Clause structure and verb movement in a Greek–English speaking bilingual patient with Broca’s aphasia: Evidence from adverb placement

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Abstract

In this paper, we investigate the performance of a Greek–English bilingual patient with Broca’s aphasia and mild agrammatism on the placement of CP, MoodP, AspectP, and NegP-related adverbs, labeled specifier-type adverbs, and VP-related adverbs, labeled complement-type adverbs, by means of a constituent ordering task and a grammaticality judgment task. Based on the results derived by means of these two different tasks in both Greek and English, we argue that (i) the CP layer causes great difficulties to aphasic performance in both languages but it is not missing from aphasic grammar, whereas the VP layer remains intact in both languages; (ii) the MoodP, AspectP, and NegP-related adverbs cause more difficulties in English than in Greek. We attribute this to the independent differences between English and Greek that relate to properties of verbal morphology and syntactic head movement.

Keywords: Broca’s aphasia; Mild agrammatism; Adverb placement; Clause structure; Verb movement; Parameterized performance

1. Introduction

Recently, types of language impairment associated with damage in the Broca’s area have been the focus of an increasing number of cross-linguistic studies. A unique opportunity to study the effect of brain damage in different linguistic systems simultaneously is offered by bilingual and multilingual aphasics. Assuming that the particularities of the structure of the individual language have an effect on the manifestation of grammatical disorders in Broca’s aphasia (cf. Paradis, 1988), then the study of bilingual aphasics will allow us to investigate which aspects of the linguistic system of languages have been broken down. Therefore, similarities or differences in the structure of languages known by patients may be crucial to grammatical errors produced. For example, in agrammatic patients speaking similar languages grammatical errors will probably be similar in both languages and will differ only at the junctures where the two languages differ (see Fabbro, 2001; Paradis, 1988). Describing the different affected subcomponents of the different languages known by multilingual and bilingual patients can contribute to the cross-linguistic characterization of the deficit in Broca’s aphasia and consequently offer a new insight into the contemporary explanatory theories of Broca’s aphasia. In this respect, the aims of the research on bilingual/
multilingual aphasia are not so different than those of cross-linguistic research on aphasia, which aims to account for the cross-linguistic variation in the patients’ performance on the basis of differences and similarities between languages.

Following this line of research, the present study aims at investigating the architecture of clause structure and verb movement in the grammar of a bilingual patient with Broca’s aphasia and mild agrammatism, who speaks two languages with different surface properties, namely Greek and English. This investigation will be done through the study of adverb placement across different modalities, specifically production and comprehension; in Section 2 of this paper we explain the reason why we take adverbs to be a significant diagnostic for the presence of clause structure and verb movement.

Clearly this study, as any study of bilingual aphasia, is a complex enterprise, due to the fact that the cross-linguistic variation is located within a single individual. Thus our study, apart from discussing issues of cross-linguistic variation, will touch upon further neuro-linguistic aspects of bilingualism, that mainly have to do with age of acquisition/learning and fluency in a language.

Before we move on to present the experimental part of the study, we will provide some linguistic background with respect to the significance of studying adverb placement to investigate the clause structure and the cross-linguistic differences between Greek and English; then we will refer to current competing theories of aphasia and the predictions these make with respect to the aphasic performance pattern.

2. Clause structure and adverb placement: Cross-linguistic differences between Greek and English

In the recent literature, it has been proposed that adverbs occupy the specifier position of the various functional projections in the CP-IP (Alexiadou, 1997; Cinque, 1999). Assuming the functional projections in (1), the structure in (2) illustrates the mapping between adverbs and functional projections that we have included in experimental paradigm:

(1) \[ \text{CP} \{ \text{MoodP} \{ \text{AgrSP} \{ \text{TP} \{ \text{NegP} \{ \text{AspP} \{ [\text{AspP} \{ \text{VoiceP} \{ \text{VP} \}}])\}}}\}\}\]\n
(2) \[ \text{CPrileave}_1 \{ \text{MoodP} \{ \text{AspP} \{ [\text{AspP} \{ \text{TPfin} \{ \text{NegP} \}}]\}}\}\}\{ \text{AspP} \{ [\text{AspP} \{ \text{TPfin} \{ \text{AspP} \{ [\text{AspP} \{ \text{VoiceP} \{ \text{VP} \}}]\}}]\}}\}\{ [\text{AspP} \{ \text{VoiceP} \{ \text{VP} \}}]\}\}\{ \text{aspektikiL} \}\]\n
In (2), speaker-oriented adverbs, e.g., fortunately appear in the specifier of CP; modal adverbs, e.g., probably appear in the specifier of MoodP; aspectual adverbs, e.g., always appear in the specifier of Aspects projections; and negative adverbs, e.g., anymore appear in Specifier of NegP. We call these adverbs specifier adverbs here. In languages with V-movement, Aspect and Neg-related adverbs, also called low-IP adverbs, are crossed by the verb, while CP and MoodP adverbs, also called high ones, are never crossed by V-movement. Hence, the distribution of low specifier adverbs (relative to verbal elements) is a crucial diagnostic both for the presence of functional architecture and for the presence of V-movement (Pollock, 1989 and subsequent work).

In addition to specifier adverbs we have included a second group of adverbs in our experiment. Following Lonzi and Luzzati, and Alexiadou (op. cit.), we call them complement-type adverbs. This group comprises manner adverbs. We assume in agreement with McConnell-Ginet (1982), and Larson (1988) among others that these are generated following the verb, i.e., in the complement domain of verb and they do not normally interact with V-movement.

Given our assumptions, adverbs occupy the same positions in English and Greek and any differences between the two languages in the order of adverbs with respect to verbal elements are reduced to the presence vs. absence of verb movement. We review these in turn:

On the one hand, Greek is a null subject language characterized by rich verbal morphology; the language marks aspectual, i.e., perfective vs. imperfective, as well as voice, i.e., active- vs. non-active, distinctions morphologically (see Appendix A). Greek also has a number of uninflected modal particles, located in the Inf area: na, to mark subjunctive Mood, and tha, used primarily to mark future tense (see Alexiadou & Anagnostopoulou, 2000 and references therein). English, on the other hand, is not a null subject language, has relatively poor morphology, and uses modal and auxiliary verbs to mark distinctions that are signaled by particles and verbal inflection in Greek.

