

Greek neurolinguistics

The State of the Art*

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1. Introduction

As its name implies, neurolinguistics is the study of “how the brain permits us to have language” (Obler & Gjerlow 1999:1). The areas of study to which it refers, the relation between language and the brain as well as language breakdown and disorders, are much older than the term. Western Philosophy since its beginning has already addressed the question of the relation between language and the brain as part of the general question between mind and brain (Whitaker 1998). However, the scientific study of language–brain relationships began only in the last half of the nineteenth century: it was physicians who opened up the field of clinical aphasiology with their detailed descriptions of language disturbances after brain damage (Whitaker 1998, Caplan 1987). In 1861, one of those physicians, the neurologist Paul Broca, published the first truly scientific paper on language–brain relationship, as pointed out by Caplan (1987:46). Broca (1861) presented data from a patient known as ‘Tan’ or ‘Tan Tan’ in the literature, as ‘Tan’ was the only syllable he could speak. Despite being unable to get his message across, the patient showed relatively intact comprehension abilities.

A post-mortem examination of his brain showed the lesion was confined mostly to the lower areas of the left frontal lobe and in particular to a small part of the inferior frontal gyrus; that area became known as Broca’s area. Paul Broca contributed to the establishment of the study of aphasia as a part of clinical neurology and the nineteenth-century neuroscience. A careful examination of the papers published in the first century of work in the field shows that most of the observations were based on clinical reports of single case studies (Ca-

plan 1987). The early accounts of aphasia and language–brain relationships, therefore, were clinically derived accounts and, thus, subject to the limitations imposed by what can be observed clinically. A principal consideration of those clinically derived accounts was the distinction between localizationalist and holist approaches to the brain–language relationship; according to the former, the brain processes language through the operation of centres and connections whereas, according to the latter, the entire brain or at least large portions of the brain were responsible for particular language functions (see Caplan 1987, Whitaker 1998 for review of the literature). Despite any fundamental differences between localizationalist and holist approaches, it seems that localizationists and holists were similar in many respects: for example, many localizationists and, in particular, connectionists considered linguistic performance as the result of the integrated activity of different areas of the brain (Caplan 1987:138). Due to current developments in neuro-imaging techniques that enabled us to investigate the localization of language functions, the issue of cerebral localization for language has recently received considerable attention.

The development of neurolinguistic theory has been highly interwoven with linguistic aphasiology (Caplan 1987). The field of contemporary linguistic aphasiology started developing after the emergence of new approaches to the psychology of language, under the influence of Chomsky's theories of language, and models of language processing developed in psychology, as pointed out by Caplan (1987). Linguistic aphasiology has focussed on the effect that brain damage has on the adult language system; however, issues related to language development and lateralization in childhood (Lenneberg 1967) as well as to the effect of environmental factors on the brain–language relation, e.g. the effect of literacy on the brain–language relation, have also been investigated by neurolinguists.

Contemporary neurolinguistics is a highly interdisciplinary field whose establishment as a subject on its own only became possible when an increasing number of scientists from different fields, i.e. linguistics, psychology, speech and language pathology, and neuroscience, started to make their primary study the relationship between language and the brain (Caplan 1987). It raises research questions such as the following (Clahsen 2004:1): (1) What is the relationship between a disordered and a normal linguistic system? (2) What is the relationship between language acquisition and language loss? (3) How are language functions and language structures represented in the brain? (4) How does the functional specialization of the language areas in the brain emerge?

The contribution of linguistics has been quite crucial for the field's establishment and development. This is because contemporary neurolinguistics is

not limited to descriptive approaches to language impairments but also exploits linguistic theory in explaining the manifestation of language disorders and the language–brain relation. In fact, linguistics constitutes the theoretical apparatus necessary for capturing aspects of the language breakdown and language representation in the brain. Selective language impairment in cases of language breakdown and neural correlates of particular language functions can be better understood in the light of current approaches to phonology, morphology, syntax, semantics, and pragmatics.

Cross-linguistic studies afford us crucial new insights into the language–brain relationship. Investigations into the way in which the language system in different languages is related to brain structure and functions constitute a fruitful approach to neurolinguistics, since they allow us to evaluate competing neurolinguistic theories. Thus, there is strong motivation for these cross-linguistic comparisons: we should discover not only universal principles of language organization, but also systems set up to process language specific phenomena. Although the majority of neurolinguistic investigations have been conducted with English-speaking subjects, there is an increasing amount of work on languages structured differently from English.

Even though neurolinguistics constitutes a topic that has only recently started being extensively discussed for Greek, an increasing amount of work covering different areas in the field has already been produced. So far the main research areas in the field of Greek linguistics include (1) lateralization of language-processing components in illiteracy, (2) language abilities in acquired disorders, i.e. adult aphasia and dementia, and child aphasia, (3) language abilities in developmental disorders such as Specific Language Impairment (SLI), Williams syndrome (WS), Down's syndrome (DS), and finally, (4) neuro-imaging work on language processing. Some of the above research areas have not been studied intensively (e.g. there is just one neuroimaging study — Malogiannis et al. 2003, whereas there are only two studies on the Greek WS children — Stavrakaki 2004a, 2004b, just one study each on child aphasia — Stavrakaki et al. 2000, and DS — Tsakiridou in press). Besides, not all of the above research areas have equally sparked linguists' research interest (e.g. language processing in illiterate Greek-speaking subjects has been exclusively investigated by psychologists and psychiatrists (Kosmidis et al. 2004, Tzavaras et al. 1981).

This review paper aims at focussing on issues that have been extensively investigated and addressed by the Greek linguistic community; it deals, therefore, with SLI and acquired disorders and, specifically, aphasia and dementia — for which there is a substantial amount of work. These studies are critically presented and evaluated in both methodological and theoretical terms. Despite

any drawbacks or missing points that can be identified, I suggest that Greek neurolinguistic studies have significant theoretical implications for current neurolinguistic theories and discuss them throughout this review paper.

Most of the Greek neurolinguistic studies have been motivated by theoretical discussions developed in the field of aphasia, dementia and SLI. A primary question in the field focuses on the status of the linguistic abilities of aphasic, demented patients and SLI children and the proper characterization of the deficit in those disorders. Due to the diversity and richness of current neurolinguistic theory, a brief sketch of those theoretical issues related to the work conducted by researchers working on the field of Greek neurolinguistics is presented. A central issue in the studies of acquired and developmental language disorders concerns the extent of the language deficit: Is it limited to difficulties with the application of linguistic knowledge, or extended to linguistic representations and thus affecting aspects of knowledge of language (e.g. Kolk 1998, Leonard 1998)? This question has been addressed by Greek neurolinguistic researchers in order to identify the preserved vs. impaired aspects of language processing in Greek language impaired subjects. More specific issues concerning the effect of word class on language production and comprehension, the status of the inflected and derived words in the mental lexicon, the effect of regularity on impaired subjects' performance, the effect of syntactic complexity on linguistic performance, and the status of functional vs. lexical categories in the language impaired subjects' performance have been extensively studied.

There is much controversy surrounding all the above issues in current literature, which is accentuated by the following factors (among others): (1) the diversity within the population tested and (2) the linguistic diversity — since the cross-linguistic results are quite often conflicting. The contribution of Greek can be quite crucial at this point: being a highly inflectional language, it offers experimental material that allows us to provide crucial tests for the neurolinguistic theories in a novel way and thus to distinguish between competing theoretical models in the field.

This paper is split into two parts: the first part focuses on acquired disorders in adults, and in particular on aphasia and dementia, whereas the second part focusses on developmental disorders, in particular SLI. This structure has been motivated by theoretical matters. Acquired disorders in adults occur in the face of a mature language system, whereas children with developmental disorders are still in the process of language acquisition. These two main parts have been further divided into subparts that correspond to the linguistic domains investigated by researchers working on Greek: phonology, morphology, syntax, and the lexicon. Not all of these linguistic domains have equally attract-

ed the attention of researchers: for example, morphosyntax in SLI and aphasia has been more intensively investigated than phonology.¹ Similarly, not all types of aphasia or SLI have been equally studied; consequently, this review paper is highly restricted to those language disorders studied by researchers working in the field of Greek neurolinguistics.

