

THE REPRESENTATION OF CP IN AGRAMMATISM: HIERARCHICAL DEFICIT OF SEVERITY

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1 INTRODUCTION

The representation of the Complementizer Phase (CP) layer is a controversial issue in the study of language deficits in agrammatic aphasia. The debate has centered on the question of whether or not the grammar of agrammatic patients contains a full set of functional categories, in particular structurally high categories like the CP layer.

Damage to Broca's area, the left anterior cortical region of the brain, causes a disturbance to the comprehension and production of language, known as agrammatism. The speech production of agrammatic Broca's aphasia is characterized by the omission of function words and by a reduction of sentence length and complexity. To explain these characteristic impairments, researchers argue that agrammatic aphasia causes a deficit of phrase structure representation, as the nodes that head functional projections (e.g. CP) are impaired and thus, inaccessible (De Bleser & Bayer, 1991; Ouhalla, 1993). Earlier work on agrammatism took the position that all functional elements are equally impaired in agrammatic speech (Goodglass, 1976; Grodzinsky, 1984). In contrast, evidence from a number of recent studies (Friedmann & Grodzinsky, 1997; Hagiwara, 1995; Lee, 2002; Platzak, 2001) suggests that the deficit is hierarchically selective, affecting functional projections depending on their structural position (from high to low) in the syntactic tree.

In order to account for the selective hierarchical deficit of agrammatic speech, Friedmann (1994) proposed the syntactic-based Tree-Pruning Hypothesis (TPH). In this approach, the impairment of the functional category is defined in terms of its hierarchical position in syntactic tree. Based on the finding that verbal tense, but not agreement is impaired in the speech of a Hebrew-speaking agrammatic patient, the TPH proposes that aphasics produce intact syntactic trees up to the tense node (T) and are pruned from this node up. Therefore, agrammatic patients cannot produce functional categories which are dependent on nodes higher than T (e.g. CP).

Along the same lines, findings of Hagiwara (1995) indicate that the hierarchical site of the deficit varies in accordance with the degree of severity, suggesting that the site of the dissociation is not consistently located at the Tense node. She predicts that the higher a functional node is in the syntactic representation, the more susceptible it is to impairment. Thus, the CP node is the most susceptible to be impaired, as it is the highest functional node.

A study by Friedmann and Grodzinsky (1997) on the use of tense and agreement use of Hebrew- and Palastinian Arabic-speakers confirmed that the severity of the agrammatic impairment affects the hierarchical site of the impairment and the number of nodes that are impaired. They discovered that in severe agrammatism, the syntactic tree is pruned at a lower node (e.g., Agr), thus impairing all higher nodes including: the AgrP, TP and CP layers. In milder cases, the impairment occurred at a higher node (e.g., C), only affecting the CP layer including C and spec-CP. In order to account for this individual discrepancy they proposed a revised TPH in (1).

- (1) The Tree Pruning Hypothesis (Friedmann & Grodzinsky, 1997, p. 420)
 - (a) C, T, or Agr is underspecified in agrammatism
 - (b) An underspecified node cannot project any higher.