In Greek the finite verb moves to T as it precedes all adverbs that are generated in the low-IP domain, see (3) (see also Alexiadou & Anagnostopoulou, 1998; Rivero, 1988/1994 and others). Participles also move, at least as high as Aspect, since they follow aspectual adverbs (4), see Alexiadou (1997).

(3) \[ [\text{T diavaze} \{ [\text{Asp sihna} \{ [\text{VP t to mathima}]]}\}]\]

He was reading the lesson often

(4) \[ [\text{chi} \{ [\text{Asp idi diavasi} \{ [\text{VP t to vivlio}]]}\}]\]

He has already read the book

In English there is no overt verb movement (Chomsky, 1995; Pollock, 1989). Both the main verb and the

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1 See Pollock (1989), Belletti (1990), and Chomsky (1995). In (1) we follow Chomsky and Belletti (op. cit.) in assuming that Agr is higher than Tense, but this is immaterial for the purposes of our discussion; in fact the arguments to split Agr from Tense are not conclusive either for Greek or for English (Rivero, 1988/1994; Sabine, 1990).
participle remain below adverbs situated in the low-IP area. For the auxiliary do it is assumed that it is base-generated in T. The same holds for all modal verbs (Lasnik, 1999). On the other hand, auxiliaries have and be undergo short verb movement to T (see Pollock, 1989 and much subsequent work).

(5) a. [TP Peter [Asp often [VP kissed Mary]]]
       b. [TP Peter will [VP visit Mary]]
       c. [TP Peter does [like pasta]]
       d. [TP Peter is [AuxP t [VP leaving]]]
       e. [TP Peter has [AuxP t [VP left]]]

In summary, Greek differs from English in the following two interrelated points: Greek is characterized by rich verbal inflection. This correlates with the fact that in Greek verbal elements move outside the VP, but this is not the case in English where verbal elements remain within the VP. In English auxiliary do and modals are inserted in T, while auxiliaries be and have undergo short movement to T.

3. Aphasiological background

With this in mind let us discuss the aphasiological background for our study. The performance of the aphasics on adverb placement has been used as a diagnostic criterion for the presence or not of functional categories in aphasic representation (Lonzi & Luzzatti, 1993). Lonzi and Luzzatti (1993) raised the question of whether the functional category of Inflection, which is responsible for the relative order verb-adverb, exists in the grammar of Italian-speaking aphasics. Through the use of a constituent ordering task it was shown that when the verb was in a non-finite form, it either preceded or followed the specifier-like adverb, but when the verb was finite the adverb always followed it. Based on these results, Lonzi and Luzzatti (1993) have suggested that the functional category Infl must exist in agrammatic grammar.

Following Lonzi and Luzzatti (1993), we further exploit the use of adverb placement as a diagnostic for the presence of clause structure layers and syntactic operations aiming to draw conclusions as to the extent and nature of syntactic deficits in the Greek and English grammar of our patient across different modalities through production and comprehension tasks. We aim at evaluating whether there is any dissociation among production and comprehension and consequently whether the hypothesis of parallelism is valid. Being a strictly empirical question, as pointed out by Kean (1995), the issue of parallelism is one of high controversy. So far studies on aphasia show conflicting results: there are studies that have reported dissociation between comprehension and production (Goodglass & Mean, 1986; Miceli, Mazzucchi, Men, & Goodglass, 1983), whereas others have not (Wenzlaff & Clahsen, 2004).

Furthermore, based on the production evidence we aim at evaluating the validity of the predictions of production theories of agrammatism. In particular, for the purposes of this work that looks at the syntactic aspects of the patient’s production abilities, the following hypotheses are of particular interest: the tree-pruning hypothesis, Friedmann and Grodzinsky (1997) and Friedmann (2001), and the verb movement deficit hypothesis, by Bastiaanse and colleagues (Bastiaanse & Thompson, 2003; Bastiaanse & van Zonneveld, 1998).

Let us discuss these approaches in detail. Bastiaanse and colleagues showed that Dutch-speaking agrammatic Broca’s aphasic individuals have more difficulty generating finite verbs in matrix clauses than in embedded clauses. They have suggested that the problems with finite verbs are the result of an underlying syntactic and not morphological impairment, i.e., agrammatic Broca’s aphasics are compromised in applying verb second but not in producing finite verbs in final position. Hence, syntactic verb movement causes the verb inflection problems in production, although agrammatics are sensitive to the relation between finiteness and structural position (Bastiaanse & van Zonneveld, 1998).

While Bastiaanse and colleagues restrict the aphasic problems to verb movement, others suggest that production deficits in agrammatism can be predicted by the structural position of the syntactic structure in the syntactic tree. Specifically, Friedmann postulates that functional projections belonging to both C and T are impaired but C is more impaired than T, in the sense that it is not present in the syntactic representation (tree-pruning hypothesis). With respect to comprehension, it is assumed that only the CP projection is absent.

Consider the relevance of these approaches for our discussion. The tree-pruning hypothesis would predict that the structural position determines the degree of impairment in the sense that CP should be more impaired than MoodP in both languages. Hence, it would predict that the patient would have problems with the CP domain in both languages and as such it would not predict any differences to exist between the two languages. In other words, on this view, the patient would have problems with inserting CP-related adverbs correctly, but in principle should be able to deal with lower adverbs on the basis of the structures in (1) and (2) correctly. If lower categories were also impaired, one would expect that the patient would produce low Adv-V orders in all cases that would require V-low Adv orders in both languages (main verbs in Greek and auxiliaries in English), since she would not have any functional categories. But crucially no
difference is expected between Greek and English. On the other hand, Bastiaanse and Thompson (2003) would predict that the patient would have problems with V-movement in both languages. This account crucially would expect our patient to face problems with lower IP adverbs, crucially aspectual and negative adverbs, in both Greek and English. That is if the patient lacks syntactic V-movement, the patient would produce Adv-V orders with these adverbs that, as mentioned in Section 2, are crossed by V-movement. In particular, Bastiaanse and Thompson (2003) would expect that low-IP adverbs would not be crossed by the verb in Greek, and that auxiliaries be and have would not surface higher than low-IP adverbs in English. Hence, they would predict that the patient is not able to order the verb with respect to these adverbs correctly, while she would be able to insert do and modals correctly in English. Under the tree-pruning hypothesis, an Adv-V order would imply that the patient lacks the functional layers and as a result the process of V-movement, in Bastiaanse’s system the adverbs could still be in the functional specifier but since the patient would lack the syntactic process of V-movement, she would produce Adv-V orders.