2. Acquired disorders

2.1 Aphasia

Brain injury in the left hemisphere can lead to language disorders called ‘aphasia’, which refers to the collective deficits in language comprehension and production that accompany neurological damage (Gazzaniga et al. 1998:303).² However, aphasia can develop after lesions in the right hemisphere, i.e. the case of ‘crossed aphasia’,³ since 3% of the population has language represented primarily in the right hemisphere (Obler & Gjerlow 1999). Aphasiologists have elaborate criteria for diagnosing and characterizing language disorders such as aphasia. Based on the patients’ performance, they classify aphasics into general groups. Patients classified as Broca’s aphasics do not necessarily show structural lesions in the Broca’s area (Dronkers et al. 1992). Being primarily a disorder in language production, Broca’s aphasia is characterized by non-fluent speech, and often includes a range of symptoms referred to as ‘agrammatism’, that is, telegraphic simplified speech with morpheme omissions or substitutions. On the other hand, ‘Wernicke’s aphasia’ is primarily a disorder of language comprehension characterized by fluent but meaningless speech. Wernicke’s aphasia is not necessarily associated with lesions in ‘Wernicke’s area’: sometimes lesions that spare Wernicke’s area lead to comprehension deficits (Gazzaniga et al. 1998). “All patients with aphasia of any type have ‘anomia’, that is, problems with remembering the names of things; however, one set of relatively mildly impaired subjects are called ‘anomic aphasics’ because their naming problem is their only language problem” (Obler & Gjerlow 1999: 44).

The question of which linguistic abilities of aphasic patients have been preserved, impaired or totally lost is a fundamental one in the field of aphasia. Let us now consider the contribution of the Greek studies to the field of aphasia.

2.1.1.1 *Studies of the lexicon: Verbs and nouns in Greek aphasic patients*

2.1.1.1.1 *Non-fluent aphasia.* The aphasic performance on nouns and verbs has been widely the focus of current cross-linguistic studies and has given rise to competing theories of aphasic performance with interpretations that cover all those domains involved in verb/noun production and comprehension, i.e. phonology, morphology, syntax, and semantics (see Bastiaanse & van Zonneveld 2002, Marshall et al. 1998, among others).

Following that line of research, neurolinguistic studies in Greek have raised questions such as: (1) The effect of grammatical class, i.e. nouns vs. verbs, on the aphasic performance (Kehayia 1988, Kehayia & Jarema 1991, Kehayia 1997a, Tsapkini 2001, Tsapkini et al. 2001, 2002a, 2002b, Kampanaros 2003), (2) The effect of verb type (instrumental vs. non-instrumental) on aphasic performance (Kampanaros 2003), (3) The effect of regular vs. irregular morphology on aphasic performance (Kehayia 1988, Tsapkini et al. 2002a, 2002b). Those questions have been investigated through different methods including several off-line and on-line tasks.⁴

Early investigations by Kehayia and colleagues (Kehayia 1988, Kehayia & Jarema 1991, Kehayia et al. 1990) into Greek speaking patients with Broca's aphasia have shown (1) dissociations between nouns and verbs, e.g. *vuno* "mountain" vs. *lino* "I untie", (2) dissociations between present and past tense verbs, e.g. *pleno* "I wash" vs. *eplina* "I washed", (3) dissociations within the past tense verbs, e.g. *e-li-s-a* "I untied" vs. *e-plin-a* "I washed".

Specifically, Kehayia & Jarema (1991) have investigated the performance of two non-fluent aphasic patients on morphologically complex words, nouns and verbs, across tasks involving repetition, comprehension, and production. The results indicated task dependent performance by aphasic patients: both of them performed better on comprehension and repetition tasks than on the production task. Grammatical class dependent performance was also shown: the patients performed better on nouns than on verbs in production and repetition tasks. With respect to nouns, the patients had problems with those nouns marked for both case and number (e.g. *anthrop-ous.ACC.PL* "men"). Kehayia & Jarema (1991) have claimed that the more features attached to the noun, the lower the correct performance.

With respect to verbal inflection in Greek agrammatic speech, throughout the different tasks, the patients performed at ceiling on present tense except for the *-etai* (reflexive/passive) verbs. Both patients performed significantly lower on the past tense of irregular verbs than on the past tense of regular verbs in the production and repetition tasks. This performance was explained in terms of

the predictability of the past tense from the present stem: due to root transparency within the verbal paradigm (e.g. *grafo/egrapsa*, “I write/I wrote”), the past tense of regular verbs is predictable from the present, whereas the past tense of irregulars is not (*troof/efaga*, “I eat/I ate”). Based on the above dissociation between regular and irregular verbs, Kehayia & Jarema (1991:58) have suggested that the forms of regular verbs in which the root is transparent throughout the verbal paradigm are stored in a single storage unit,⁵ whereas the forms of irregular verbs are stored in different storage units. Therefore, it is the link between the two storage units (present and past) of irregular verbs that is problematic, hence the incorrect production of the past tense of irregular verbs.

A further dissociation was found within the verbs in which the root is transparent throughout the verbal paradigm: the patients performed better on past tense forms like *fiteps-a* “I planted”, than *metr-is-a* “I counted” and *htenist-ik-a* “I combed myself”. This pattern of performance has been interpreted on the grounds of affixation complexity: two affixes are required for the past tense formation of verbs like *metr-is-a* and *htenist-ik-a*, while just one affix is required for verbs like *fiteps-a*. Based on this analysis, it has been further suggested that verb entries within a single storage unit are hierarchically ordered, that is, the word-internal complexity is reflected in a hierarchical organization of complex lexical items. In this respect, aphasic performance was dependent on word internal complexity within a single storage unit.

Interestingly, the Greek aphasic patients substituted, but did not omit inflectional affixes; this is because Greek words must always comprise a root and an inflectional affix. Therefore, despite overt morphological problems, the aphasic performance was constrained by the Greek language rules.

Further investigations into the linguistic abilities of Greek aphasic patients have been carried out by Kehayia (1997a) through an on-line word recognition experiment. Two non-fluent patients and twenty-four normal adults participated in simple and primed⁶ lexical decision experiments; specifically, they performed non-word judgements⁷ for inflected and derived words (e.g. *grafo/egrapsa* “I write/I wrote”, *skapsimo* “the act of digging”) and non-words. The same patterns in response latencies were shown by non-impaired and aphasic participants, although the aphasic subjects showed increased reaction times and overt morphological deficits in off-line comprehension, production, and repetition tasks.

Strikingly, the simple lexical decision experiment revealed that both aphasic and normal subjects were slowing down in the recognition of a root of a real word, e.g. *graf-* of *graf-io* compared to recognition of a real word (e.g. *grafio* “desk”); the primed experiment indicated that aphasics and normal subjects

were faster when the root *graf-* primed *graf-o* “I write”, than when *treh-* primed *graf-o*. Furthermore, longer reaction times were shown by aphasics and normal controls for derived, rather than inflected words. Based on these data, Kehayia (1997a) has concluded that morphological deficits in aphasia can be better accounted for in terms of problems with lexical access and production, rather than in terms of impaired mental representations.

