

Functional Categories and Clause Structure in a Greek-English Speaking Bilingual Patient with Broca's Aphasia: Evidence from Adverb Placement¹

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1. Introduction

Recently, types of language impairment associated with damage in Broca's area have been the focus of an increasing number of cross-linguistic studies. There are at least two reasons for this. First, it has been observed that manifestations of Broca's aphasia differ across languages, and thus the cross-linguistic evidence is crucial in order to understand better the nature of linguistic disorders in aphasic performance. Second, the Principles and Parameters theory of Universal Grammar (Chomsky, 1981, 1986, 1995; Chomsky & Lasnik 1993) offers a fruitful framework to account for the variation attested in aphasic performance across languages. For instance, preserved or damaged language-particular elements are likely to be due to a retained or not value of a certain parameter in the language in question.

A unique opportunity of studying the effect of brain damage to different linguistic systems simultaneously is offered by bilingual and multilingual aphasics. If the particular language structure has 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. These theories attribute the language deficits in aphasia to different factors, such as consistent problems with the CP-layer (Grodzinsky, 2000; Friedmann, 2001), difficulties in verb movement (Bastiaanse & van Zonneveld, 1998), unspecification of the [+Past] feature of the T/INFL category (Wenzlaff & Clahsen, in press), or problems with the process of accessing and using grammatical knowledge (Crain et al., 2001).

Apart from the specific language-dependent disorders in bilingual aphasia, current research has also examined whether there are differences in linguistic disorders in aphasia across languages with respect to the degree of severity. The issue of whether the two languages were acquired and used as in the same contexts as opposed to different contexts at different times of development became a central one in the study of bilingual aphasia. Great variation across patients has been found since all the possible patterns of performance were attested from the acute to the late phase: similar performance in

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both languages, greater impairment of L2, greater impairment of L1 (Fabbro, 1999; Paradis, 1977). Hence, the effect of the way (e.g. spontaneously or not) and time (e.g. early or not) of language acquisition upon aphasic linguistic performance is not quite clear.

In this paper, we focus on the architecture of clause structure and verb movement as these can be seen through the study of adverb placement in the grammar of a bilingual patient with Broca's aphasia and mild agrammatism, who is speaking two languages with different surface properties, namely Greek and English. The aphasic performance on adverb placement has been used as a diagnostic criterion for the presence or not of functional categories in aphasic sentence representation (Lonzi & Luzzatti, 1993). In particular, Lonzi & 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 & Luzzatti (1993) have suggested that the functional category Infl must exist in agrammatic grammar.

Following Lonzi & Luzzatti (1993), we assume that adverbs are a valid diagnostic for the presence of clause structure layers and draw conclusions as to which part of the clause structure is preserved or impaired in the grammar of the two languages on the basis of the behavior of our patient with respect to adverb placement. Consequently, the aims of this study are defined as follows. We first aim at investigating whether the complete clause structure is preserved in the Greek as well as the English grammar of our patient; second, we aim at exploring whether our patient manifests the same language deficits with the same degree of severity in both languages. Finally, we offer an account of the patient's performance on adverb placement across her two languages and discuss the implications of this performance for current theoretical approaches developed to account for the linguistic deficits in Broca's aphasia.

2. Theoretical background: clause structure and adverb placement

The examination of the performance of a Greek-English speaking patient with Broca's aphasia on adverb placement through different tasks in both Greek and English language enables us to get a straightforward evidence of the sentence structure in her grammar. This is so for the following reason. In the recent syntactic literature, adverbs are viewed as closely related to clausal architecture. In particular, the traditional distinction into Sentence and VP adverbs has been re-interpreted as follows. Lonzi & Luzzatti (1993), and Alexiadou (1997) distinguish between so called complement adverbs and so called specifier adverbs. The latter have their base position to the left of the verb. They are non-thematic adverbs, which they are necessarily VP-external. It has been proposed that such adverbs are directly merged as specifiers of functional heads (Alexiadou 1997, Cinque 1999, in the spirit of Kayne 1994). This hypothesis partly embedded within the framework of *Antisymmetry* (see Kayne 1994), is closely related to the research on the type and content of functional projections which constitute the clausal architecture. It crucially builds on the transparent semantic relation that can be observed crosslinguistically between projections and adverbs, which is very much suggestive of a Spec-head relation. The group of specifier adverbs comprises the set of sentence modifiers and of verb-group modifiers, i.e. evaluative adverbs e.g. *honestly*, speaker oriented adverbs e.g. *fortunately*, modal adverbs e.g. *probably*, domain adverbs e.g. *financially*, subject-oriented adverbs e.g. *cleverly*, frequency adverbs e.g. *frequently*, aspectual adverbs e.g. *always*, degree adverbs, negative adverbs and so on. These enter agreement relations with the functional heads in the clause. For instance, a modal adverb will appear in the specifier of MoodP, an evaluative adverb will appear in the specifier of CP, a negative adverb will appear in Spec,NegP, an aspectual adverb will appear in the specifier of Aspect. Here the term VP-external adverbs includes higher, CP- and MoodP-level adverbs, and lower ones, NegP and AspP related adverbs. In languages with V-movement, low-adverbs are crossed by the verb, while high ones, i.e. CP ones appear to its left. Hence the distribution of low specifier adverbs (in connection with verbal elements) is a crucial diagnostic both for the presence of V-movement and for the presence of the functional categories associated with them.