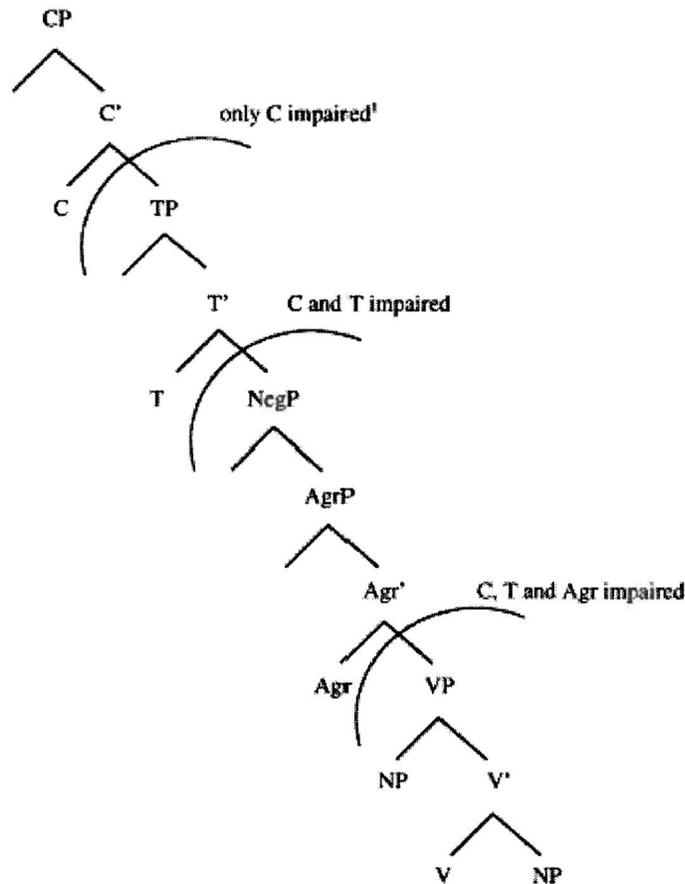


Figure 1 Degrees of severity in agrammatical impairment determined by pruning location (Friedmann & Grodzinsky, 1997, p. 421). The arch represents the site of the deficit.

According to the TPH, agrammatical patients cannot construct projections of the syntactic tree which are higher than an impaired node, as shown in Fig. 1. Moreover, the extent to which functional categories and their projections are lost depends on the severity of the impairment. Friedmann maintains the strong claim that the impairment always involves a loss of the CP layer. Consequently, any element base-generated in CP (e.g., complementizer), structure requiring CP (e.g., subordinate clause introduced by a complementizer), or element moved to spec-CP (e.g., wh-question word) is inaccessible and cannot be produced by agrammatical patients.

In support of this claim, Friedmann (2002) recently reported that Hebrew- and Arabic-speaking agrammaticals encounter severe difficulties in wh-question production. However, they retain the ability to produce yes-no questions, which in these languages differ from declarative sentences in intonation only and therefore do not require movement of the verb beyond the tense node. In a group of English-speaking patients, this dissociation was not observed, as both wh- and yes-no questions were severely impaired. This is understandable in terms of the tree-pruning hypothesis, as yes-no questions in English require movement, either in the form of *do*-support, or in the form of subject/auxiliary inversion. The loss of structures requiring CP in agrammatism has been reported in a number of empirical studies. Several other researchers have shown that production of wh-questions is severely impaired or absent in agrammatical speech (De Roo, 1999; Friedmann, 2002; Goodglass, 1976; Thompson & Shapiro, 1995).

An inability to project the CP layer and to perform syntactic operations depending on COMP or spec-CP must also affect subordinate clauses. If the CP layer can no longer be projected, because the tree is pruned, the agrammatical production should not contain subordinate clauses introduced by a complementizer, since complementizers are base-generated in COMP. The lack of embedded clauses in agrammatical speech has been

reported in numerous studies (Gleason et al., 1980; De Roo, 1999; Thompson, Shapiro, Tait, Jacobs, & Schneider, 1996)

The goal of this paper is to examine cross-linguistic data from the spontaneous speech of six agrammatic patients (two English-speaking, two French-speaking, and two Italian-speaking) to further investigate representation of CP in agrammatic production. Furthermore, I will test the validity of the TPH, focusing on three main issues: (1) the hierarchical impairment of functional categories, (2) the level of the pruning site in relationship to the severity of agrammatism, and (3) the complete impairment of the CP layer. The primary analysis will focus on the production of subordinate clauses introduced by a complementizer requiring the CP layer and coordinate clauses that are introduced by a conjunction not requiring the CP layer. The secondary analysis will examine the further implication that members of the CP layer are subject to the same degree of impairment. In this light, I will note whether there is equal disruption to all elements in the CP layer by observing the production of wh-question words that move into spec-CP.