Building on Kehayia’s studies, Tsapkini and colleagues (Tsapkini 2001, Tsapkini et al. 2001, 2002a, 2002b) offered detailed investigations of the aphasics’ performance on different categories of verbs and nouns across different modalities and through different methodologies (off- vs. on-line) and described the exact deficit in the aphasic linguistic system. Tsapkini (2001) and Tsapkini et al. (2002a) have studied the performance of “SK”, a Greek-speaking patient whose neurological diagnosis was CVA with motor aphasia and right hemiparesis. His speech was non-fluent at the time of testing. The patient’s performance on nouns and verbs had been tested through cued production, repetition, comprehension, and reading. The experimental material included both verbs and nouns. Specifically, three verb categories have been tested (Tsapkini 2002a:265): (1) verbs that form the perfective past tense by attaching the rule-based aspectual marker *-s-* to their stem-allomorphs, e.g. *mil-o*, *mili-s-a* “I speak, I spoke”, where *mili-* is an allomorph of *mil-*; (2) verbs that form the perfective past tense by attaching the rule-based aspectual marker to their imperfective stem, e.g. *graf-o*, *e-grap-s-a* “I write, I wrote”, and *lin-o*, *e-li-s-a* “I untie, I untied”, and (3) verbs that form the perfective past tense on their perfective stem-allomorphs, e.g. *plen-o*, *e-plin-a* “I wash, I washed”. Three categories of nouns have been tested as well (Tsapkini et al. 2002a:275): (1) nouns whose plurals are formed by adding the plural suffix to a stem-allomorph, e.g. *som-a*, *somat-a* “body, bodies”, (2) nouns whose plurals are formed on the same stem where a phonological change takes place, e.g. *pedi*, *pedi-a* “child, children”, where the letter *i* in *pedia* is pronounced /j/; (3) nouns whose stem does not undergo change for both singular and plural forms, e.g. *vun-o*, *vun-a* “mountain, mountains”.

The findings indicated that the patient had more difficulties with the verb inflectional morphology than with the noun. Moreover, he had more problems with the retrieval of the irregular perfective verb forms than with the regular verb forms involving *-s* suffixation; however, the patient did not have problems with the comprehension and repetition of either perfective verbal form. Furthermore, the patient did not show completely intact oral reading abilities.

Based on these data, Tsapkini et al. (2002a) argued that the patient’s deficit is not at the semantic level, because of the patient’s intact comprehension of

past tense and plural number across all morphological categories tested for verbs and nouns. Although the patient was able to repeat non-words, Tsapkini et al. (2002a) suggested that a phonological output deficit could not be completely excluded due to the patient's difficulties with oral reading.

A major theoretical issue addressed by Tsapkini and colleagues (2002a) was whether the patient's noun-verb dissociation could be interpreted in the light of a deficit in morphology per se. Based on the patient's better performance on the verbs, where grammatical rules are employed for the formation of the past tense than on irregular verbs, Tsapkini and colleagues (2002a) excluded the case of a morphosyntactic deficit and argued in favour of a morphophonological deficit.

Another non-fluent patient, "IS", has been tested by Tsapkini and colleagues (2001) on the same off-line tasks as the patient SK. He showed deficits with nouns, but not with verbs — as also was the case with SK. However, in contrast to SK, IS's performance dropped on the sigmatic rule-based past tense forms; in particular, the patient performed lower on the perfective past tense forms that require the attachment of the rule-based aspectual marker *-s-* to their stem-allomorphs, e.g. *mil-o*, *mili-s-a* "I speak, I spoke", than on the other verb classes tested. Based on the drop in the aphasic performance on that category, which combines both rule-based and stem-allomorph mechanisms, Tsapkini et al. (2001) have claimed that the patient's performance could not be interpreted in terms of dichotomies between rule-based vs. stored-allomorph mechanisms, and thus morphological breakdown in Greek is not an "all-or-nothing" phenomenon (Tsapkini et al. 2001:292).

Tsapkini and colleagues (2002b) have investigated aphasic performance on the Greek past tense on the basis of on-line tasks. Two non-fluent patients have been tested along with eleven control subjects matched by chronological age. The experimental material included the same categories of verbs as those used by Tsapkini et al. (2001, 2002a); the procedure included a lexical decision judgement task. Two priming conditions have been used: the present first person singular form of each verb was primed by either the past tense or an unrelated item. The controls showed priming effects for all morphological categories. The patients showed different patterns of performance. Patient "MH" showed priming effects for those perfective past tense forms that involve stem alternation, but not for the perfective past tense forms that involve *-s-* suffixation without stem alternation; on the other hand, patient IS did not show any priming effects for either of the categories that require *-s-* suffixation, but he did show priming effects for the perfective past tense formed through stem alternation (e.g. *pleno/eplina*, "I wash/I washed"). Interestingly, patient

IS showed the same pattern of performance on on- and off-line tasks; recall that his performance dropped on the production of the perfective past tense required *-s-* affixation (Tsapkini 2001, Tsapkini et al. 2001).

2.1.1.2 Anomic aphasia. The question of whether nouns and verbs are differentially impaired in aphasia has also been addressed by Kampanaros (2003), who investigated the manifestations of anomia in the performance of Greek-English anomic patients. In the aphasic literature, it has been claimed that non-fluent, agrammatic patients with an anterior lesion in the left hemisphere including Broca's area often have more difficulty accessing and retrieving verbs, whereas fluent anomic patients usually with left posterior lesions often show the reverse pattern, that is, they have more difficulty accessing and retrieving nouns than verbs.

Kampanaros (2003) and Kampanaros & van Steenbrugge (2003) have investigated the performance of bilingual Greek-English anomic patients on verbs vs. nouns. All patients have been classified as fluent anomic aphasics. Except for looking at selective verb vs. noun deficits in the performance of anomic patients, Kampanaros (2003) investigated possible dissociations in anomic performance on different kinds of verbs. In particular, she studied the patients' performance on instrumental verbs, which denote actions requiring an instrument/noun (e.g. *to sweep*), and non-instrumental verbs (e.g. *to climb*). Furthermore, that study aimed at investigating whether there were any effects of name- vs. non-name-related instrumental verbs on aphasic performance (*vourtsa/vourtsizi*: "brush/brushing" and *pirouni/troi*: "fork/eating", respectively). The overall study aimed at investigating whether there were specific effects of first (Greek — L1) or second (English — L2) language on the performance of aphasic patients on nouns and verbs.

The results indicated that noun retrieval was significantly better preserved in bilingual individuals with anomic aphasia, than verb retrieval in L1 and L2; therefore, difficulties with verb retrieval are not necessarily restricted to agrammatism (cf. Berndt et al. 1997).

Moreover, instrumentality was found to have a significant positive effect on verb retrieval, but not on noun retrieval. With regard to verbs, the bilingual aphasics retrieved instrumental verbs significantly easier than non-instrumental verbs across the two languages. This pattern of performance has been explained in terms of the additional information on the noun-instrument that the lemma of instrumental verbs contains; the verb retrieval process is significantly facilitated by co-activation of the instrument/noun lemma that is part of the verb lemma (Bastiaanse 1991).

Furthermore, name relation was found to have a significant effect on instrumental verb retrieval in L1 (Greek), but a negative effect in L2 (English). This pattern of performance has been attributed to morphological matters: specifically, it is argued that in Greek, where noun-verb pairs share the same stem but have different suffixes, verb retrieval has been facilitated by the overt morphological markers such as verb inflection; in English, however, such overt morphological markers were not available since name-related noun-verb pairs have identical word forms.

An exceptional case of anomic patient has been recently reported by Pita and colleagues (in press). The patient's CT showed large ischemic infarcts involving cortical and subcortical areas of the parietal lobes bilaterally, especially left temporo-parietal and right parietal (Pita et al. in press:4); he has been diagnosed with vascular dementia with color anomia, and optic aphasia for colors. Although the patient showed satisfactory oral comprehension skills at word and sentence level, and exhibited communicative effectiveness during conversation, he exhibited a marked inability to name and indicate colors. Pita and colleagues argue that the patient's inability to retrieve color names could not be attributed to impaired visual color perception, impaired visuo-color recognition or impaired color knowledge, since he showed a high level of performance on the test measuring the above abilities. They suggested (Pita et al. in press: 10) that the patient's deficit should be attributed to impaired access to color names in the phonologic output system (Fukatsu et al. 1999). The patient has developed a strategy to compensate for his difficulties with color naming: being a soccer fan, he associated teams with colors and so he employed a soccer-team color-code that he developed for compensating for his inability to name colors.