Complement-type adverbs, on the other hand, have their base position to the right of the verb, hence they are merged VP internally. To this group belong the set of *verb-modifiers*, i.e.

manner/instrumental adverbs and so on. These adverbs contribute to event individuation and are no different from argument DPs (McConnell-Ginet 1982, Larson 1988 among others). Such adverbs are normally never crossed by V-movement, unless they themselves undergo movement to specifiers of functional projections for licensing purposes and only under special circumstances. For instance, manner adverbs have been argued to be in close connection with Voice, and to move to Spec, VoiceP in Alexiadou (1997).

On the above view, the presence of adverbs in the clause structure is directly related with the presence of a functional layer that is responsible for its licensing. It follows then that, if certain adverbs are specifiers of functional projections universally, they should be situated in the same position across languages. Differences that exist among the individual languages are reduced to (a) morphological properties as is proposed in Borer (1984) and Chomsky (1995) and (b) the presence vs. absence of verb movement.

We assume that both English and Greek have the minimal structure in (1). (2) illustrates the mapping between adverbs and functional projections:

- (1) [CP [MoodP [AgrSP [TP [(NegP) [AspP [(Asp2P) [VoiceP [VP]]]]]]]]]]
 (2) CP^{efithos} -MoodP^{piathanos} -TP^{ktes} -(NegP^{pja}) - AspP^{sinithos} -(Asp2P^{endelos}) - VoiceP^{kala}
 fortunately probably yesterday anymore usually completely well

As is clear from (1-2), we only focus on a sub-group of the type of adverbs that have been discussed in the recent literature (see e.g. Cinque 1999 for extensive discussion). The group of adverbs we label here specifier adverbs involves: (i) adverbs which belong to the left periphery of the clause such as CP-level and modal adverbs, (ii) adverbs belonging to the lower functional part of the clause such as aspectual and negative adverbs. Our complement adverbs crucially involve adverbs belonging to the class of manner adverbs (see Appendix 2).² Since CP-adverbs are connected to the presence of the CP layer, the study of their distribution will bring insight into the question of whether language deficits in aphasia are related to problems with the CP-layer. The study of lower specifier adverbs is directly linked to both the presence of further inflectional categories and the presence of movement in the grammar of our patient. In other words, This specific view on adverbs enables us to approach cases of bilingual aphasia in a novel way. First, it enables us to draw conclusions on the parts of the aphasic clause structure, which are preserved or impaired. Second, this specific view on adverbs allows us to investigate whether she presents more deficits in the one language than in the other. If the patient exhibits variation in her performance across her two languages, then we should examine the possible factors that contribute to the differentiated performance.

Assuming that Greek and English have the structure in (1-2), we can observe the following differences between the two languages. First, Greek is a null subject language that exhibits V-movement (see e.g. Rivero 1994, Alexiadou & Anagnostopoulou 1998 and others). In particular the finite verb moves to the highest category in Infl, namely (Agr)/T. Evidence for this comes from the observation that, in the unmarked case, the finite verb precedes all adverbs generated in the left periphery of the VP, i.e. specifier adverbs (see above):

- (3) diavaze sihna to mathima
 read-1sg often the lesson
 He was reading the lesson often

In addition, participles can also move in Greek, though not as high as the finite verb. They have been argued to move at least as high as Asp^o; see Alexiadou (1997) for arguments based on the distribution of adverbs.

As is well known, English lacks both overt finite main verb movement to Infl as well as participial movement (Pollock 1989, Chomsky 1995). Both the main verb and the participle remain below the specifier adverbs situated close to (or at) the VP border. In English only auxiliaries move to Infl (5):

² In our discussion we leave out temporal adverbs, which have been argued in the literature to pattern like complement adverbs, although arguably their licensing position is Spec,TP.

- (4) Peter often kisses Mary
 (5) Peter has already read the book carefully

Greek further has a number of modal particles, which have been argued to occupy MoodP: *na* and *tha*, the latter used primarily to mark future tense (see Alexiadou & Anagnostopoulou 2000 for an overview of the literature on Greek syntax and the status of particles). In addition Greek marks aspectual, i.e. perfective vs. imperfective, as well as voice, i.e. active- vs. non-active, distinctions morphologically (see Appendix 1). Such distinctions are not found in English which uses modal and auxiliary verbs instead.