2 METHOD

2.1 Data

The data used in this investigation was taken from Menn and Obler (1990), a large cross-linguistic narrative sourcebook of agrammatic aphasia, which includes transcribed spontaneous speech of patients from 14 different languages. The data was collected during an interview with a speech therapist where the patients were asked to perform a communicative task including: discussing the history of their illness, telling a well-known folktale (e.g., Little Red Riding Hood), or describing a complex picture series. Additionally, for each language, two non-aphasic controls matched for language, sex, age, education and literacy were recorded in the same situations. Data gathered for this study included: coordinate clauses which did not require the CP layer and subordinate clauses and wh-questions requiring the CP layer. The number and rate of grammatically correct formations was measured and analyzed.

2.2 Subjects

The transcripts of six agrammatic patients and six matching controls were examined: four native speakers of English (Menn, 1990), four native speakers of French (Nespoulous et al., 1990), and four native speakers of Italian (Miceli & Mazzucchi, 1990) were observed. (See Table 1 for background information of each subject). All patients displayed characteristic agrammatic speech production according to the criteria outlined by Menn and Obler (1990, p. 14): omission of function words and reduction of syntactic complexity.

TABLE 1
Background Information on Subjects

Subject	Severity of Condition	Age	Gender	Language	Literacy	Education (years)
Agrammatics						
ME	severe	56	M	English	high	14
MF	mild	49	M	English	adequate	16
MC	moderate	59	M	French	high	15
MA	mild	30	F	French	minimal	10
MV	moderate	20	M	Italian	high	18
MR	mild	44	M	Italian	high	16
Controls						
MS		51	M	English	high	15
MW		57	M	English	adequate	18
MFT		56	M	French	high	15
MP		23	F	French	adequate	11
MN		25	M	Italian	high	16
MB		40	M	Italian	high	16

2.3 Transcription Style

Since the speech of agrammatic patients is non-fluent and contains numerous errors the transcription style was reworked as follows (Menn & Obler, 1990, p.18):

line 1, patient's morphemes Le loup demande au [PCR] ou elle va.
 line 2, morphemic translation DET.M/SG wolf asks of&the [LRRH] where she goes.
 line 3, English equivalent of line 2 The wolf asks [LRRH] where she's going.

As an additional note, the inconsistent style of the morphemic translation in this paper follows the variation chosen by different authors in the narrative sourcebook. The English samples did not include line 2 or 3. PCR (French) and LRRH (English) stand for 'Little Red Riding Hood'.

3 RESULTS

The analysis of the spontaneous speech of the six agrammatic subjects is reported in Table 2. Columns 1 to 4 present the data on number of utterance, subordinate clauses, coordinate clauses and wh-questions for the six agrammatic subjects.

TABLE 2
 Subordinate Clauses vs. Coordinate Clauses in Spontaneous Speech:
 Number and Grammaticality Rate

Patient	Severity of condition	Number of	Grammatical/Total	Grammatical/Total	Grammatical/Total
		utterances	Subordinate Clause	Coordinate Clauses	Wh-questions
		1	2	3	4
English-speaking patients					
ME	severe	260	0/2	10/10	0/0
MF	mild	400	1/2	6/7	3/3
French-speaking patients					
MC	moderate	730	0/2	26/28	0/0
MA	mild	633	3/4	28/29	1/2
Italian-speaking patients					
MV	moderate	510	0/3	15/15	0/0
MR	mild	873	5/7	15/15	1/1
Total (%)		3406	9/20 (45%)	100/103 (98%)	5/6 (83%)

3.1 Subordinate clause production

The results show that subordinate production that required the CP layer is severely impaired as only 9 grammatically correct subordinate clauses were produced out of 20 attempts (column 2). The accuracy rate was also quite low, at only 45%. Select examples of incorrect subordinate clauses are reproduced below:

(1) Trova [che] non c'è il pollo {MV}
 Finds.3.SG not there+is DET.M/SG chicken
 Finds [that] the chicken isn't there (Miceli & Mazzucchi, 1990, p. 774)

(2) [II] y a une petite fille qui... {MA}
 There is a little.F girl COMP
 There is a little girl who... (Nespoulous et al., 1990, p. 679)