2.1.2 *Discussion of the findings and directions for further research*

In sum, the research findings on verbs and nouns in aphasia strongly suggest that verbs are more difficult than nouns for both fluent (anomic) and non-fluent patients. It could therefore be concluded that aphasic breakdown is differentially manifested across grammatical class; in this respect, grammatical class constitutes an "organizational principle of the mental lexicon" (Tsapkini et al. 2002a:288). The patients performed well on nouns, although their performance decreased when morphological complexity increased (Kehayia & Jarema 1991). The aphasic performance on the past tense production revealed a very complex pattern: on the one hand, better performance was shown on the regular than on the irregular past tense forms (Kehayia & Jarema 1991, Tsapkini 2001, Tsapkini et al. 2002a); on the other hand, one of the two patients who

participated in Tsapkini's studies (Tsapkini 2001, Tsapkini et al. 2001, 2002a, 2002b) showed problems with those past tense forms that involve *-s* suffixation and stem alternation in off-line tasks, whereas in on-line tasks he showed no priming for all forms that involve *-s* suffixation.

Collectively, these results have been highly significant for the fields of cognitive neuroscience of language and neurolinguistics: this is in part because they can be interpreted as providing evidence against Ullman's influential hypothesis of past tense deficits in non-fluent aphasia (Ullman et al. 1997). This hypothesis postulates that the regular past tense is formed through grammatical rules that constitute part of the procedural memory system, whereas the irregular past forms are listed in the lexicon that constitutes part of the declarative memory system; it predicts that anterior non-fluent patients and Parkinson's disease patients, in which degeneration strikes frontal/basal-ganglia structures, have problems with the regular past tense forms, whereas Alzheimer disease patients, in which degeneration affects temporal lobe regions, and posterior fluent patients have problems with irregular past tense. Interestingly, the Greek findings showed that aphasic patients might not necessarily have a deficit in the domain of grammatical rules (regular inflection) and procedural memory — as argued by Ullman and colleagues (1997). However, they indicated that the regular vs. irregular distinction was a principal one and reflected in the aphasic performance as shown by the following findings: (1) the better performance that some of the patients showed on the rule-based forms than the irregular ones (Kehayia & Jarema 1991, Tsapkini 2001), (2) the constantly 'problematic' performance of the patient IS (Tsapkini et al. 2001) on the perfective past tense forms that require *-s-* suffixation in both on- and off-line tasks. Therefore, the distinction between regular vs. irregular past tense may have psychological reality.⁸

Further investigations into issues related to aphasic performance on the Greek past tense should extend the experimental material and include non-words that rhyme with existing verbs and non-rhymes. In this way, the knowledge of the past tense formation constraints in Greek by the aphasic patients will be further investigated and the results will be directly comparable to those by Ullman and colleagues who have included existing verbs, novel verbs, and non-rhymes in their experimental material.

Another significant contribution to the field of aphasia that has been made by Tsapkini et al. (2002a) is related to the question of whether the attested aphasic deficits are located in specific sub-components of language processing. Tsapkini and colleagues provided convincing evidence that pure morphological deficits do exist in verb production in non-fluent aphasia, contrary to

current syntactic approaches to aphasia that attribute the verb problems to pure syntactic processes (e.g. Bastiaanse & van Zonneveld 1998).

Although primary deficits in morphology exist for some aphasic patients, for other patients morphology facilitates aphasic performance: Kampanaros (2003) has convincingly argued that overt morphological (inflectional) information facilitates verb retrieval in anomie aphasics. A possible explanation would be that the controversial role of morphology could be associated with the linguistic deficits attested in non-fluent aphasia and anomia, i.e. grammatical and lexical deficits, respectively. Non-fluent patients are expected to have problems with morphology *per se*, whereas the anomie patients are not necessarily expected to show problems with it. Finally, Pita and colleagues (in press) have made a contribution to the field of cognitive rehabilitation in aphasia: they have shown that the strategies, which the patients themselves develop, can be successfully incorporated into an intervention program for word retrieval deficits.

2.1.3 *Functional categories and clause structure in aphasic patients*

Recent research on aphasic patients indicates that their linguistic difficulties could be ascribed to a deficit in some functional categories of grammar and their projections. A contemporary influential hypothesis by Friedmann and Grodzinsky (1997) and Friedmann (2001) postulates that the impairment in agrammatic production is highly selective and lends itself to characterization in terms of a deficit in the syntactic tree. That is, agrammatic patients produce trees that are intact up to the tense node and 'pruned' from this node and up. On the tree-pruning hypothesis, impaired structure building at a lower level of projection ensures that no higher-level projections can be built.

Greek clause structure offers a new domain where the predictions of the tree-pruning hypothesis can be tested. Several functional categories are instantiated in Greek, since they form part of the morphology of the Greek verb (see Alexiadou & Anagnostopoulou 2000 for a review of the literature on Greek clause structure). The order of functional categories in the extended projection of the Greek verb is as follows: ArgP > TP > AspectP > VP. Negation precedes all inflectional material on the verb. Greek has two negation articles: *den*, which co-occurs with the indicative mood, and *min*, which co-occurs with subjunctive mood. If a negative element needs to be selected according to the status, indicative or not, of the mood, then MoodP is higher than NegP. Therefore, the hierarchy of functional categories in Greek is the following: CP > MoodP > NegP > AgrP > TP > AspectP > VP. If deficits in agrammatism affect the highest nodes of syntactic tree to a greater extent than the lower nodes, then the basic predictions of the tree-pruning hypothesis hold.

Plakouda (2001) studied the elicited production of past tense, subject-verb agreement and aspect by one patient with agrammatism. The results indicated that the patient did not have any problems with tense marking; she actually showed a near-ceiling performance on tense marking; she performed lower on subject-verb agreement, although she still exhibited a high level of correct performance. However, the patient's performance dropped significantly on aspect marking. Based on these results, Plakouda has suggested that her results are highly incompatible with the tree-pruning hypothesis due to the fact that AspectP occupies a low position in the syntactic tree.

Following the same line of research, Stavrakaki & Kouvava (2003) have addressed the question of functional categories and their projections in Greek-speaking patients with Broca's aphasia across different tasks. Specifically, they have studied the performance of two patients with Broca's aphasia and agrammatism on the production and comprehension of definite and indefinite article, personal pronouns, wh-pronouns, aspect, tense, subject-verb agreement, negation, complementizers and the subjunctive mood marker *na*. The tasks used in that study included (1) *Spontaneous speech*, (2) *Picture description task*, (3) *Grammaticality judgments for grammatical and ungrammatical sentences*, (4) *Preference test between grammatical and ungrammatical sentences*.

The results of the spontaneous speech data indicated dissociations within the nominal domain: both patients omitted definite articles and object clitics, but not genitive clitics and strong pronouns. Further dissociation was also observed between the patients' performance on definite articles and object clitics: the patients performed higher on the former than the latter. The drop in the patients' performance on object clitics has been explained in terms of the syntactic requirements that object clitics impose, i.e. syntactic chains.

As far as the verbal domain is concerned, although both patients were able to produce past tense forms, they encountered difficulties with the past tense production. Detailed error analysis has also revealed aspect as a significant factor in Greek past tense processing. Most errors were found in the obligatory contexts of perfective past tense: when the default present tense was not produced, imperfective past tense forms were produced (e.g. *alaze* "change".3SG.PAST.IMPERFECTIVE) instead of the target perfective past tense forms (e.g. *alakse* "change".3SG.PAST.PERFECTIVE). Both patients showed high levels of performance on the correct use of subject-verb agreement in the obligatory contexts. Individual variation was found in the performance of both patients on negation *den*, whereas the negation *min* is altogether omitted by SC, and no obligatory contexts of the negation *min* were found in the spontaneous speech of VF. The performance of both patients dropped considerably on the

grammatical categories associated with the highest projections of the syntactic tree, the MoodP, and CP, as the mood marker *na* “to” and complementizers like *oti* “that” were omitted, while there was no evidence for productive use of wh-questions. Both patients showed a task-dependent performance, since they showed high levels of performance on the grammaticality judgment task and the preference task even on structures associated with the higher projections of the syntactic tree, i.e. NegP, MoodP, and CP.