3. The study

3.1 The subject

KS is a 32-year-old, right-handed woman. 30 months before entering our study, she suffered a stroke due to an ischemic infarct in the left hemisphere, as shown by neuroimaging data. She presented with right hemiplegia. She has been diagnosed as Broca's aphasic on the basis of the Boston Diagnostic Aphasia Exam³ (Goodglass & Kaplan, 1982) and clinical consensus among by neurologists and speech therapists. At the time of testing, her speech was consistently non-fluent in both Greek and English. She occasionally exhibited mild agrammatic characteristics in both languages. A brief assessment of the patient's morphosyntactic abilities based on spontaneous speech data was carried out. The patient produced few errors in both languages as shown in Table 1.

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

	OMISSIONS				SUBSTITUTIONS			
	ART	AGR-S	TENSE	NEG	ART	AGR-S	TENSE	NEG
Greek	3/12 (25%)					1/20 (5%)	2/19 (10.5%)	
English	4/18 (22.22%)	1/15 (6.7%)	4/16 (25%)					4/14 (28.57%)

There were some instances of definite article omission in both Greek and English, 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 1st person plural ending instead of the 2nd one, and the present tense ending instead of the past one. She 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. It should be noted 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 marker *will* in English. *Na* was produced in very simple structures, such '*na pao?*' (= Shall I go?). The patient produced simple wh-questions, but she did not produce embedded structures in either Greek or English.

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 L1 but and English is her L2 that was used 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). Immediately after her

³ A Greek version of the Boston Diagnostic Aphasia Exam was also used.

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 it⁴ (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 this 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, 1997). She told us that, being a teacher of English, she knew the rules of grammar and applied them carefully, but she was very unhappy because she spoke very slowly and was unable to produce long sentences. Specifically, she tried to plan what she would say before saying it (cf. Schlenck et al. 1987); also she was aware of her erroneous speech and frequently produced self-corrections (cf. Marshall & Tomkins, 1982; Marshall et al. 1985).

There were three control groups for the aphasic patient of this study: two groups of 5 native speakers of Greek and 5 native speakers of English and one group of 5 Greek teachers of English. All groups were matched to the aphasic patient on the basis of chronological age and years of education. The control group of Greek teachers of English met the following additional criteria. First, all these teachers had studied and lived in UK or USA for at least 7-8 years; second, all of them have been working as teachers of English in Greece for about 10 years at the time of testing. The reasoning behind the participation of this control group in the study is the following. The patient of this study had near native performance in English before her CVA but nevertheless she is not a native speaker of English, since she was taught English in school. Therefore, English is her L2 whereas Greek is her L1. Comparing the performance of the patient with that of subjects who have similar educational and professional background to her allows us to investigate whether the performance of the aphasic patient on the tasks in English is comparable or not to that of the control subjects. In so doing, we will be able to examine whether the patient's performance on tasks in English is simply the result of the way and time she acquired English. Specifically, if the same pattern of incorrect performance is exhibited by both the patient and the control group of the Greek teachers of English on the experimental tasks in English, then the patient's performance can be explained as a result of the non-native way of English L2 acquisition.

3.2 Design and materials

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

(i) 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. The patient was presented with the stimuli on separate cardboard tasks. Since she suffered a slight reading deficit associated with function words, she was 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. All control groups were presented with the same material in order to check whether the patient's preferences were in accordance or not with those of native speakers.

(ii) A contrastive grammaticality judgment task, made up by 60 sentences in English and other 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 3-4 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 3-4 sentences. All possible adverb places were included: sentence initial and final position, between the sentence

⁴ We are grateful to the speech therapist of KS for a detailed discussion on KS's linguistic performance on different tasks from the acute to the late stage.

subject and the main/auxiliary verb, and between the main and auxiliary verb, or the main verb and the verb complement. The patient presented with 3 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

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). The test sentences were also given to all control groups and so comparisons between the performance of the aphasic patient with the native unimpaired speakers of both languages and Greek learners of English L2 were made possible. 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

Filler items were also included in the stimuli presented to the patient.

3.3 Results

3.3.1 Constituent ordering task

The subjects' responses were classified as correct, incorrect, and marked responses. As far as the classification of the responses is concerned, it should be noted that correct responses were the grammatical and unmarked ones. Incorrect responses included ungrammatical responses, i.e. the responses including grammatical violations of adverb placement. Finally, marked responses with respect to adverb placement were those that were not completely impossible in both languages but could occur under certain context requirements. 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.⁵ This is so for the following reason. Although these orders are not ungrammatical in the strict sense, accounts of the patterns in which the adverb follows the subject claim either that the adverb is a parenthetical in which case the adverb is not really part of the main tree (Williams) 1994 or that the subject is

⁵ 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*.

topicalized (see Belletti 1990). The latter account seems problematic as it is quite unlikely that subjects in English undergo 'short-distance' topicalization (see the discussion in Lasnik & Saito 1992: 110). It seems then 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. The same holds for the respective Greek order, as Alexiadou (1997) has argued in detail that DP-Adv orders in Greek involve adverbs as well as subjects in dislocated positions (see Alexiadou (1997) and Alexiadou & Anagnostopoulou (1998) for further discussion).