In contrast, the production of coordinate clauses which do not require the CP layer is unimpaired. The agrammatic patients produced 100 grammatically correct coordinate clauses, with an accuracy rate of 98%, as seen

in column 3. Select examples of correct coordinate clauses reproduced below in (3) to (5) show that the agrammatic patients have no difficulty creating a clause that does not require structurally high nodes:

(3) the farmer is driving the truck and carry[ing] [the] corn {MF} (Menn, 1990, p. 159)

(4) jambes et les bras surtout {MC}
 legs CONJ DET.M/PL arms especially
 legs and my arms especially (Nespoulous et al., 1990, p. 676)

(5) l' acqua scorre e va per {MV}
 DET.FEM/SG water runs CONJ goes to
 the water is overflowing and going to (Miceli & Mazzucchi, 1990, p. 770)

The subordination deficit shown in (1) & (2) is emphasized in Table 3, where the number of grammatically correct subordinate clauses in the agrammatic subjects' speech is compared to that of the controls. First, the contrast in the production of subordinate clauses is striking between the controls (138) and the agrammatic subjects (9). Secondly, the controls' production rate of both clauses was relatively close, producing 138 subordinate clauses and 172 coordinate clauses, while the agrammatic subjects' production rate of both clauses was severely contrasting, producing 9 subordinate clauses and 100 coordinate clauses. Since subordination involves using the nodes higher than T (specifically the C node), the patient's inability to subordinate is an important indicator that the CP layer is impaired.

TABLE 3
 Agrammatic Subjects vs. Control:
 Number and Grammaticality Rate of Subordinate Clauses requiring CP

Subjects ¹	Grammatical/Total Subordinate Clauses 1	Grammatical/Total Coordinate Clauses 2
Agrammatics		
Total (%)	9/20 (45%)	100/103 (98%)
Controls		
Total	138/138 (100%)	172/174 (99%)

The two error types produced by the agrammatic subjects were: (1) complementizer omission (c.f. (6), (8), (10) and (11)) and (2) false starts ending with the complementizer with no following subordinate clause (c.f. (7) and (9)). Examples of ungrammatical subordinate clauses for each of the six agrammatic patients are seen below in (6) to (11).

(6) [She] forgot [that] [she] [was] the wash the dishes {ME}
 forgot DET wash DET dishes
 forgot the wash...the dishes (Menn, 1990, p. 171)

(7) The wolf told her that... {MF}
 DET wolf told her COMP
 The wolf told her that... (Menn, 1990, p. 182)

(8) Le paysan attend [qu'] le posse {MC}
 DET.M/SG farmer wait.PRES [that] the:PRO/DET grow.PRES
 The farmer is waiting it/the grows (Nespoulous et al., 1990, p. 708)

(9) [Il] y a une femme qui... {MA}
 There is a woman COMP
 There is a woman who... (Nespoulous et al., 1990, p. 679)

(10) non s'é accorta [che] l' acqua scorre {MV}
 not herself+is aware.F/SG DET.FEM/SG water runs

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she doesn't notice [that] the water is overflowing (Miceli & Mazzucchi, 1990, p. 770)

- (11) [sono] meravigliati [che] la le la cesta non [che] il pollo {MR}
 astonished.M/PL DET.F/M/F basket not DE.M/SG chicken
 [are] astonished [that] the, the the basket doesn't [that] the chicken
 (Miceli & Mazzucchi, 1990, p. 806)

In the above examples, the agrammatic patients are unable to produce a grammatically correct subordinate clause. In their attempt to create a subordinate construction they omit the element that requires the CP layer, the complementizer, or produce an incomplete clause, halting abruptly after the complementizer. These types of errors support the hierarchical nature of agrammatic impairments as they illustrate the fact that the lexical knowledge of the complementizer 'that' is intact (c.f. (5) and (7)), but somehow the syntactic knowledge of the COMP projection is impaired.