Based on the above evidence, Stavrakaki & Kouvava (2003) suggested that the performance of both patients was task-dependent and indicative of a high level of grammatical sensitivity. Furthermore, they suggested that although the patients showed problems with the higher projections of the syntactic tree in spontaneous speech, that is, CP and MoodP, these projections were not missing per se as shown by the patients’ performance on grammaticality judgment tests. The tree hierarchy, although reflected in the patient’s performance, was not the only factor that influenced aphasic performance: grammatical complexity was another factor that influenced the patients’ performance, e.g. in the case of the perfective past tense the combination of tense and perfective aspect contributed to the drop in the aphasic performance and not tense on its own. In other words, patients had difficulties with producing past tense forms that require complex computational processes: for example, there were problems with *alak-s-e*: “change.3SG.PAST.PERFECTIVE” and not with *alaze*: “change.3SG.PAST.IMPERFECTIVE”, since *alaz-e* is very close to the present stem form (*alaz-i*: “change.3SG.PRESENT”) and requires fewer computational processes than *alak-s-e*.

The effect of grammatical complexity on aphasic performance has also been investigated by Jarema et al. (1987) in a study that focused on pronouns across different tasks. Specifically, the following types of pronouns have been under investigation: personal pronouns (strong pronouns vs. clitics), possessive pronouns (possessive adjectives, i.e. *dikos mou*: *mine* vs. genitive clitics), and relative pronouns across spontaneous speech, comprehension and forced production tasks. Two agrammatic patients participated in the study. The results indicated that the patients performed better on the comprehension than on the production tasks. They had more problems with object clitics than strong pronouns especially in sentences with genitive and accusative clitics (*I gineka tu to dini*, The-woman.NOM-he.GEN-it.ACC-give.3SG “the woman is giving it to him”). They also showed lower performance on possessive pronouns than clitics. Interestingly, one patient performed at ceiling on the production of relative pronouns, whereas the other one did not produce relative pronouns. Jarema et al. (1987) suggested that their results could be interpreted in terms of

the processing load that pronouns associated with empty categories have, e.g. object clitics that are assumed to undergo movement in terms of the linguistic theory Jarema and colleagues (1987) followed.

The question of pronominal reference in agrammatic patients has also been investigated by Varlokosta & Edwards (2003). Two Greek-speaking agrammatic patients have participated in a comprehension experiment. The methodological design that has been originally developed for testing the acquisition of Principle B in English (Crain & Thornton 1998) and modified by Varlokosta for Greek (1999) was employed in this study. Studies on the interpretation of pronouns by aphasic patients indicate that English-speaking agrammatic aphasics show the same pattern of performance as typically developing children, which is characterized by the children's violation of Principle B of the Binding Theory (Chomsky 1981, 1986); that is, pronouns are allowed to take interclausal antecedents: *Papa Bear_i covered him_i* (Avrutin & Wexler 1992 among others). This phenomenon has been known as the Delay of Principle B Effect (DPBE). In languages that allow strong pronouns and clitics, e.g. Romance languages, children's interpretation of strong pronouns but not of clitics gives rise to the DPBE (cf. Baauw et al. 1997). However, in Greek neither clitics nor strong pronoun contexts give rise to the DPBE, presumably due to the demonstrative nature of strong pronouns (Varlokosta 1999).

The next step is to investigate whether the aphasic patients that speak languages with strong pronouns and clitics show the asymmetry observed in child language between strong pronouns and clitics (Varlokosta & Edwards 2003:562). Varlokosta & Edwards (2003) used the true value judgement task in order to test the aphasic performance on pronominal reference: in this task subjects are presented with meaning-utterance pairs and asked to decide if each pair is true or false. In this experiment there were five test conditions (Varlokosta & Edwards 2003:560): clitic contexts (*O pateras ton zografizi* "the father is painting him"), reflexive pronoun contexts (*O pateras zografizi ton eafto tou* "the father is painting himself"), quantificational antecedent and clitic contexts (*kathe pateras ton zografizi*: "every father is painting him"), quantificational antecedent and reflexive pronoun contexts (*kathe pateras zografizi ton eafto tou* "every father is painting himself"), and *na*-clause-clitic contexts (*O pateras ton ide na chorevi* "the father saw him dance"). A strong pronoun condition was not included, although the main aim of this study was to look at possible dissociations between clitics and strong pronouns as the authors claimed. The results indicated that both patients showed almost ceiling performance on all conditions.

A recent study by Nanousi (2004) has re-addressed the issue of functional categories in agrammatical grammar in Greek. Six agrammatical Broca's aphasic patients participated in this study. All of them have been systematically tested on different tasks at word and sentence level. The elicitation of agreement, tense, and aspect marking at single-word level showed that the production of agreement marking inflections in single verbs was impaired for all patients, since there were errors involving both person and number — with the plural being more impaired than singular. Furthermore, both types of aspect, perfective and imperfective, were problematic; poor performance was also shown on the present perfect, simple past, simple future and past continuous, whereas the simple present was somewhat better preserved.

Moreover, Nanousi (2004) has explored aphasic performance on the same features, i.e. agreement, aspect, and tense, in sentential context through elicitation tasks. The results from tense and agreement marking tasks indicated that the production of tense yielded more errors than the production of agreement in accord with cross-linguistic investigations (cf. Friedmann 2001). Interestingly, the patients performed better on tense and agreement within sentences, than in the single word tasks for the same features. Furthermore, the results obtained from the two tasks involving the production of aspect revealed problems with the perfect and perfective aspect, while the imperfective aspect appeared to be relatively less impaired. Interestingly, the patients' performance was better in the production of aspect when a sentential frame was available.

Furthermore, the grammatical features of agreement, tense and aspect have been assessed through a free and forced (contrastive) grammaticality task. All errors involved the acceptance of ungrammatical sentences as correct. Similar numbers of errors were made for sentences with violations of tense and aspect, and fewer errors were made on sentences testing agreement. The contrastive grammaticality judgment task indicated that, while tense and aspect gave rise to similar error rates, agreement yielded fewer errors. Errors were made in all tense forms in roughly equal numbers. The overall performance of patients in the grammaticality judgment tasks for all three features under investigation appeared to be better than the performance on the same features in the production tasks.

In sum, the study by Nanousi (2004) indicated dissociation between interpretable features (tense/aspect) on the one hand, and non-interpretable features (agreement) on the other — in both sentence production and grammaticality judgment. By contrast, the results from the single word tasks showed no such dissociation since the features of tense, aspect, and agreement have been equally affected. That pattern of performance has been interpreted in terms of

the distinct ways in which uninterpretable and interpretable morphosyntactic features are associated with phonologically relevant values: for uninterpretable features, this is achieved under 'Agree', while for interpretable features this is achieved via the operation of 'Spell-out', that is, direct mapping of the interpretable features onto PF. It, therefore, seems that aphasic patients have problems with direct mapping of interpretable features to PF, but not with Agree. In single word tasks, the mechanisms of feature valuation are not operative since narrow syntax is not engaged; as a result, aphasic patients showed problems with uninterpretable features as well.