For the other classes 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 or to 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. 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.

In Tables 2 and 3, the word order of the attested correct, incorrect and marked responses of the patient in Greek and English are presented respectively. It should be noted that due to the null subject nature of Greek in some of the aphasic patients responses, the initial DP (the subject) was not included, since it was not also included in the material presented to the patient.

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

ADVERB TYPE/ LAYER	CORRECT	INCORRECT	MARKED RESPONSES
Speaker oriented adverbs/ CP layer	Adverb-DP-Verb (+finite)-DP	DP-Verb(+finite)-DP- Adverb DP-Aux-Participle-DP- Adverb	DP-Verb(+finite)-Adverb-DP DP-Aux-Adv-Participle-DP
Modal adverbs/ MoodP layer	Adverb-DP-Verb (+finite)-DP		DP-Adverb-Verb (+finite)-DP DP-Aux-Adv-Participle-DP
Negation Adverbs/ NegP layer	DP-Neg-Aux-Participle- Adv(akomi) DP-Neg-Mod-part-Verb- Adv(pia)-DP	Neg-ADV-DP-Aux- Participle-DP	Adv-Neg- Aux-Prt-DP DP-Neg-Aux-Prt-Adv-DP
Aspectual adverbs/ AspectP layer	DP-Aux-Adv-Participle- DP		Adverb-DP-Verb (+finite)-DP
Manner adverbs/ VP layer	DP-Verb (+finite)-DP- Adverb DP-Aux-Participle-DP- Adverb		Adverb-DP-Verb (+finite)-DP

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

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

ADVERB TYPE/ LAYER	CORRECT	INCORRECT	MARKED RESPONSES
Speaker oriented adverbs/ CP layer	Adverb-DP-Verb (+finite)-DP	DP-Verb (+finite)-DP-Adverb DP-Aux-Participle-DP-Adverb	DP-Adverb-Verb (+finite)-DP DP-Aux-Adv-Participle-DP
Modal adverbs/ MoodP layer	DP-Verb (+finite)-Adverb-DP	DP-Verb (+finite)-DP-Adverb DP-Aux-Participle-DP-Adverb	DP-Verb (+finite)-Adverb-DP DP-Adverb-Verb (+finite)-DP DP-Adv-Aux-Participle-DP DP-Aux-Adv-Participle-DP
Negation adverbs/ NegP layer	DP-Aux-Neg-Participle-DP-Adverb- (anymore)	DP-Neg-Verb-Adv-Aux Neg-DP-Verb-Adv	DP-Aux-Neg-Participle-Adverb-DP DP-Aux-Neg-Part-DP-Adv(yet)
Aspectual adverbs/ AspectP layer	DP-Aux-Adv-Participle-DP	Adverb-DP-Verb (+finite)-DP	
Manner adverbs/ VP layer	DP-Verb (+finite)-DP-Adverb		DP-Adverb-Verb (+finite)-DP

Table 4. The aphasic patient's performance on the constituent ordering task: correct, incorrect and marked responses

ADVERB TYPE/TREE LAYER	CORRECT RESPONSES		INCORRECT RESPONSES		MARKED RESPONSES	
	GREEK	ENGLISH	GREEK	ENGLISH	GREEK	ENGLISH
Speaker oriented adverbs/CP layer	3/12 (25%)	2/12 (16.66%)	7/12 (58.33%)	5/12 (41.66%)	2/12 (16.66%)	5/12 (41.66%)
Modal adverbs/MoodP layer	4/12 (33.33%)			5/12 (41.66%)	8/12 (66.66%)	7/12 (58.33%)
Negation adverbs/NegP layer	7/12 (58.33%)	3/12 (25%)	2/12 (16.6%)	4/12 (33.33%)	3/12 (25%)	5/12 (41.66%)
Aspectual adverbs/AspecP layer	9/12 (75%)	5/12 (41.66%)		7/12 (58.33%)	3/12 (25%)	
Manner adverbs/VP layer	11/12 (91.66%)	10/12 (83.33%)			1/12 (8.33%)	2/12 (16.66%)

As shown in Table 4, the patient performed better on MoodP, AspectP, and NegP adverbs in Greek than in English but she showed the same pattern on performance on CP and VP adverbs in both languages: low level of performance on CP adverbs and high level of performance on VP adverbs.

Let us now compare the performance of our patient to that of Greek and English native speakers.