Let us now see how our patient performs on the production and comprehension tasks and fares with respect to the predictions of the production theories of agrammatism.

4. The study

4.1. The subject

KS is a 32-year-old, right-handed woman. Thirty months before entering our study, she suffered a left CVA; the MRI-scan showed the presence of an ischemic infarct at the left parietal lobe. The patient presented with right hemiplegia; she has been diagnosed as Broca’s aphasic on the basis of the Boston Diagnostic Aphasia Exam in both English and Greek (Goodglass & Kaplan, 1982) and clinical consensus among neurologists and speech therapists. Specifically, the patient’s performance as revealed by sub-tests of the Boston Diagnostic Aphasia Exam in both languages was the following: With respect to fluency in both English and Greek, the patient’s utterances consisted of two words in most of the cases but there were some instances of one and three-word runs. Her speech was rarely aphasoid and in most of the cases sentence intonation was limited to short phrases; grammatical structures were simplified and some morphemes were occasionally omitted in English (e.g., the past tense morpheme -ed) but substituted in Greek. Based on conversational data, the patient’s morphosyntactic abilities have been assessed. The patient produced few errors in both languages as shown in Table 1.

There were some instances of definite article omission in both Greek and English language, whereas her performance on bound morphemes is language dependent, as she omitted the agreement marker (-s) and tense marker (-ed) in English but she made substitution errors in Greek agreement and tense marking; in particular, she used the first person plural ending instead of the second (pl) one, and the present tense ending instead of the past one. More tense than agreement errors were produced in both languages. Suffixes in Greek cannot be omitted and bare stems cannot stand on their own. Therefore, omissions in English and substitutions in Greek are totally compatible with the nature of each language. A number of factors including the phonological and morphosyntactic factor of the language conspire to influence the manifestation of aphasia in each language (cf. Paradis, 2001).

Therefore, the manifestation of agrammatism appears in a different way in Greek and English. The patient also used the anaphoric negation no in English in the obligatory contexts of ‘do not’ and ‘does not.’ Similar errors were not attested in Greek. Note that the patient was able to produce modal markers in both Greek and English, i.e., the markers tha (=will) and na (=to) in Greek and the auxiliary will in English. Na was produced in very simple structures, such ‘na pao?’ (= Shall I go?). The patient produced simple/formulaic wh-questions (e.g., How are you? Ti ekanes xte?) (what-did-2s-yesterday: what did you do yesterday), but she did not produce complex and embedded structures in either Greek or English. The fact that she produced some simple and formulaic wh-questions cannot be taken as evidence that her ability to produce wh-questions was intact. The overall picture of the patient’s spontaneous speech was compatible to that of mild agrammatism.

Although the patient had grammatical difficulties, she performed at ceiling on simple social responses. She also did well on auditory comprehension in both languages (above average score) whereas she performed low on sentence repetition. The patient’s articulation was occasionally effortful but all words were intelligible without any transcribable phoneme substitutions while her naming abilities were near normal. Finally, the patient had difficulties with function words in oral sentence reading and more difficulties with writing—especially with narrative writing—in both Greek and English.

\footnote{There does not seem to be a necessary and sufficient lesion profile for Broca’s aphasia. As pointed out by Alexander (1997) chronic Broca’s aphasia can be associated with parietal cortical damage.}

\footnote{A Greek non-standardized version of the Boston Diagnostic Aphasia Exam was also used.}

4 For the morphosyntactic abilities of Greek patients with Broca’s aphasia, see Stavrakaki and Kouvava (2003) and Tsapkini, Jarema, and Kehayia (2002).
Before her CVA, KS had worked as a teacher of English in Greek private schools for 10 years. She was born in Greece and started learning English in the primary school; in her puberty (14 years old) moved with her family to the States where she graduated from a high school in Illinois and got some professional qualification to be a teacher of English as a foreign language. Immediately after her studies, she came back to Greece and started working as a teacher of English. Greek is her mother tongue but she used English almost half of a day while she was working before her CVA. This patient can be characterized as bilingual since the term ‘bilingual’ refers to all those people who use two or more languages or dialects in their every day lives (Grosjean, 1994). Although the patient was not an early bilingual and was initially taught English in school, she was a fluent speaker of English and spent half of her day in teaching English to students before her CVA. The patient, therefore, could be classified as a late bilingual being highly proficient in L2.

Immediately after her CVA, i.e., during the acute phase, KS was able to articulate some words only in English, which means that the language acquired during childhood was more impaired than the one learned after it (cf. Paradis & Goldblum, 1989). She received speech therapy services only in Greek, after her own decision and gradually managed to use the Greek and English language although she has not received therapy services in English. It should be noted that the patient’s pattern of performance has clear consequences for the way the speech and language therapy influences the language recovery in aphasia. Although the patient received speech therapy services in Greek at the time of testing she showed similar characteristic in English and Greek, i.e., non-fluent speech with mild agrammatism. It seems, therefore, that speech therapy in one language can contribute to improving language abilities in the other language, at least for the structures, which remain similar across languages (cf. Fabbro, De Luca, & Vorano, 1996).

