002) and Thompson et al. (2002), not the loss of certain structure in the syntactic tree. Quantitative analysis of the data showed that functional categories, including complementizers, *-s* and *-ed*, were all present in the speech of our patients. Neither FG nor LC showed complete absence of any item; they used at least one of the three grammatical categories. The error analysis of the two experiments further showed that a) affixation per se is intact and inflectional rules are present, but b) the patients were unable to apply rules correctly, resulting in faulty selection of an inflectional morpheme. In the first experiment, error analysis showed that both FG and LC made more substitution than omission errors, indicating that the patients are sensitive to inflectional rules, and their processing of affixation is not impaired. FG's error analysis in the second experiment showed a similar pattern; his errors were dominated by substitution and he rarely produced bare stems when an inflected form of a verb was required. These findings suggest deficits in selection of the correct inflectional marker.

Several issues, however, remain for further investigation. First of all, LC's data from experiment 2 should be examined in order to untangle the relationship between tense and agreement found in experiment 1. These data would clarify whether or not his higher score in agreement *-s* was simply due to faulty implementation of inflectional rules as in the case of FG. Another interesting question to be further studied pertains to why tense and agreement appear to be easily affected in agrammatic speech. This question could be explored in two ways. First, a thorough examination of various verb inflections, such as present progressive, future tense, and present perfect should be undertaken. Secondly, the patterns found in our study could also be English-specific since *-s* marks both tense and agreement. Therefore, looking at FG's verb inflections in Spanish, which unlike English more clearly distinguishes agreement and tense morphology, will help to clarify the relation between the two inflections.

## **5 Conclusion**

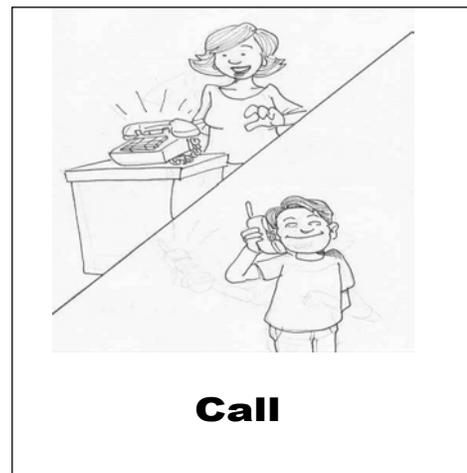
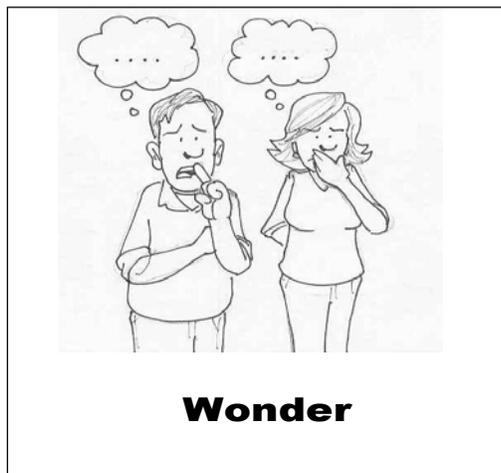
This study investigated three functional categories in terms of their hierarchical positions in the syntactic tree. Production of complementizers (*if*, *whether*, and *that*), tense (*-ed*) and agreement (*-s*) was examined in two English-speaking agrammatic patients. Results showed that a) the TPH, a "truncated" tree, is not supported, but rather b) faulty implementation of morphological rules may underlie the impairment pattern of our patients, based on the fact that both tense and agreement were impaired while complementizers were preserved. Error analyses indicated that the patients were aware of when to apply inflectional rules but had difficulty selecting the appropriate morphemes.

## Appendices

### Appendix 1. List of verbs for experiment 1

Call  
Cover  
Crown  
Follow  
Paint  
Pull  
Save  
Shave  
Tickle  
Weigh

### Appendix 2. A set of picture stimuli for the complementizer production task



Target: They wonder *if* ( *whether* or *that* ) the man is calling the woman

**Appendix 3. A set of picture stimuli for the verb inflection task**

**Yesterday**

**Nowadays**



Target: Yesterday the man *called* the woman.  
Nowadays the man *calls* the woman.

**Appendix 4: List of verbs used in the verb inflection task**

Bathe	Iron	Saw
Blow	Kiss	Sew
Catch	Milk	Shove
Climb	Mow	Sleep
Cook	Polish	Smoke
Dive	Read	Swim
Drink	Ride	Swing
Dug	Row	Toss
Eat	Run	Walk
Film	Sit	Write

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