Additional evidence for the hierarchical impairment of agrammatism is found in following examples:

- (12) I can't speak, my right side was limp and I was crying, it's just foolish, y'know. {MF}
 (Menn, 1990, p. 156)
- (13) Le PCR [lui] donne le panier avec les friandes et entretient avec la grandmère {MA}
 The RRH [him] gives the basket with the goodies and converses with the grandmother
 LRRH gives the basket with the goodies and converses with the grandmother.
 (Nespoulous et al., 1990, p. 681)
- (14) Questo è il problema, perché ho 180[di] minima {MV}
 This.M/SG is DET.M/SG problem because I have 180 minimal
 This is the problem, because I have 180 minimal
 (Miceli & Mazzucchi, 1990, p. 796)

From these examples, it can be noted that the selective impairment of agrammatic speech is not linked to length or complexity of sentence (c.f. (12) & (13)). Additionally, the pragmatic knowledge of subordination must be unaffected as five subordinate clauses without a complementizer were produced by the Italian agrammatic subject MV (c.f. (14)). In these cases the subordinate clauses were introduced by the clausal subordinator, 'perché' (because).

The results up to this point have focused on the production impairment and subsequent error types of subordination requiring the CP layer in all agrammatic subjects. In the next section, I will show the performance of individual subjects with different degrees of agrammatism, from mild to severe (see Table 4 on page 8).

TABLE 4
 Severity of Agrammatic Condition: Number and Grammaticality Rate
 of Subordinate and Coordinate Clauses

Subjects	Language	Grammatical/Total Subordinate Clauses 1	Grammatical/Total Coordinate Clauses 2
Moderate/Severe			
ME	English	0/2	10/10
MC	French	0/2	26/28
MV	Italian	0/3	15/15
Total (%)		0/7 (0%)	49/50 (98%)
Mild			
MF	English	1/2	6/7
MA	French	3/4	28/29
MR	Italian	5/7	15/15
Total (%)		9/13 (69%)	51/53 (96%)

As shown in column 2 above, the severity of the agrammatism does not affect the production of coordinate clauses. In contrast, when looking at the production of subordinate clauses by each subject in column 1 above, two grades of impairment emerge. One grade of impairment, which is manifested by the moderate to severe patients, is that of complete impairment to embedded clauses requiring CP (0/7). The milder patients show a different grade of impairment, as they were able to produce 9/13 correct embedded complementizer clauses. However, the number of correct subordinate clauses produced by the mild agrammatic subjects is still a deficit from normal production, as their matched controls produced 37/37 subordinate clauses. These results show that although mild agrammatic patients have difficulty accessing the C° projection, they are still able to produce structures in their spontaneous speech that require the CP layer in their spontaneous speech. Samples of correct subordinate clause formations are reproduced below in (15) and (16):

(15) un chasseur je crois qui est venu {MA}
 a hunter I believe COMP be.AUX.PERF come.PAST.PART
 A hunter, I believe, who came (Nespoulous et al., 1990, p. 704)

(16) was surprise—surprised—to—to... that [the] basket was open {MF}
 (Menn, 1990, p. 160)

The mild English-speaking agrammatic subject has large difficulties producing a subordinate clause (c.f. (16)). First, he attempts to create an infinitival construction, breaking off in mid-clause to create the subordinate construction ‘that [the] basket was open’. Though the final embedded construction is correct, it is by no means a simple task for this subject, which suggests that there is still some impairment to the C° projection.

3.2 Wh-Question Production

In order to identify whether any of the agrammatic subjects could access the highest projection of CP, spec-CP, the production of wh-questions is considered in section 3.2. Only the mild agrammatic patients, MF, MA and MR produced question formations in their spontaneous speech. The production of subordinate clauses and wh-questions in the speech of these three subjects is reported in Table 5.