### 4.2. Design and materials

To evaluate the patient’s ability to construct a sentence in Greek and English, two tasks in both languages were employed:

1. A constituent ordering task, made up by 60 sentences in Greek and other 60 in English, requiring different position of adverbs. We selected 23 adverbs in English and 21 in Greek (see Appendix B). The patient was visually presented with the stimuli on separate cardboard tasks. Since she suffered a slight reading deficit associated with function words, she read aloud the stimuli in a random order by one of the researchers. The patient was told that she should order the stimuli presented in order to form the best Greek and English sentence, as more than one sentence would be possible. Clearly constructing sentences in an anagram task is different than oral production, although this task requires the patient to produce a sentence at the end. This is so because the patient should understand the sentence before completing the anagram. The disadvantage, however, of testing sentences with adverbs through oral production tasks is that the patient may use an adverb different than the target or may not use an adverb at all. Although most of the claims made on the clause structure in agrammatic aphasia (cf. Friedmann, 2001) have been based on data from conversational speech analyses, imitation, and other production tasks, as pointed out by an anonymous reviewer, sentence-anagram tasks were also used to investigate clause structure in agrammaticism (cf. Lonzi & Luzzatti, 1993; Rispens, Bastiaanse, & van Zonneveld, 2001).

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A crucial question related to late bilingualism is whether the system of the second language is quite close to that of the monolingual speaker of that language or somewhat different. Although the exact effect of attained proficiency on the determination of cortical representation of L2 is still an open question, there is some evidence suggesting that proficient but fluent L2 bilinguals show highly similar cortical activation patterns to those of L1 speakers. For example, neurolinguistic studies investigated story comprehension that requires integration of both lexical and syntactic abilities in highly proficient second language learners (Perani et al., 1998) showed that L1 speakers and late but proficient L2 learners showed highly similar cortical activation patterns. Similarly, an ERP study by Carreiras, Gillon-Dowens, Barber, and Betancort (2004) showed a Left Anterior Negativity effect taken to indicate automatic processing in both monolingual Spanish speakers and competent English speakers of Spanish L2 while they were presented sentences containing grammatical gender and number violations.

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**Table 1:** Morphosyntactic errors produced by the patient in obligatory contexts of articles, AgrS, Tense, and Negation

<table>
<thead>
<tr>
<th></th>
<th>Greek</th>
<th>Substitutions</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Article</td>
<td>Agr-S</td>
<td>Tens</td>
</tr>
<tr>
<td>Greek</td>
<td>3/12 (25%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td></td>
<td>1/5 (20%)</td>
<td>4/16 (25%)</td>
</tr>
</tbody>
</table>

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A. Alexiadou, S. Stavrakaki / Brain and Language 96 (2006) 207–220
C. Caplan, 1983). Other factors related to the experimental design may affect the aphasic performance. For example, the saliency of a particular word in memory may be such a factor since the patient was presented orally with sentence fragments or words, as pointed out to us by an anonymous reviewer. However, we should stress here the fact that the experimental design itself could not result in the saliency of a particular word in memory. This is so for two reasons. First, the patient was also presented visually with the sentence fragments; thus, she had the opportunity of looking at the stimuli and thinking about it before the final production. Second, the patient was presented orally the stimuli in neutral intonation; thus, she could not get cues from oral presentation to keep a particular word more salient than others in memory.

(ii) A contrastive grammaticality judgment task, made up by 60 sentences in English and another 60 in Greek. This task aimed to check whether the patient exhibited grammatical sensitivity in judging adverb placement in sentences. On each trial, the subject was presented with three to four sentences, which differ in the adverb placement, in visual and auditory presentations simultaneously. In other words, the subject had to make contrastive judgments picking up the most preferred from a set of three to four sentences. All possible adverb places were included: sentence initial and final position, between the sentence subject and the main/auxiliary verb, and between the main and auxiliary verb, or the main verb and the verb complement. The patient was presented with three sentences when the verb (+finite) was intransitive and hence there were three possible positions of adverbs: the preverbal one, the postverbal one, and the sentence initial one. More precisely, the sentences in Greek and English were constructed according to the following schemes:

(1) Adverb-DP-Verb (+finite)
(2) DP-Verb (+finite)-Adverb
(3) DP-Adverb-Verb (+finite)
(4) Adverb-DP-Verb (+finite)-DP
(5) DP-Verb (+finite)-DP-Adverb
(6) DP-Verb (+finite)-Adverb-DP
(7) DP-Adverb-Verb (+finite)-DP
(8) Adverb-DP-Aux-Participle-DP
(9) DP-Aux-Participle-DP-Adverb
(10) DP-Adv-Aux-Participle-DP
(11) DP-Aux-Adv-Participle-DP
(12) DP-Aux-Participle-Adv-DP.

Different orders were classified as marked, grammatical, and ungrammatical for the different adverbial classes. For instance, as far as speaker oriented as well as for modal adverbs are concerned, we take the unmarked order to be Adv-DP-Verb-DP and consider the order DP-Adv-Verb or DP-Adv-Aux(have), e.g., *John unfortunately has met Mary*, as marked. Although these orders are not ungrammatical in the strict sense, it seems to us that there is no straightforward syntactic analysis of such patterns and hence we cannot take them to be the unmarked order of English (see Belletti, 1990; Lasnik & Saito, 1992; Williams, 1994 for English and Alexiadou, 1997; Alexiadou & Anagnostopoulou, 1998 for Greek). Orders that change the scopal relations in the clause, i.e., when a speaker-oriented adverb appears before the DP object and takes directly scope over it instead of appearing in initial position, were also considered marked.

For aspectual adverbs, marked orders were those that seemed either to require special intonation, is in the case of *IDI ihe teliosi ti doulia ‘Already had he finished the job’ in Greek, in which case the adverb is focalized. With respect to manner adverbs, the unmarked order in Greek is one in which the adverb precedes the object, while in English the unmarked order is the one in which the adverb follows the object. In Greek final position for manner adverbs is possible but they necessarily receive special stress.

Due to the null subject nature of Greek, the first DP (the subject) was not included in some structures. One of the sentences would first appear on a cardboard card in front of the subject along with its oral presentation. This was followed by the next presentation of the other sentence. The subject could listen to the sentences as many times as she wanted and was given as much time as she needed to complete the task. She was told that she had to mark the correctness (grammaticality, in our terms) of each of the sentences by rating her judgments on a 5-point scale (1, totally incorrect; 5, totally correct).