The question of the status of verbal inflection in aphasic grammar has been recently re-addressed by Varlokosta et al. (2005) who employed different tasks to test the performance of seven aphasic patients with diverse clinical diagnosis (non-fluent, anomia, Broca's and Wernicke's aphasia) on agreement, tense, and aspectual marking. Specifically, the experimental procedure included (1) elicitation of spontaneous speech, (2) a picture description task, (3) a grammaticality judgment task, and (4) a sentence completion task. The overall results indicated more problems with aspect marking than with tense marking and agreement. Interestingly, that pattern of performance was shown by patients with different aphasia diagnosis: both the sentence completion experiment and the grammaticality judgment experiment showed that agreement was the less vulnerable category, whereas aspect was the most affected one. Varlokosta et al. (2005) interpret these findings within Chomsky's (2000) minimalist program: agreement is considered to be an operation, whereas tense is just an interpretable feature of the functional category T in current minimalist terms. The authors argue that categories that carry interpretable features are difficult for the aphasic patients because of their 'extra processing load' (Varlokosta et al. 2005:23).

Another perspective on functional categories and clause structure in Broca's aphasia has been offered by Alexiadou and Stavrakaki (2005 in press). The subject of this study was a Greek late learner of English who worked as a teacher of English until her CVA. At the time of testing, her speech in Greek and English was consistently non-fluent with mild agrammatism.

In the experimental part of their study, Alexiadou & Stavrakaki (2005 in press) examined adverb placement by means of a constituent ordering (production) task in Greek and English, and a grammaticality judgment (comprehension) task in Greek and English. The adverbs have been split into two main types (Lonzi & Luzzati 1993): specifier-type adverbs and complement-type adverbs. The former include speaker oriented and modal adverbs, which are part of the highest part of the left periphery situated in Spec.CP and Spec.MoodP

respectively, and aspectual and negation adverbs, which are part of the lower part of the clause in Spec.AspP and Spec.NegP respectively. Complement type adverbs include manner adverbs, which are merged VP internally. Both types were tested.

There were two main points revealed by the results of the first experiment (production task). First, the patient's performance was language independent on the CP- and VP-related adverbs; in particular, selective difficulties with the CP-related adverbs were found, whereas the patient performed at ceiling on complement adverbs in both Greek and English. Second, she exhibited language dependent performance on MoodP, AspectP, and NegP related adverbs: her performance was better in Greek than in English. The results of the second experiment (comprehension task) indicated increased grammatical sensitivity even to those adverbs that are part of the high parts of the left periphery, i.e. the CP-related adverbs.

Based on the above findings, Alexiadou & Stavrakaki (2005 in press) argue that the CP layer causes great difficulties to aphasic performance in both languages, although the CP layer was not altogether missing. The better performance of the patient with MoodP, AspectP and NegP adverbs was directly attributed to the peculiarities of English and Greek verbal morphology and movement. Specifically, the researchers suggest that the subject received cues from morphology in Greek, but not in English, for close connection (agreement) between aspectual and modal-adverbs and the respective functional categories, since Greek, but not English, has a number of mood particles appearing adjacent to the inflected verb, as well as overt grammatical aspectual distinctions. Alexiadou & Stavrakaki (2005 in press) argue that the linguistic breakdown of this patient can be better described as a breakdown at the level of syntax rather than of morphology (cf. Bastiaanse & van Zonneveld 1998).

2.1.4 *Discussion of the findings and directions for further research*

To summarize the findings so far, current research on clause structure in Greek aphasics showed some interesting results: first, it revealed problems related to aspectual marking (Nanousi 2004, Plakouda 2001, Stavrakaki & Kouvava 2003, Varlokosta et al. 2005). In the studies by Plakouda (2001), Nanousi (2004), and Varlokosta et al. (2005) aspect was found to be impaired, that is, the patients had problems both with the perfective and imperfective aspect, whereas in the study by Stavrakaki & Kouvava (2003) the patients had problems with perfective aspect combined with tense and so they had difficulties with perfective past tense, although they performed well on imperfective past tense; it should be noted that Stavrakaki and Kouvava (2003) made their conclusions on aspect

only on the basis of spontaneous speech data, since they did not test aspect through a grammaticality judgement task.

Second, all studies on Greek-speaking aphasic patients indicate that the patients perform better on agreement than on tense in accord with cross-linguistic findings. They also indicate that the attested difficulties with aspect cannot be accounted for in terms of the tree-pruning hypothesis — due to the low position of the aspectual node in the syntactic tree.

In fact, the difficulties that the Greek aphasics have with aspectual marking constitute a serious challenge to the tree-pruning hypothesis. Different accounts of deficits related to aspectual features have been suggested. On the one hand, an interpretable-feature deficit account has suggested by Nanousi (2004); on the other hand, a processing account postulating difficulties with increased complexity of perfective past tense marking vs. imperfective past tense has been suggested by Stavrakaki & Kouvava (2003). Furthermore, Varlokosta and colleagues (2005) associated the interpretable features with extra processing load and argued that the deficits are due to that association. All analyses lead to the same conclusion, that is, the tree-pruning hypothesis cannot explain the Greek data with respect to aspect. Future research should focus on the aspectual deficits in aphasia in order to study them in detail and offer a coherent account of those deficits in aphasia.

However, syntactic hierarchy plays a role in the Greek aphasic's performance — as shown by the problems that the patients had with the higher tree projections: NegP, MoodP, and CP especially with spontaneous speech production (Stavrakaki & Kouvava 2003, Alexiadou & Stavrakaki 2005 in press). Moreover, the issue of the role that overt morphological marking plays in aphasic production and comprehension has been raised again by Alexiadou & Stavrakaki (2005 in press). Alexiadou & Stavrakaki argue that morphology interacts with syntax and provides 'cues' for the aphasic patient — as shown by the patient's better performance on verb movement in Greek than in English. This claim is contra Burchert et al. (2003), who suggest that morphology cannot help syntactic production and comprehension in agrammatism. Finally, there was an effect of grammatical complexity on aphasic performance, e.g. the case of clitics (Jarema et al. 1987, Stavrakaki & Kouvava 2003) — at least for a subgroup of Greek aphasic patients. However, the patients performed better on the comprehension than on the production of clitics (Jarema et al. 1987); finally, the intact aphasic performance on clitic comprehension (Varlokosta & Edwards 2003) indicates a significant degree of individual variation within the aphasic population.

2.2 Dementia

The term 'dementia' refers to the results of a number of different diseases, which lead to a loss of intellectual abilities (Obler & Gjerlow 1999:91). Dementias are distinguished as cortical and subcortical: in the former, the cellular changes that affect the brain are primarily associated with cortical areas, whereas in the latter the cellular changes are associated with subcortical areas. The most commonly known cortical dementia is Alzheimer's disease (AD), whereas the most common subcortical dementia occurs in about one-third of the cases with Parkinson's disease (PD) (Obler & Gjerlow 1999). The linguistic profiles of Greek-speaking PD and AD patients have already attracted research attention, and so some preliminary conclusions of the reversed vs. impaired linguistics abilities in PD and AD patients can be drawn.

2.2.1 *Alzheimer's disease: Findings, evaluation, and directions for further research*

Kaprinis (2003) has investigated the language abilities of Greek-speaking patients with Alzheimer's disease on a number of cognitive and psycholinguistic tasks. In particular, he tested thirty AD patients compared to ten controls that were matched for age, gender, and years of education. Patients' naming and word retrieval abilities have been assessed through the Boston Naming Test (BNT) and the Verbal Fluency Test (VFT), respectively. Both tests indicated significantly impaired performance compared to normal controls. Problems with naming tasks have also been reported by Okalidou and colleagues (2001). Specifically, in the early stages, AD patients showed problems with lexical retrieval; those problems were more evident in the later stages where patients were not able to retrieve the correct lexical item even though lexical cues were provided.