TABLE 5
 Wh Questions and Subordinate Clauses in Spontaneous Speech: Number and Grammaticality Rate

Subject	Language	Grammatical/Total Wh questions	Grammatical/Total Subordinate Clauses
MF	English	3/3	1/2
MA	French	1/2	3/4
MR	Italian	1/1	5/7
Total		5/6 (83%)	9/13 (69%)

Though only six wh-questions were attempted in the mild agrammatic subjects’ narratives, five wh-questions were grammatically correct. The examples of correct and incorrect are provided below:

(17) Qu’est-ce que c’est? {MA}
 What is it? (Nespoulous et al., 1990, p. 706)

(18) [comment] on appelle ça?
 [how] they call that?
 is it called? (Nespoulous et al., 1990, p. 706)

(19) What’s wrong? {MF} (Menn, 1990, p. 174)

(20) What d’ya know? (Menn, 1990, p. 173)

(21) Where you—where does your mother, uh /b/ranmother live, LRRH,--Hood? (Menn, 1990, p. 176)

(22) Come stai? {MR}

Two subjects, MA and MR each produced one correct wh-question (c.f. (17) & (22)). The incorrect question by MA in (18) lacks a wh-word in spec-CP. MF shows difficulty in the production of the question in (21), but creates correct questions in all three attempts. The finding that MF produced 3/3 correct wh-questions suggests that this mild agrammatic subject can access the highest CP projection, spec-CP. This is a surprising result, as his production of subordinate clauses requiring a lower CP projection C° showed the greatest impairment of all the mild agrammatic subjects (1/2). It is important to note that there is a strong possibility that all correct questions produced by these subjects (c.f. (17), (19), (20) and (22)) are formulaic questions which do not involve movement of the wh-word into spec-CP. This may explain why the subjects were able to produce these questions.

To summarize, the four main findings in this paper are as follows:

(1) Agrammatic subjects produce significantly less subordinate clauses requiring CP than control subjects; (2) The impairment of subordinate clauses is greater in moderate and severe agrammatic subjects; (3) There is no significant difference in the production of coordinate clauses between the agrammatic subjects and the control subjects; (3) The severity of agrammatism affects the production impairment of complementizers, not coordinate conjunctions.

4 DISCUSSION

The goal of this paper was to further investigate the validity of Friedmann's TPH focusing on three controversial issues in the study of the selective language deficits in agrammatism: (1) The impairment of functional categories is hierarchical, affecting functional categories from high to low in the syntactic tree; (2) The degree of severity affects the structural level of the syntactic pruning (3) The CP layer is inaccessible in agrammatism, therefore all projections of CP including, C° and spec-CP are equally impaired.

The results presented in this paper support the claim that the impairment of functional categories in agrammatism is hierarchical. The results clearly demonstrated that structures requiring CP, (e.g., subordinate clauses) and elements base-generated in CP, (e.g., complementizers) are severely impaired in agrammatic production. This main claim of the TPH predicted by the pruning site of the syntactic tree is supported in this investigation and in numerous studies on many languages including, Hebrew and Palestinian Arabic (Friedmann & Grodzinsky, 1997), Japanese (Hagiwara, 1995), Swedish (Platzak, 2001) and Finnish (Neimi et al., 1990). Additionally, several of these studies reported that the severity of the agrammatic impairment affected the structural level of the tree pruning (Friedmann & Grodzinsky, 1997; Hagiwara, 1995).

In this paper, the number of grammatically correct structures and attempts at structures requiring the CP layer varied in accordance with the degree of severity of the agrammatism. The ability to correctly produce subordination and wh-question formation was restricted to mild agrammatic subjects. These subjects appeared to be able to access the CP layer, and produce a limited amount of CP productions. Other researchers have reported similar findings (Hagiwara, 1995; Lee, 2003). To account for such findings, Hagiwara (1995) proposed that the underlying impairment of agrammatism is not a structural syntactic deficit, but rather a deficiency of resources necessary to construct a full syntactic tree. Following Chomsky's (1995) Minimalist Program as the theoretical basis, Hagiwara suggests that each application of the Merge operation requires a certain amount of resources. Because more combination operations are required for building structures with higher functional projections, these will be less likely to be successfully constructed than structures with only lower functional projections. Additionally, the tree structure of higher elements which undergo movement, such as wh-question words, requires even more resources to produce. This may explain why agrammatic patients frequently produce partial syntactic representation, as they are unable to apply Merge the required number of times. The Hierarchical Complexity Hypothesis, a recent proposal by Izvorski and Ullman (1999), follows along the same lines as Hagiwara. This hypothesis predicts that because the deficit affects the likelihood of successful combination of Merge operations, the resulting impairment will not be all-or-nothing, but graded between different functional categories and members of the same functional category.