This graded grammaticality judgment task was preferred over a simple grammaticality task because we have included marked structures in addition to grammatical and ungrammatical ones in the experimental design. Marked responses with respect to adverb placement were those that were not completely impossible in both languages but could occur under certain context requirements. Therefore, a graded grammaticality judgment task was thought to be appropriate in order to evaluate the patient’s performance on judging sentences.

Consider below an example of the sentences presented to the patient.

(6) a. Ann has lost her luggage unfortunately
    b. Unfortunately Ann has lost her luggage
    c. Ann has unfortunately lost her luggage
    d. Ann unfortunately has lost her luggage

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6 Note that there is a difference between auxiliary be and auxiliary have here. Strings such as *John perhaps is clever* are ungrammatical. This is why it has been argued in the syntactic literature that *be* raises higher than *have.*
Filler items were also included in the stimuli presented to the patient.

4.3. Results

4.3.1. Constituent ordering task

The subjects’ responses were classified as correct, incorrect, and marked responses. As far as the classification of the responses is concerned, correct responses were the grammatical and unmarked ones. Incorrect responses included only ungrammatical responses, i.e., the responses including grammatical violations of adverb placement.

In Tables 2 and 3, the word order of the attested correct, incorrect, and marked responses of the patient in Greek and English is presented, respectively. The initial DP (the subject) was not included in Greek, since it was not also included in the material presented to the patient.

The performance of aphasic patient on adverb placement in Greek and English through the constituent ordering task is summarized in Table 4.

The patient exhibited a similar pattern of performance in English and Greek on CP-related adverbs, since she produced a comparable number of correct and incorrect responses in both languages. Furthermore, she did not appear to have productive knowledge of the syntactic position of the speaker-oriented adverbs. Not only did she produce a number of marked responses she also gave ungrammatical responses (5/12 in English and 7/12 in Greek) in which the adverb occupied the sentence final position. We believe that this suggests that not only does the patient have problems with the CP layer, but she also has difficulties in correctly analyzing the adverb as belonging to the specifier class and attempts to attach it to lower levels of structure.

### Table 2
Constituent ordering task: Word order of the attested correct, incorrect, and marked responses in Greek

<table>
<thead>
<tr>
<th>Adverb type/tree layer</th>
<th>Correct</th>
<th>Incorrect</th>
<th>Marked responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speaker-oriented adverbs/CP</td>
<td>Adverb-DP-Verb (+finite)-DP</td>
<td>DP-Verb(+finite)-DP-Adverb</td>
<td>DP-Verb(+finite)-Adverb-DP</td>
</tr>
</tbody>
</table>

### Table 3
Constituent ordering task: Word order of the attested correct, incorrect, and marked responses in English

<table>
<thead>
<tr>
<th>Adverb type/tree layer</th>
<th>Correct</th>
<th>Incorrect</th>
<th>Marked responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speaker-oriented adverbs/CP</td>
<td>Adverb-DP-Verb (+finite)-DP</td>
<td>DP-Verb(+finite)-DP-Adverb</td>
<td>DP-Verb(+finite)-Adverb-DP</td>
</tr>
<tr>
<td>Modal adverbs/MoodP layer</td>
<td>DP-Verb (+finite)-Adverb</td>
<td>DP-Aux-Participle-DP-Adverb</td>
<td>DP-Aux-Participle-DP-Adverb</td>
</tr>
</tbody>
</table>

### Table 4
The aphasic patient’s performance on the constituent ordering task: Correct, incorrect, and marked responses

<table>
<thead>
<tr>
<th>Adverb type/tree layer</th>
<th>Greek Correct responses</th>
<th>English Correct responses</th>
<th>Greek Incorrect responses</th>
<th>English Incorrect responses</th>
<th>Greek Marked responses</th>
<th>English Marked responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speaker-oriented adverbs/CP</td>
<td>3/12 (25%)</td>
<td>2/12 (16.66%)</td>
<td>7/12 (58.33%)</td>
<td>5/12 (41.66%)</td>
<td>2/12 (16.66%)</td>
<td>5/12 (41.66%)</td>
</tr>
<tr>
<td>Modal adverbs/MoodP layer</td>
<td>4/12 (33.33%)</td>
<td>5/12 (41.66%)</td>
<td>8/12 (66.66%)</td>
<td>7/12 (58.33%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negation adverbs/NegP layer</td>
<td>7/12 (58.33%)</td>
<td>3/12 (25%)</td>
<td>2/12 (16.66%)</td>
<td>4/12 (33.33%)</td>
<td>3/12 (25%)</td>
<td>5/12 (41.66%)</td>
</tr>
<tr>
<td>Aspectual adverbs/AspectP layer</td>
<td>9/12 (75%)</td>
<td>5/12 (41.66%)</td>
<td>7/12 (58.33%)</td>
<td>3/12 (25%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manner adverbs/VP layer</td>
<td>11/12 (91.66%)</td>
<td>10/12 (83.33%)</td>
<td>1/12 (8.33%)</td>
<td>2/12 (16.66%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
As can be seen, the patient had more problems with modal adverbs in English than in Greek. In fact, the patient exhibited remarkably better performance in Greek than in English, as she produced no correct responses in English. Our patient attaches the modal adverbs to the VP area in English 5 out of 12 times but produces no errors in Greek.

The sentence final position the patient preferred for modal adverbs in English and CP adverbs in Greek suggests that the patient resorts to re-analyze the adverbs as VP-related when she has problems with high projections.

With respect to negation adverbs, the patient’s performance in Greek is better than in English, since she produced more correct and less incorrect word orders in Greek than in English. This difference could be directly attributed to the different status of negation in the two languages see Zanuttini (1991) for discussion, but we will not pursue this any further here.

While ordering constituents including aspectual adverbs, better performance is exhibited in Greek than in English, as no incorrect responses were found in Greek but such responses were found in English. There 7/12 ungrammatical responses in English, where the adverb is placed in sentence initial position, but none in Greek. This error pattern contrasts with the errors she produced with CP and MoodP adverbs, as she placed these adverbs in sentence final position. This difference can be interpreted as follows: on the one hand, the patient is at least aware of the aspectual adverbs’ position somewhere at the left border of the VP hence she put them incorrectly in a very high position; on the other hand, due to the problems she had with the higher projections, she re-analyzed CP and MoodP adverbs (in English) as VP-related. This is so because the lower part of the tree, i.e., the VP domain, is completely intact in both languages, as shown by the fact that the patient produced no attachment errors with manner adverbs.