Table 5. The performance of Greek and English native speakers on the constituent ordering task

ADVERB TYPE/TREE LAYER	CORRECT		INCORRECT		MARKED RESPONSES	
	GREEK	ENGLISH	GREEK	ENGLISH	GREEK	ENGLISH
Speaker oriented adverbs/CP layer	57/60 (95%)	58/60 (96.66%)	1/60 (1.66%)		2/60 (3.33%)	2/60 (3.33%)
Modal adverbs/MoodP layer	57/60 (95%)	55/60 (91.66%)		3/60 (5%)	3/60 (5%)	2/60 (3.33%)
Negation adverbs/NegP layer	59/60 (98.3 %)	57/60 (95%)		1/60 (1.66%)	1/60 (1.66%)	2/60 (3.33%)
Aspectual adverbs/AspectP layer	56/60 (93.3%)	57/60 (95%)			4/60 (6.66%)	3/60 (5%)
Manner adverbs/VP layer	59/60 (98.3%)	58/60 (96.6%)			1/60 (1.6%)	2/60 (3.33%)

With respect to the number of incorrect responses, it should be noted that the patient showed a pattern of performance relatively comparable to that of the control group of Greek native speakers on modal, aspectual, and manner adverbs as well as on negation adverbs. Recall that the patient produced no

incorrect responses on modal, aspectual, and manner adverbs whereas she produced just 2 incorrect responses on negation adverbs. However, a sharp dissociation between the performance of the control group and the patient's performance on CP-related adverbs was attested, as more than half of the patient's responses were classified as incorrect. Interestingly, the patient's performance on CP- NegP- MoodP- and AspectP related adverbs was less identical to that of the control group of English native speakers. This is so because the patient consistently made errors while producing structures involving the above adverbial types, whereas few incorrect responses were produced by English native speakers on structures including NegP and ModalP related adverbs. Finally, the patient's performance on manner adverb placement in English is comparable to that of native speakers of English.

Let us now consider the performance of Greek teachers of English. As shown in Table 6, they performed more closely to the group of the native speakers of English than to the aphasic patient as few incorrect responses were found in the placement of CP, NegP, MoodP, and AspectP related adverbs where the patient had the most difficulties. A slight drop of performance of the Greek teachers of English occurred in the MoodP related adverbs; however, there were few ungrammatical responses, since the most non-target responses were marked ones, and in any case the performance of the Greek teachers of English was not identical to that of the aphasic patient; recall that no correct response was produced by the aphasic patient on the MoodP related adverbs placement in English. Therefore, the performance of the patient on adverb placement in English, and especially the drop of her performance on CP, MoodP, NegP, and AspectP related adverbs cannot be explained in terms of the fact that English is the L2 language for the aphasic patient, since the control subjects show a different pattern of performance than the aphasic patient; consequently, the drop of the aphasic performance on CP, MoodP, NegP, and AspectP related adverbs in English may be due to the CVA she suffered⁶.

Table 6. The performance of the Greek teachers of English on adverb placement in English (constituent ordering task)

ADVERB TYPE/TREE LAYER	CORRECT	INCORRECT	MARKED RESPONSES
Speaker oriented adverbs/CP layer	57/60 (95%)		3/60 (5%)
Modal adverbs/MoodP layer	49/60 (81.66%)	4/60 (6.66%)	7/60 (11.66%)
Negation adverbs/NegP layer	52/60 (86.66%)		8/60 (13.33%)
Aspectual adverbs/AspectP layer	58/60 (96.66%)		2/60 (3.33%)
Manner adverbs/VP layer	57/60 (95%)		3/60 (5%)

3.3.2 Contrastive grammaticality judgment task

Analysis on 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,

⁶ It should be noted that we have not made any independent measurement of the patient's linguistic abilities in English adverbs before her CVA. Based on her educational and professional background as described in Section 3.1, we assume that her knowledge of English before her CVA should be similar to the control subjects. It should also be noted that errors that produced by our aphasic patient, e.g. errors in negation adverb placement where the auxiliary verb *does* occupies the final position are not produced even from non-fluent Greek speakers of English. Hence, the patient's performance on the placement on particular adverbs in English may be due to her CVA rather than to fossilized problems with particular aspects of English language. We thank Michaela Wenzlaff for underlying this point to us.

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 7 & 8 where the word order of the preferred (judged as grammatical by the patient) structures is presented for Greek and English. In table 9 the results from the grammaticality judgment task are presented.

Table 7. Contrastive grammaticality judgment task: Word order of the preferred structures in Greek

ADVERB TYPE/ LAYER	CORRECT	INCORRECT	MARKED RESPONSES
Speaker oriented adverbs/ CP layer	Adverb-DP-Verb (+finite)-DP	DP-Verb(+finite)-DP-Adverb DP-Aux-Participle-DP-Adverb	DP-Verb(+finite)-Adverb-DP
Modal adverbs/ MoodP layer	Adverb-DP-Verb (+finite)-DP		DP-Verb (+finite)-Adverb-DP DP-Adverb-Verb (+finite)-DP DP-Adv-Aux-Participle-DP
Negation Adverbs/ NegP layer	DP-Neg-Aux-Participle-DP-Adv DP-Neg-Mod-part-Verb-Adv(pia)-DP		DP-Neg- Aux-Adv-Prt-DP
Aspectual adverbs/ AspectP layer	DP-Aux-Adv-Participle-DP		Adverb-DP-Verb (+finite)-DP
Manner adverbs/ VP layer	DP-Verb (+finite)-DP-Adverb DP-Aux-Participle-DP-Adverb		Adverb-DP-Verb (+finite)-DP