Based on elicitation tasks, Kaprinis (2003) has also extensively examined the production of morphosyntactic categories, such as the definite and indefinite article, strong pronouns and clitics, past tense marking, subject-verb agreement, negation, and complementizers, by AD patients. He concluded that the AD patients do not have any difficulties with morphosyntax, since all patients showed a high level of performance on the morphosyntactic categories. However, the same patients showed significantly lower performance than controls on naming and word retrieval abilities. Further investigations into phonological and non-verbal aspects of speech indicated that at an early stage of the disease the AD patients do not show a significantly different performance than normal controls on the processing of suprasegmental elements of speech;

however, there was a significant effect of the segmental elements of speech on the AD performance (Iliadou & Kaprinis 2003).

In sum, it should be pointed out that although there are few studies on Alzheimer's disease for Greek, the findings illuminate different aspects of the AD patients' language profile. No difficulties with morphosyntax were found indicating that aspects of procedural memory in AD are spared, whereas lexical abilities were found to be significantly impaired indicating problems with declarative memory in AD as suggested by Ullman and colleagues (1997). Further research on morphosyntactic and lexical abilities in AD patients should be methodologically expanded since conclusions on morphosyntax have been exclusively made on the basis of spontaneous speech data.

2.2.2 *Parkinson's disease*

Parkinson's disease (PD) is associated with loss of dopamine in the basal ganglia due to degeneration of dopaminergic neurons in the substantia nigra. This deficit causes a high level of inhibition of motor and other frontal cortical areas to which the basal ganglia circuits project (Obeso et al. 2000). PD patients exhibit problems with various executive functions including planning, selective attention, working memory, inhibitory control, and information processing speed (Obler & Gjerlow 1999, Brown & Marsden 1988, 1991). Nevertheless, it has not been clear whether specific language disturbances form part of the PD cognitive profile. Research on the linguistic abilities of Greek-speaking patients with Parkinson's disease has focused on the morphological, syntactic, and semantic abilities of the PD patients.

2.2.2.1 *Morphology in PD patients.* Terzi et al. (in press) have investigated PD performance on the past tense. This study was motivated by the hypothesis of impaired procedural memory system in PD (Ullman et al. 1997). They tested twenty-five Greek-speaking non-demented PD patients and twenty-five normal controls on the production of the past tense in sentence contexts. The experimental material included regular and irregular verbs. PD patients showed lower, but not significantly lower, performance on regular and irregular past tense than the controls. These results have been explained in terms of the grammatical properties of the Greek past tense: grammatical rules, e.g. grammatical inflection, are always applied to the past form of both regular and irregular verbs and so there are no verbs whose past tense is formed without application of any grammatical rules. In this respect, Terzi et al. (in press) have suggested that the past tense formation task in Greek PD patients cannot be a crucial test

for the hypothesis of impaired grammatical rules in PD advocated by Ullman et al. (1997).

2.2.2.2 Syntax in PD patients. A further question related to the hypothesis of impaired procedural memory system in PD patients is whether they have impairments in the computational component of language, i.e. syntax. This is an issue of considerable controversy: on the one hand, Ullman and colleagues (1997) predict that the syntactic performance of PD patients would be impaired, while on the other hand other researchers and, in particular, Caplan & Waters (1999) predict intact grammar in PD patients on the grounds that the general impairment of the procedural memory system in PD does not affect the verbal working memory system for assigning the syntactic structure of a sentence. The question of whether PD patients have impairments in syntax has motivated a number of studies on Greek patients with PD.

Stavrakaki et al. (2004) have tested PD patients classified in four stages according to the Hoehn and Yahr scale. Nine patients at stages one and two, four patients at stages three and four, and six normal controls matched on chronological age and educational level participated in the study. The experimental material included sentences that were semantically reversible and differed in syntactic complexity, which was measured on the basis of the following syntactic properties: (1) Disruption of agent-theme linear word order (topic structures, focus structures, passive sentences, object clefts), (2) Formation through A- or A-bar movement (focus structures, object-clefts, passive sentences), (3) Presence of a clitic pronoun associated with a NP (topic structures). This study indicated that syntactic complexity does not have an effect on the patients' performance — as even patients at stages three and four performed similarly to their normal controls. Therefore, Stavrakaki et al. (2004) have suggested that the linguistic performance of PD patients cannot be accounted for in terms of their overall cognitive profile. Hence, the results of Stavrakaki et al. support the hypothesis by Caplan & Waters (1999).

In an attempt to identify whether PD patients have any difficulties with syntactic processing, Natsopoulos et al. (1991) investigated the PD patients' comprehension of relative clauses. The experimental material included the following sentence types: (1) S-S relatives 'The dog that chased the cat scared the child', (2) S-O relatives 'The dog that the cat chased scared the child', (3) O-S relatives 'The dog chased the cat that scared the child', (4) O-O relatives 'The dog chased the cat that the child scared'. A picture-pointing task was used. The results indicated that the PD patients performed better on S-S than that on O-O, O-S, and S-O relatives. The overall PD performance was interpreted in

terms of heuristic strategies applied by the PD patients. In particular, Natsopoulos and colleagues (1991) have suggested that PD patients applied linear strategies while interpreting sentences; hence, they correctly interpreted S-S relatives in which the first NP functions as the agent of the main and relative clause and thus, syntactic linearity holds.

Aiming at investigating the strategies used by PD patients in sentence comprehension, Natsopoulos and colleagues (1993) tested PD patients and normal controls on eight sentence types in the form of main and complement clause with eight matrix verbs: *ask*, *promise*, *tell* (order, command), *tell* (give information) in sentences with no semantic constraints (e.g. *John promised Mary to do the homework*), and *confess*, *sell*, *trust*, and *scold* in sentences with semantic constraint (e.g. *John trusted Paul because he was a good driver*). There are some theoretical assumptions behind this design: first, the verbs in sentences with semantic constraints express implicit causality — the assignment of NP1 or NP2 to the embedded verb as the subject reference, that is, the direction of the causality, is dependent on that semantic property (Garney et al. 1976). For example, in the sentence *John sold Paul the car because he wanted to buy a new one*, the NP1 functions as subject of V2 ‘want’ because of the semantic properties of V1 ‘sold’. Such semantic constraints do not hold in sentences with verbs like *ask*, *promise*, and *tell*.

Subjects were presented with pictures; they were also orally presented with a sentence. A picture-pointing task has been used. The results indicated that PD patients performed significantly below normal controls; furthermore, the results showed that embedded sentences with semantic constraints were more easily understood than embedded sentences without semantic constraints. Those results have been interpreted as evidence for a heuristic principle that the patients followed: they exploited the direction of the causality in order to determine the sentence’s specific meaning. Another heuristic principle used by the patients was the minimal distance principle (MDP): the closest NP is assigned to the complement clause verb as the subject reference in sentences that do not conform to the application of MDP. Natsopoulos et al. argued (1993) that PD patients employed those heuristic strategies because of their syntactic deficits.

Furthermore, Terzi et al. (in press) have investigated the comprehension of active sentences vs. adjectival and verbal passives in PD patients through a picture identification comprehension task. For each passive sentence read to the participants, two pictures were presented to them. Both pictures had the verb of the sentence uttered, but the characters involved in the event were reversed. Participants were asked to point to the picture that corresponded to the

sentence they heard. According to linguistic theory, verbal passives have been considered the result of A-chain formation while adjectival passives have been regarded, by some researchers at least, as constituting entries of the lexicon in Greek⁹ (Lascaratou and Philippaki-Warburton 1983/1984). If any dissociation between the two types of passives is found, then that dissociation could be interpreted as an effect of the specific syntactic and lexical properties of the tested structures as described by Lascaratou and Philippaki-Warburton (1983/1984).

The results showed that the PD patients of this study performed similarly on the two types of passives, i.e. verbal and adjectival. However, the patients did significantly worse at adjectival passives when compared to actives; according to the authors, the drop of patients' performance on adjectival passives could be attributed to the fact that they are less natural in contexts in which the agent is expressed overtly (in the by-phrase). Based on the patients' performance on both verbal and adjectival passives, Terzi et al. (in press) have argued that A-chains have been well-preserved in the PD patients' grammar.