In sum, the patient showed high level of performance on VP-related adverbs and low level of performance on CP-related adverbs in both languages. A consistent pattern of performance across Greek and English was the drop of the correct performance while you are going highly in the tree as shown by Table 4; there was a slight exception for English where the patient showed no correct responses for the MoodP-related adverbs, although MoodP was lower than CP. Interestingly, the patient’s incorrect performance decreased when you are going high in the syntactic tree with the exception of AspectP-related adverbs in English. In general terms, the patient’s performance was highly dependent on the syntactic tree hierarchy. Further analysis indicated statistically significant effect of the adverb category on the patient’s performance (Pearson $\chi^2 = 15.204$ $p < .005$ and Pearson $\chi^2 = 21.750$ $p < .005$ for Greek and English, respectively) and thus confirmed the effect of the tree hierarchy on the patient’s performance.

Furthermore, the patient performed better in Greek than in English on MoodP, NegP, and AspectP-related adverbs; The better pattern of performance in Greek is not only found with respect to the number of correct responses produced, as sometimes the differences in the correct responses are not so striking, as pointed out to us by an anonymous reviewer, but is also evident by the fact that while she mostly produced ungrammatical responses in English, she produced marked ones in Greek.

### 4.3.2. Contrastive grammaticality judgment task

Our analysis of the results from the grammaticality judgment task has been focused on the structures that were thought to be completely correct by the patient. Specifically, we have classified the structures, which were ranked as completely grammatical by the patient, as correct, incorrect, and marked responses. For this classification we used the same criteria as in the constituent ordering task. See Tables 5 and 6 where the word order of the preferred (judged as grammatical by the patient) structures is presented for Greek and English.

In Table 7 the results from the grammaticality judgment task are presented.

<table>
<thead>
<tr>
<th>Adverb type/tree layer</th>
<th>Correct</th>
<th>Incorrect</th>
<th>Marked responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speaker-oriented adverbs/CP layer</td>
<td>Adverb-DP-Verb (+finite)-DP</td>
<td>DP-Verb(+finite)-DP-Adverb</td>
<td>DP-Verb(+finite)-Adverb-DP</td>
</tr>
<tr>
<td>Modal adverbs/MoodP layer</td>
<td>Adverb-DP-Verb (+finite)-DP</td>
<td>DP-Aux-Participle-DP-Adverb</td>
<td>DP-Verb(+finite)-Adverb-DP</td>
</tr>
<tr>
<td>Aspectual adverbs/AspectP layer</td>
<td>DP-Aux-Adv-Participle-DP</td>
<td>DP-Verb(+finite)-DP-Adverb</td>
<td>Adverb-DP-Verb (+finite)-DP</td>
</tr>
<tr>
<td>Manner adverbs/VP layer</td>
<td>DP-Verb (+finite)-DP-Adverb</td>
<td>DP-Aux-Participle-DP-Adverb</td>
<td>Adverb-DP-Verb (+finite)-DP</td>
</tr>
</tbody>
</table>
Interestingly the aphasic patient’s performance was better on the grammaticality judgment task than on constituent ordering task. However, as was the case with the constituent ordering task, her performance dropped when going higher in the syntactic tree in both languages. The effect of adverb type and tree hierarchy on the patient’s performance did not turn to be statistically significant (Pearson $\chi^2 = 2.708, p = .608$ and Pearson $\chi^2 = 7.059, p = .133$ for Greek and English, respectively) in contrast with the constituent ordering task. Nevertheless, the same pattern of performance was shown across the two tasks, that is, drop of the correct performance when you are getting higher in the tree. Furthermore, in contrast to the first task, the patient’s correct performance on the judgment task did not indicate any dissociation between Greek and English with respect to Negation, Modal, and Aspectual adverbs, as similar performance was exhibited in both languages. The only dissociation had to do with the responses that were not classified as correct; the patient, when she did not produce the correct response, produced marked responses in Greek and incorrect (ungrammatical) responses in English. This pattern of performance indicates that although the patient did have access to grammatical knowledge required for correct grammatical judgments in both Greek and English, her performance in Greek was facilitated for some reason.

5. Discussion

The results of our experimental study can be summarized as follows. In the first experiment, the patient performed almost at ceiling on manner adverb placement in both languages and showed consistent problems with the CP adverbs in both languages. However, the patient had difficulties with modal, negation, and aspectual adverbs in English but not in Greek. In the second experiment, the patient showed better performance on grammaticality judgment task than on constituent ordering task; she also resorted to ungrammatical choices in English and marked in Greek, when she failed to produce the correct judgment.

This apparent dissociation between the patient’s performance across tasks, i.e., selective and language dependent problems with adverb placement in the first experiment and increased—language independent—grammatical sensitivity in the second experiment may be directly related to the different task requirements: On the one hand,—as mentioned before—the constituent ordering task is not identical to other production tasks used in the study of aphasia, but nevertheless includes production requirements. On the other hand, the contrastive grammaticality judgment task requires exclusively comprehension abilities and thus can be used as a measure of whether syntactic operations can be carried out or not. Despite the dissociation described above, the patient’s performance on the two tasks shows an apparent convergence: the correct performance increased while going lower in the syntactic tree whereas incorrect performance decreased while going lower in the syntactic tree.

These results are only partially compatible with the predictions of the parallelism hypothesis that postulates parallel deficits in grammar or processing. On the one hand, the patient showed low performance on
CP-adverbs in Greek and English and selective deficits in MoodP, NegP, and AspectP-adverbs in English only in production and not in comprehension task. On the other hand, there was obvious effect of the tree hierarchy on the patient’s performance in both tasks: the main trend in the patient’s performance on the production was also observed in the comprehension task. In this respect, the grammaticality judgment task seems to be so sensitive to production deficits as pointed out by an anonymous reviewer. This might be interpreted as an indication that the parallelism hypothesis holds to some extent for the patient of this study. It should be noted the patient’s better performance on the grammaticality judgment task shows that she is able to deal with the application of grammatical rules.