Table 8. Contrastive grammaticality judgment task: Word order of the preferred structures in English

ADVERB TYPE/ LAYER	CORRECT	INCORRECT	MARKED RESPONSES
Speaker oriented adverbs/ CP layer	Adverb-DP-Verb (+finite)-DP	DP-Verb (+finite)-DP-Adverb DP-Aux-Participle-DP-Adverb	DP-Adv-Aux-Participle-DP
Modal adverbs/ MoodP layer	DP-Verb (+finite)-Adverb-DP	DP-Verb (+finite)-DP-Adverb DP-Aux-Participle-DP-Adverb	DP-Verb (+finite)-Adverb-DP DP-Aux-Adv-Participle-DP
Negation adverbs/ NegP layer	DP-Aux-Neg-Participle-DP-Adverb	Adverb-DP-Aux-Neg-Participle-DP	
Aspectual adverbs/ AspectP layer	DP-Aux-Adv-Participle-DP	Adverb-DP-Verb (+finite)-DP	
Manner adverbs/ VP layer	DP-Verb (+finite)-DP-Adverb	Adverb-DP-Verb (+finite)-DP	

Table 9. The aphasic patient's performance on the contrastive grammaticality judgment task

ADVERB TYPE/ LAYER	CORRECT		INCORRECT		MARKED RESPONSES	
	GREEK	ENGLISH	GREEK	ENGLISH	GREEK	ENGLISH
Speaker oriented adverbs/CP layer	8/12 (66.66%)	7/12 (58.33%)	2/12 (16.66%)	4/12 (33.33%)	2/12 (16.66%)	1/12 (8.33%)
Modal adverbs/MoodP layer	9/12 (75%)	6/12 (50%)		3/12 (25%)	3/12 (25%)	3/12 (25%)
Negation adverbs/NegP layer	10/12 (83.33%)	9/12 (75%)		3/12 (25%)	2/12 (16.66%)	
Aspectual adverbs/AspectP layer	11/12 (91.66%)	10/12 (83.33%)		2/12 (16.66%)	1/12 (8.33%)	
Manner adverbs/VP layer	10/12 (83.33%)	11/12 (91.66%)		1/12 (8.33%)	2/12 (16.66%)	

It should be noted that the aphasic patient's performance was better on grammaticality judgment task than on constituent ordering task. Apart from exhibiting better performance on the second task, the patient's correct performance on this task did not indicate any dissociation between Greek and English with respect to the Negation, Modal, and Aspectual adverbs, as similar performance was found. 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 the grammatical knowledge required for correct grammatical judgments in both Greek and English, her performance in Greek was facilitated for some reason.

Let us now consider the aphasic performance on judging adverb placement compared to the performance of Greek and English native speakers. In general, the patient's performance is close to that of normal speakers on adverb placement with the exception of CP and MoodP related adverbs in English where the patient's performance drops slightly. Note that normal subjects exhibited correct performance in almost all cases, since only in 2 cases (2/60) the incorrect structures including modal adverbs were classified as correct ones by English speakers. Moreover, there were 2 cases (2/60) where the marked restructures including negation adverbs were preferred by English speakers and 2 marked structures including modal adverbs were thought to be correct by Greek speakers (2/60). Furthermore, the performance of Greek teachers of English is closer to that of native speakers of English than to that of the aphasic patient, since they prefer the marked rather than the incorrect structure when they do prefer the correct one. Consider Table 10 where this pattern of performance is presented.

Table 10. The performance of the Greek teachers of English on adverb placement in English (grammaticality judgment task)

ADVERB TYPE/TREE LAYER	CORRECT	INCORRECT	MARKED RESPONSES
Speaker oriented adverbs/CP layer	58/60 (96.66%)		2/60 (3.33%)
Modal adverbs/MoodP layer	50/60 (83.33%)	3/60 (5%)	7/60 (11.66%)
Negation adverbs/NegP layer	55/60 (91.66%)		5/60 (8.33%)
Aspectual adverbs/AspectP layer	59/60 (98.33%)		1/60 (1.66%)
Manner adverbs/VP layer	56/60 (93.33%)	1/60 (1.66%)	3/60 (5%)

4. Discussion

Across two experiments, the performance of a Greek-English bilingual patient with Broca's aphasia on adverb placement has been examined. This performance was compared to that of native speakers of English and Greek and that of Greek speakers of English who studied and lived in an English-speaking country and worked about 10 years as teachers of English in Greece.