Friedmann's implication that the CP layer is always impaired in the production of agrammatic speech due to the pruning of the tree below CP is partially supported in this paper. The majority of the findings presented here showed that both the C° projection and the spec-CP are impaired in agrammatic speech. These findings can be accounted for by the TPH. In contrast, the TPH cannot account for the finding that one mild agrammatic patient

suffered greater impairment to the C° projection than the spec-CP projection. This finding suggests that a higher projection in the CP layer, spec-CP, is preserved and can be produced in spontaneous speech, even when a lower projection, such as C° is impaired. In this case, the tree cannot be pruned at C as the TPH claims because the CP layer is not entirely impaired. Furthermore, this shows that there may be dissociation between members of the same functional category CP.

These results are similar to observed dissociations among tense and agreement, elements belonging to the same IP layer reported by Friedmann and Grodzinsky (1997). In order to account for the finding that tense, but not agreement, was impaired in agrammatic speech, they incorporated Pollack's (1989) Split IP structure into the TPH (c.f. Fig. 1). This structure allowed for the pruning of the tree at T, thus impairing T, but not Agr. It is possible then, that the results presented in this paper may be better captured with Rizzi's (1997) Split CP analysis. In Rizzi's proposal, CP is not a single projection but a left-periphery of the clause. Rizzi's analysis displays a more elaborated CP structure including: ForceP – TopP – FocP – FinP – AgrOP – VP (De Roo, 2003). In this proposed structure, the complementizer 'that' and wh-morphemes are located in the different nodes. The complementizer 'that' is located the highest node, ForceP, while wh-elements in main questions move into spec-Foc of the FocP. This interpretation would allow the impairment of both elements without compromising the hierarchy of these elements in the Minimalist CP node. Moreover, this account would not compromise the TPH, as the pruning of the tree in mild agrammatism could occur at ForceP, only impairing elements in ForceP (e.g., complementizers) and not wh-morphemes in main questions. Recent research by De Roo (2003) on the status of topicalization and sentence embedding in Dutch agrammatic speech has yielded positive findings for a Split CP analysis of CP deficits in agrammatic speech.

5 CONCLUSION

This study presents data on the representation of CP by six agrammatic subjects from three languages. The findings show a selective impairment to elements base-generated and structures requiring CP. This result is in accordance with previous observations that functional categories are not equally impaired in agrammatic production, but rather impaired based on their structural location in the hierarchy of the syntactic tree. Two important findings presented in this paper partially contradict the prediction of the TPH that the CP layer is inaccessible in agrammatism: (1) Mild agrammatic subjects were able to produce nine correct subordinate clauses and five correct wh-questions; (2) A dissociation between members of the functional category CP (i.e., C° in subordinate clauses and spec-CP in wh-question formation) was found in the spontaneous speech of one mild agrammatic subject. It is proposed that the application of Rizzi's (1997) Split CP to the TPH may solve these noted discrepancies. To confirm the validity of this suggestion, further cross-linguistic studies on Split CP in agrammatism are necessary.

REFERENCES

- Bleser, R. de., & Bayer, J. (1991). On the role of inflectional morphology in agrammatism. In M. Hammond (Ed.), *Theoretical morphology* (pp. 45–69). San Diego: Academic Press.
- Chomsky, N. (1995). *The minimalist program*. Cambridge, MA: The MIT Press.
- Friedmann, N. (1994). *Morphology in agrammatism: A dissociation between tense and agreement*. M.A. Thesis, Tel Aviv University.
- Friedmann, N. (2002). Question production in agrammatism: The tree pruning hypothesis. *Brain and Language*, 30, 160-187.
- Friedmann, N., & Grodzinsky, Y. (1997). Tense and agreement in agrammatic production: Pruning the syntactic tree. *Brain and Language*, 56, 397-425.
- Gleason, J. B., Goodglass, H., Opler, L., Green, E., Hyde, M. R., & Weintraub, S. (1980). Narrative strategies of aphasic and normal-speaking subjects. *Journal of Speech and Hearing Research*, 23, 370–382.
- Goodglass, H. (1976). Agrammatism. In H. Whitaker, & H.A. Whitaker (Eds.), *Studies in*