Let us now consider what these production results show for the clause structure in the Greek–English grammar of the aphasic patient in view of the two hypotheses that we introduced in Section 3. We start from these points of the aphasic performance, which are similar in both languages.

The lowest correct performance across both languages was attested on the CP-related adverbs, as shown by the first experiment. The best performance was exhibited on the VP-related adverbs; this finding indicates that the lowest part of the tree remains intact. Therefore, these findings indicate that the lowest part of the syntactic tree is preserved whereas the CP area is severely impaired. At first sight this suggests that the hierarchical structure of the syntactic tree is present in a way that supports the tree-pruning hypothesis (cf. Friedmann, 2001, 2002) since the correct performance increases when going lower in the tree and in most cases the incorrect performance decreases when going higher in the tree except for the aspectual layer for English in the anagram task. In particular, as pointed out in Section 3, the patient has problems with inserting CP-related adverbs correctly, but in principle is able to deal with lower adverbs correctly, which is exactly the prediction that the tree-pruning hypothesis makes. Let us see in detail how. Recall the basic structure we assumed with respect to adverbs–layers combinations repeated below, containing only the relevant adverbs we checked for:

\[
(7) \text{CP } \text{MoodP } \text{NegP } \text{AspP } \text{VPprosektika}
\]

On the basis of (7), the results of our study suggest, in agreement with the tree-pruning hypothesis, that the CP layer is impaired in both languages. Since she is able to attach VP-related adverbs correctly, she offers evidence for the presence of the VP layer in both languages. Although her performance on the MoodP, NegP, and AspectP layer is language dependent (better in Greek than in English), the patient constantly showed the following pattern of correct performance in both languages in the anagram task: better performance on VP than AspP, better performance on AspP than NegP, better performance on NegP than MoodP, and better performance on MoodP than CP. In other words, the syntactic hierarchy in (7) was directly translated in performance’s decrease when you are going higher in the tree. That is the syntactic tree is hierarchically represented in the patient’s grammar as follows:

\[
(8) \text{CP } \text{MoodP } \text{NegP } \text{AspP } \text{VPprosektika}
\]

But it should be kept in mind here, that although this problematic pattern of aphasic performance on the CP layer has been confirmed by a number of studies on aphasics speaking different languages (cf. Friedmann, 2001; Friedmann & Grodzinsky, 1997; Grodzinsky, 2000), it still remains unclear whether the source of the CP-related deficit can be attributed to the lack of grammatical knowledge or to the aphasic inability to access the CP domain (cf. Friedmann, 2002). The patient’s better performance on the CP-related adverbs in the grammaticality judgment task indicates that the accessibility to the CP domain is not totally lost.

While a consistent pattern of performance was exhibited on the CP- and VP-related adverbs in the production task in the two languages, better performance was exhibited on NegP, MoodP, and AspectP-related adverbs in Greek rather than in English. This does not seem to be expected under the tree-pruning hypothesis, but not entirely unexpected under the verb movement deficit hypothesis account. In fact the performance of our patient in English suggests that she uses the operation of V-movement wrongly in the structures where it should apply namely Aux-to-T movement. This is in line with what Bastiaanse’s account would predict. But our patient has difficulties with correctly inserting do (and modals) in T(Mood) in English, which is again unexpected under Bastiaanse’s hypothesis, but follows from the tree-pruning hypothesis, suggesting that T, Aspect and layers such as Mood are occasionally inactive for the purposes of syntax from her English grammar. As a result, she is unable to correctly place the adverbs related to them, and to order NegP with respect to T.\(^7\) This pattern of perfor-

\(^7\) See Bastiaanse, Rispens, and van Zonneveld (2000) for an account of aphasic problems with negation in English. It is suggested that English aphasic patients have problems with negation since it interferes with verb movement; that is, Neg as a functional head blocks verb movement to T and AgrS in English.
mance is consistent with the spontaneous speech data where difficulties with the production of Neg were found (see Table 1). The fact that she orders the lower adverbs and the verb correctly in Greek suggests that a category hosting the finite verb, T, exists in her grammar and the patient applies the syntactic rule of V-movement correctly in Greek, again contrary to what Bastiaanse would predict.

Thus, our patient seems to have one surprising property for both hypotheses: on the one hand, she exhibits cross-linguistic differences in adverb placement, not expected under the tree-pruning hypothesis, and on the other hand, she is selective with the application of V-movement, being able to apply it correctly in Greek but not in English, against what the verb movement hypothesis would predict.

A possible explanation of the patient’s better performance on NegP, MoodP, and AspP-related adverbs in Greek than in English would assume that the patient recovered better the language that was her mother tongue and consequently the most fluent language, i.e., Greek rather than English. Several clinical studies have shown that bilingual aphasics do not necessarily manifest the same language disorders with the same degree of severity in both languages (Fabbro, 2001). However, on this line of reasoning, two things remain unclear. First, we should explain why the patient shows selectively better performance only on the MoodP, NerP, and AspectP-related adverbs and not to the CP- and VP-related adverbs. Second, we should explain why the patient shows this better pattern of performance in Greek on these particular structures while at the same time she produces non-fluent speech with mild agrammatic characteristics in both languages, which means that parallel recovery was made in both languages. If we take into account the above remarks, then we should investigate why the better performance does not hold generally but only specifically, i.e., for the particular structures.

We would like to argue that an explanation based on the specific linguistic properties of Greek vs. English seems more plausible. Specifically, we argue that the partition in the patient’s performance on Greek and English is related both to the type of movement involved, local head movement, and to differences in ‘strength’ of morphological inflection between the two languages. As mentioned in Sections 2 and 4.1 Greek has a number of mood particles appearing adjacent to the inflected verb, grammatical aspectual distinctions (perfective–imperfective) are marked morphologically, and verbs are fully specified for person and number inflection. Suffixes cannot be omitted and bare stems cannot stand alone. English, on the other hand, lacks the morphological properties that characterize the system of Greek. In spontaneous speech the patient produces the modal particles na (= subjunctive marker) and tha (= future marker). Hence, this suggests that MoodP exists in her grammar. In addition the presence of several suffixes in the Greek verbal system may function as a helping device in Greek. In other words, the pieces of inflection that are necessary for the built-up of the Greek verb are so robust that our patient may be getting some help for identifying the presence of functional layers in her Greek grammar, and thus is able to recognize that a close connection (agreement) exists between adverbs and the relevant functional category. On the other hand, English verbal morphology is not at all similar in the sense that the pieces of inflection are rather minimal and often bare stems are used, and hence the patient is not able to identify the presence of functional layers in the structure.