Let us summarize the results of the first experiment. First, we observe that the incorrect responses produced were not equally scattered across Greek and English. Specifically, they concerned the CP adverbs in Greek and CP, modal, negation, and aspectual adverbs in English. Second, quite often the patient resorted to the marked response instead of producing an ungrammatical one when she did not produce the correct unmarked responses; this can be interpreted as indicative of the patient's grammatical sensitivity as the patient did not produce an ungrammatical response. Third, the patient performed almost at ceiling on manner adverb placement in both languages. Interestingly, the patient exhibited a parallel pattern of performance to that of the non-impaired speakers of English and Greek

(the Greek teachers of English are included) with the exception of the CP related adverbs in English and Greek and NegP, MoodP, and AspectP in English. The results from the second experiment indicated the patient's better performance on grammaticality judgment task than on constituent ordering task; they also show that the patient resorted to ungrammatical choices in English and marked in Greek, when she failed to produce the correct judgment.

Let us now consider what these results show for the clause structure in the Greek-English grammar of the aphasic patient. We start from these points of the aphasic performance, which are similar in both languages.

On the one hand, the lowest correct performance across both languages was attested on the CP-related adverbs, as shown by the first experiment. Such difficulties may indicate problems with the highest projections of grammar; 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 & Grodzinsky, 1997; Friedmann, 2001; 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). Interestingly, the performance of the aphasic patient on the CP-related adverbs goes up while she was judging the grammaticality of the test structures. This may indicate that the accessibility of the CP domain is not totally lost at least for the patient of this study. Therefore, our patient exhibits modality dependent performance, as the CP-related deficits hold mainly for the production modality⁷. On the other hand, 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 highest part of the syntactic tree is severely impaired and thus suggest that the hierarchical structure of the syntactic tree has a psychological reality (cf. Friedmann, 2001, 2002).

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. Hence the first generalization that emerges is the following: the CP and VP domains are language independent, but language dependent performance is exhibited on MoodP, NegP, and AspectP, as the patient performed better in Greek than in English. The question that arises at this point is why the patient exhibits a language dependent performance across the MoodP, NegP⁸, and AspectP related adverbs. Let us now consider some possible explanations of this pattern of performance.

A possible explanation could be 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. Therefore, the better performance of the patient on the MoodP, NegP, and AspectP related adverbs in Greek might be due to the fact that Greek is her mother tongue. If we adopt this line of reasoning then we should answer the following questions. 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.

A promising way of considering this differentiated pattern of performance of the aphasic patient on the adverb placement is to relate it to the particular linguistic properties of each language. In other words, there should be some particular properties of Greek that facilitate the performance of the aphasic

⁷ For modality effects on the performance of Greek patients with Broca's aphasia and agrammatic speech, see Stavrakaki & Kouvava (in press). It should be noted that the patients in that study performed better on grammaticality judgment tasks than on spontaneous speech even with respect to structures associated with the CP layer.

⁸ Recall that the NegP in question is the low negation, the one immediately below T that is present in both languages.

patient on the MoodP, NegP, and AspectP related adverbs. This hypothesis leads us to adopt 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 language system (Paradis, 1988). The various manifestations of aphasia are predictably different in different languages. Following this line of reasoning, a possible explanation of this dissociation between the aphasic 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. As mentioned in section 2, 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. English, on the other hand, lacks the particle, agreement and aspectual system of Greek. In spontaneous speech the patient produces the modal particles *na* (=to) and *tha* (=will). Hence this suggests that MoodP exists in her grammar.⁹ The fact that she orders the lower adverbs and the verb correctly suggests that a category hosting the finite verb, Agr/T, also exists in her grammar. As a result, the patient seems to be sensitive to the presence of verb-movement in Greek. This is presumably related to the fact that Greek verbs show rich agreement properties, and the patient uses these morphological properties as a helping device.¹⁰ In addition, the aspectual marking of Greek verbs and the participle functions as cue for the patient that a close connection (agreement) exists between in particular aspectual adverbs and the relevant functional category. Therefore, morphology serves as a helping device to the patient in order for her to be able to correctly use the adverbs and hence her better performance in Greek. However, she uses the operation of V-movement wrongly in English in the structures where it should apply, namely Aux-to-T movement. Recall that English lacks V-to-T movement, and the presence of third person *-s* and past tense *-ed* is not considered as sufficient trigger for V-movement, in view of the fact that they do not mark robust distinctions/oppositions in the verbal system. In addition she has difficulties with correctly inserting *do* (and modals) in T/(Mood) in English. We take all this to suggest that T 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.¹¹ This pattern of performance is consistent with the spontaneous speech data where difficulties with the production of Neg were found (See Table 1). We can speculate whether the absence of agreement distinctions in English auxiliaries (*have* marks only 3rd person singular differently, *Be* marks 1st and 2nd person differently) make Agr/T invisible in English causing the problems our patient has with the ordering of the aux-adv. Note that in this case the adverb should be located in the specifier of the head hosting the auxiliary and hence at least as far as the adverb distribution is concerned it is correctly used.