- Neurolinguistics*, (pp. 237-260). New York, NY: Academic Press.
- Grodzinsky, Y. (1984). The syntactic characterization of agrammatism. *Cognition*, 1, 99-120.
- Hagiwara, H. (1995). The breakdown of functional categories and the economy of derivation. *Brain and Language*, 50, 92-116.
- Izvorski, R., & Ullman, M. T. (1999). Verb inflection and the hierarchy of functional categories in agrammatic anterior aphasia. *Brain and Language*, 69, 288-291.
- Lee, M. (2003). Dissociations among functional categories in Korean agrammatism. *Brain and Language*, 84, 170-188.
- Menn, L. (1990). Agrammatism in English: Two case studies. In L. Menn, L. Obler. (Eds.), *Agrammatic aphasia: A cross-language narrative sourcebook* (pp. 117-178). Philadelphia: John Benjamins.
- Menn, L., & Obler, L. (1990). *Agrammatic aphasia: A cross-language narrative sourcebook*. Philadelphia: John Benjamins.
- Miceli, G., & Mazzucchi, A. (1990). Agrammatism in Italian: Two case studies. In L. Menn, L. Obler. (Eds.), *Agrammatic aphasia: A cross-language narrative sourcebook* (pp. 717-816). Philadelphia: John Benjamins.
- Niemi, J., Laine, M., Hänninen, R., & Koivuselkä-Sallinen, P. (1990). Agrammatism in Finnish: Two case studies. In L. Menn, L. Obler. (Eds.), *Agrammatic aphasia: A cross-language narrative sourcebook* (pp. 623-716). Philadelphia: John Benjamins.
- Nespoulous, J. L., Dordain, M., Perron, C., Ska, B., Bub, D., Caplan, D., Mehler, J., & Lecours, A. R. (1990). Agrammatism in French: Two case studies. In L. Menn, L. Obler. (Eds.), *Agrammatic aphasia: A cross-language narrative sourcebook* (pp. 623-716). Philadelphia: John Benjamins.
- Ouhalla, J. (1993). Functional categories, agrammatism and language acquisition. *Linguistische Berichte*, 143, 3-36.
- Pollock, J. Y. (1989). Verb movement, universal grammar, and the structure of IP. *Linguistic Inquiry*, 20, 365-424.
- Platzack, C. (2001). The Vulnerable C-domain. *Brain and Language*, 77, 364-377.
- Rizzi, L. (1997). The fine structure of the left periphery. In L. Haegeman (Ed.), *Elements of Grammar*, (pp. 281-337). Dordrecht: Kluwer.
- Roo, E. de. (1999). *Agrammatic grammar: Functional categories in agrammatic speech*. Ph.D. dissertation, University of Leiden.
- Roo, E. de. (2003). Split CP in Broca's aphasia: Dutch topicalization data. *Proceedings of the Generative Linguistics in the Old World, Lund*, 1510-1600.
- Stravakaki, S., & Kouvava, S. (2003). Functional categories in agrammatism: Evidence from Greek. *Brain and Language*, 86, 129-141.
- Thompson, C. K., & Shapiro, L. P. (1995). Training sentence production in agrammatism: Implications for normal and disordered language. *Brain and Language*, 50, 201-224.

Thompson, C. K., Shapiro, L. P., Tait, M. E., Jacobs, B., & Schneider, S. L. (1996). Training wh-question productions in agrammatic aphasia: Analysis of argument vs. adjunct movement. *Brain and Language*, 52, 175–228.