These findings provide support for the widely accepted view that grammatical deficits in aphasia are dependent on the way the system can break down and, therefore, on the structure of the individual language systems in question (Paradis, 1988). The various manifestations of aphasia are thus predictably different in different languages. Following this line of reasoning, our explanation of this dissociation between the agrammatic performance across Greek and English is that such performance is related to the specific language properties, i.e., the inflectional properties of each language and particularly the peculiarities of English and Greek verbal morphology.

The exact role of morphology in the agrammatic syntactic processing is an issue of high controversy. First, recent studies in German and Hebrew indicate that case marking in German does not improve comprehension of non-canonical object relatives (Burchert, De Bleser, & Sonntag, 2003) and gender agreement in Hebrew (Burchert, Friedmann, & De Bleser, 2003) does not improve comprehension of movement derived topicalization and object relative sentences. However, we should stress on the fact that in the study by Burchert et al. (2003) there were two out of the seven patients who were able to exploit morphology. It is possible as pointed out by Burchert et al. (2003, p. 340) that ‘in morphologically rich languages the presence of a syntactic disorder may simulate normal comprehension if it is compensated by preserved morphology.’ Second, results obtained with the word-monitor paradigm (Baum, 1989; Haarman & Kolk, 1994) indicate that Broca’s patients show high morphological sensitivity to local, within, clause dependencies but not

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8 We have not investigated in detail the use of English modals by our patient. For now, we assume that all modals are generated in T. It would be worthwhile to investigate the distribution of modal verbs and their interaction with adverbs in English. Presumably different results might occur, since if the patient could use the modal verbs correctly, she should be expected to use the modal adverbs also correctly (see Cinque, 1999).

9 By this we do not mean that rich verbal morphology is the trigger for verb movement.
across clause dependencies (Baum, 1989) and to simple (conjoined sentences) (Haarman & Kolk, 1994) but not complex (i.e., embedded) ones. Third, results from the production of a past participle suffix by Italian aphasic patients showed that the patients could produce correct inflectional suffixes in several tasks but when there were no overt morphological cues for the identification of the thematic roles in the sentence their performance dropped. Based on these results, De Bleser and Luzzati (1994) have argued that morphological problems are due to syntactic complexity. Therefore, morphology may function as a helping device sometimes but not always.

Due to the variation in the performance of agrammatic patients generalizations are always difficult, but it may be the case that the role of morphology as a helping device may be restricted to particular type of syntactic processes. It may be the case that the operation of head movement that takes place within clause dependencies is highly 'helped' by overt morphological cues present in languages with rich morphology, but this may not be the case for structures involving non-local movement of phrasal categories, i.e., A-bar movement and A-movement; hence, morphological cues may not function as a helping device for the production/comprehension of complex structures.10 It might be the case that the helping role of morphology is related to the nature of the task: the patient gets cues from morphology in Greek, as she is visually and orally presented the stimuli.

What follows from the arguments above is that our patient may get cues from morphology in Greek—hence her better performance on MoodP, NegP, and AspeP-related adverbs—but not in English where such cues are not available. Hence, the patient of this study has selective deficits with the strictly syntactic aspects of verb movement (cf. Bastiaanse & van Zonneveld, 1998); consequently, it can be suggested that the patient’s deficit is highly restricted to the syntactic sub-component of language.

To conclude, in this study we have tested the performance of a Greek–English speaking patient on adverb placement through a production and comprehension task. Although the patient performed better on the comprehension than the production task, her performance was determined to a great extent by tree hierarchy in both tasks. The aphasic’s better performance in Greek than in English in the production task has been interpreted in terms of parameterization of verb movement imposed by the specific properties of English and Greek. Her performance is penetrated by a syntactic deficit in verb movement manifested in English but not in Greek.

Appendix A. grafo ‘write’

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Imperfective</th>
<th>Perfective</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Active</td>
<td>Non-active</td>
</tr>
<tr>
<td>Non-past</td>
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<td>graf-ome</td>
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<td>e-graf-an</td>
<td>graf-ontan</td>
</tr>
</tbody>
</table>

Appendix B

B.1. High specifier adverbs: Speaker-oriented and modal

In English (4)
Fortunately, unfortunately, personally, honestly.

In Greek (4)
Fortunately (eftihos), unfortunately (distihos), personally (prosopika), honestly (ilikrina).

Modal adverbs

In English (3)
Perhaps, possibly, presumably.

In Greek (3)
Perhaps (pithanos), presumably (profanos), perhaps (isos).

B.2. Low specifier adverbs: Aspectuals and negative

Aspectual adverbs

In English (4)
Already, just, hardly, as soon as.

In Greek (3)
Already (idi), just (molis), as soon as (amesos).

Negation adverbs

In English (4)
No longer, any more, yet, at all.

In Greek (3)
Anymore (pia), yet (akomi), at all (katholou).

---

10 cf. Grodzinsky and Finkel (1998), who argued that structures that involve movement of non-phrasal categories tend to remain intact, while structures that involve movement of phrasal categories cause interpretive difficulties in comprehension.
B.3. Complement adverbs

Manner adverbs

In English (8)
Gracefully, politely, cleverly, badly, carelessly, fast, angrily, strongly.

In Greek (8)
Well (kala), badly (ashima), politely (evgenika), carelessly (kseniasta), cleverly (ekspina), anxiously (anisihitika), strongly (dinata), fast (grigora).

References

Taspkini, K., Jarema, G., & Kehayia, E. (2002). The role of verbal morphology in aphasia during lexical access: Evidence from Greek.