The fact that the patient's performance is similar on CP- and VP-related adverbs across English and Greek in the production task, whereas it is parameterized on AspectP, NegP, and MoodP related adverbs suggests that the patient's performance is crucially related to the grammatical structure of each language: it remains similar when no parametric differences exist between languages (CP and VP domain) and differentiated across languages when parameterization occurs. In other words, the variation of the linguistic performance of the patient was exhibited to those adverbs related to the properties of the inflectional system of languages. According to Borer (1984), cross-linguistic differences are reduced to the inflectional systems of languages, hence we expect to find differences in inflectional projections, but not in e.g. propositional ones such as CP and VP. The patient's performance seems to reflect the way in which cross-linguistic differences are coded in languages, hence the better performance in Greek only with respect to the adverbs related to the inflectional system of Greek. As she is able to apply the operation of verb movement better in Greek where morphological

⁹ 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's hierarchy).

¹⁰ By this we do not mean that rich verbal morphology is the trigger for verb movement.

¹¹ See Bastiaanse et al. (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.

cues are available, her problems may be associated with syntactic rather than morphological operations. That is, the purely syntactic nature of auxiliary movement in English has a decreasing effect on her correct performance on adverb placement. In this respect, the patient's deficit seems to be restricted to the syntactic procedure of verb movement in the relative absence of morphological cues, as the patient exhibits sensitivity to the relation between morphological properties and verb movement. Consequently, it can be suggested that the patient's deficit is highly restricted to the syntactic subcomponent of language. This conclusion is in agreement with recent suggestions made by Bastiaanse and colleagues (cf. Bastiaanse & van Zonneveld, 1998; Bastiaanse et al., 2002) for the nature of the verb related problems in agrammatic aphasia. Specifically, it has been suggested that a syntactic and not a morphological deficit underlies the performance of Dutch agrammatic aphasics while producing finite lexical verbs since they produce finite verbs in the base-generated non-moved position significantly better than finite verbs that have been moved to the second position. Our data suggest that not only morphology is not a problem for the aphasic patients but also it has the role of the helping device in aphasic performance as shown by the different performance of our patient in Greek and English. Our findings highlight the syntactic nature of deficits in verb movement in aphasia from a different perspective than the one adopted in the work of Bastiaanse and colleagues.

Interestingly, the patient did not show the same dissociation between her performance on MoodP, NegP, and AspectP related adverbs in the grammaticality judgment task. However, her tendency to prefer marked structures in Greek and incorrect in English, while failing in choosing the correct structure indicates again that her performance is facilitated by the specific properties of Greek.

The language dependent performance of the patient on those aspects of languages that are parameterized gives further support to the hypothesis whereby grammatical disorders in aphasia depend on the structure of each language (Fabbro 2001; Paradis, 1988). Apart from the parameterized aspects of languages, her performance appears to be similar on remaining domains (VP-CP). Interestingly, the dissociation of the aphasic performance between the two languages is closely associated with the application of pure syntactic operations, i.e. the operation of verb movement. Based on this evidence, we argue that although the patient exhibited parallel pattern of performance on her two languages, her better performance on L1 is closely related to the linguistic peculiarities of both language and the wrongly application of a pure syntactic operation in English, i.e. the operation of verb movement.

To conclude, in this paper we have presented a case of a Greek-English bilingual patient; we studied her clause structure through the examination of her adverb placement abilities across different tasks. Based on the results, we have argued that her performance is dependent on the linguistic properties of each language. We showed that although the patient performed similarly on VP and CP related adverbs, she exhibited better performance in Greek rather than English on MoodP, AspectP and NegP related adverbs in the constituent ordering task; this dissociation was directly attributed to the way in which verb movement occurs in English and Greek. Since verb movement in English is a restricted syntactic operation we argued that the problems of this aphasic patient with this operation are syntactic in nature. Since the performance of our patient is language dependent, we argued in favor of the hypothesis whereby grammatical disorders in aphasia depend on the specific language structure (cf. Paradis, 1988; Fabbro, 2001).

Appendix 1. Verb grafo 'write'

Aspect	Imperfective		Perfective	
Non-past	Active graf-o graf-is graf-i graf-ume graf-ete graf-un	Non Active graf-ome graf-ese graf-ete graf-omaste graf-osaste graf-onte	Active grap-s-o grap-s-is grap-s-i grap-s-ume grap-s-ete grap-s-un	Non-Active graf-t-o graf-t-is graf-t-i graf-t-ume graf-t-ite graf-t-un
Past	e-graf-a e-graf-es e-graf-e graf-ame graf-ate e-graf-an	graf-omun graf-osun graf-otan graf-omastan graf-osastan graf-ontan	e-grap-s-a e-grap-s-es e-grap-s-e grap-s-ame grap-s-ate e-grap-s-an	graf-tik-a graf-tik-es graf-tik-e graf-tik-ame graf-tik-ate graf-tik-an

Appendix 2

High specifier adverbs: speaker-oriented and modal

Speaker oriented adverbs

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).

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).

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).

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