Similar conclusions regarding A-chains in PD grammar have been drawn by Katsarou et al. (2003) on the basis of comprehension and production of unaccusative verbs in Greek. That study aimed at investigating the grammatical abilities of Greek-speaking patients with PD by studying their performance on the production and comprehension of unaccusative verbs entering transitivity alternations (e.g. *o andras anixe tin porta/i porta anixe* "the man opened the door/the door opened"). Such verbs show evidence for A-Movement. However, they do not all show the same morphology. There are unaccusatives with active morphology (e.g. *i porta anixe* "the door opened".ACT); unaccusatives with passive morphology (*i supa kaike* "the soup burnt".PASS) and finally unaccusatives with both active and passive morphology (*o tihos lerose/lerothike* "the wall dirtied".ACT/PASS). Unaccusatives with passive morphology were considered to be more complex than unaccusatives with active morphology. Twenty-five non-demented patients with idiopathic PD and a control group of 13 normal subjects matched to the PD patients by chronological age and educational background participated in the study. There were two experiments: an elicited production experiment (cf. Bastisaanse and van Zonneveld 2002 for methodology) and a picture pointing experiment. The production experiment indicated that PD patients performed lower, but not significantly lower than normal controls in the production of unaccusative verbs. No effect of structural complexity was found in the performance of PD patients and normal controls, as shown by the same level of performance by the two groups in the production of unaccusative verbs with passive and active morphology. The second experiment indicated that both groups performed at ceiling. Based on the

above results Katsarou et al. (2003) have argued that the syntactic operation of A-movement is well preserved in the PD grammar.

2.2.2.3 Semantics and cognition in PD patients. Natsopoulos and colleagues have also addressed issues related to the interplay between language abilities and other cognitive processes in PD patients. Specifically, they have investigated the understanding of relational time terms like *prin* “before” and *meta* “after” by PD patients (Natsopoulos et al. 1991). Comprehension of both terms requires the integration of syntactic, semantic, and cognitive abilities (Natsopoulos & Abadzi 1986). Twenty PD patients and twenty normal controls participated in the experiment. The test material included eight sentence types varied in terms of (1) the order of event mention (coincidence with event occurrence vs. reversal of the event occurrence), (2) the complexity of the event — simple vs. complex sequenced events: events performed by different agents (e.g. *the girl changed after her mother went shopping*) were semantically more complex than those performed by the same agent (*the girl ate before she changed*), (3) syntactic complexity — simple vs. complex syntactic structures: in simple structures the conjunction was embedded or right branching (e.g. *the girl ate before she changed*), whereas in complex ones the conjunction is preposed or left-branching (e.g. *before her mother went shopping, the girl changed*).

Subjects were told a story and presented with pictures. Each story included two events illustrated by two pictures. Subjects heard a story and then were asked to tell the researcher which picture showed the event that occurred first and which the second event. In contrast to the normal controls who were almost without error in comprehension of *before* and *after*, PD patients had some difficulties. Furthermore, the patients were better at understanding sentences when the order of the event mentioned coincided with event occurrence and *before* was proposed, while *after* was embedded. However, the PD performance was not differentiated by simple sequenced events compared to complex sequenced events. Furthermore, with complex sequenced events, comprehension of left-branched sentences did not differ significantly from that of right-branched sentences with the same relational terms. Consequently, the syntactic complexity of left branched structures per se did not affect the PD patient’s performance.

Natsopoulos and colleagues (1997) have also raised the question of whether deductive and inductive reasoning abilities have been affected in PD. This has been investigated through a detailed experimental design that included both classic deductive reasoning syllogisms i.e. *modus ponens*, *modus tollendo tollens*, affirming the consequent, denying the antecedent and three term-series

problems phrased in brief scripts, and inductive reasoning syllogisms, i.e. logical inferences, metaphors and similes. The results showed no significant differences between the patients and normal controls in inductive and deductive reasoning abilities. However, there were significant differences between PD patients with earlier disease onset and normal controls. Therefore, although the PD patients did not suffer a generalized impairment of reasoning ability, the subgroup of earlier onset disease patients differed from normal controls.

2.2.2.4 Discussion of the findings and directions for further research. In sum, the findings showed deficits in the comprehension of relative clauses and embedded sentences, but not in the comprehension of focus structures, structures with clitics, and object clefts and verbal passives. It might be the case that the number of verbs and propositions in the tested structures should affect the PD patients' performance: in both studies by Natsopoulos and colleagues (1991) the test materials (relative clauses and embedded sentences) included two propositions (and two verbs), whereas in studies by Stavrakaki and colleagues (2004) even complex sentences in terms of linguistic theory included one preposition (and one verb).

As pointed out by Caplan and Waters (1999), the number of propositions is positively related to the drop in PD performance and not the syntactic complexity per se; otherwise PD patients would show impaired performance in structures with one preposition, such as object clefts or verbal passives where grammatical rules are required. In this respect, grammar per se should not be impaired in PD, but syntactic complexity could be overlapped with general verbal working memory demands to cause a drop in the PD performance. Therefore, the hypothesis that predicts syntactic deficits in PD due to the general deficit in implicit memory in PD (Ullman et al. 1997) has not been supported by the Greek data.

This conclusion has been further supported by the fact that same level of performance was shown in regular vs. irregular past tense by the Greek PD patients (Terzi et al. 2005). Terzi and colleagues have argued that their results could be due to the employment of grammatical rules in both regular and irregular past tense. Another possible interpretation of the data would be that PD patients do not have problems with either regular or irregular past tense. Interestingly, the PD patients were found to have some problems with understanding relational terms like *before* and *after* and deductive/inductive reasoning abilities, although significant differences were not found for all the tested structures. Future research should address issues related to the correlation be-

tween linguistic and general cognitive abilities in PD in order to identify which aspects of language in PD are particularly affected by cognitive deficits.

3. Developmental language disorders

3.1 Specific Language Impairment

The term *Specific Language Impairment* (SLI) (Clahsen 1991, Gopnik & Crago 1991, Rice et al. 1995, van der Lely 1998) has been used to describe a disorder in which a person's language does not develop at an expected and acceptable rate despite the integrity of the individual's sensory and cognitive systems. The diagnostic criteria used widely in both research and clinical contexts (Stark & Tallal 1981) are basically *exclusion* criteria: (1) No mental retardation, that is, performance IQ of 85 or above, (2) No hearing impairment, (3) No known history of recurrent *otitis media*, (4) No emotional or behavioural problems sufficiently severe to merit intervention, (5) No abnormal neurological status, i.e. no frank neurological signs, no history of head trauma or epilepsy, (6) No peripheral oral motor or sensory deficits.

SLI is not a homogeneous disorder but, nevertheless, relatively homogeneous subgroups of SLI can be identified. Research on Greek children with SLI has focused on aspects of grammar and vocabulary development and has provided a descriptive and theoretical characterization of the linguistic deficits that those children have.

3.1.1 *Phonology*

There is just one study on phonology in SLI by Kateri (2003); further analysis of Kateri's (2003) data has been done by Kateri et al. (2005). Kateri (2003) tested one Greek SLI child aged 5.9 and one typically developing child aged 4.2, matched to the SLI child by sex and language ability. Spontaneous speech samples of that child have been collected. Data analysis indicated that the SLI child showed significantly lower correct use of phonemes than the control child. Qualitative differences between the SLI and typical development have also been attested. First, the SLI child did not follow the normal pattern of acquisition with respect to voiceless stops that are acquired after the voiced ones. Second, devoicing was prevalent in the SLI child, whereas the ND children lack that phonological process. Kateri (2003) has suggested that the phonological development in the SLI child was deviant. Further analysis of the same data by Kateri et al (2005) showed that the voicing contrast was neutralized in *pro-*

sodically salient (i.e. initial, stressed) positions in SLI data. Moreover, voicing in dorsals tended to be well preserved. To account for the above findings, Kateri et al. have exploited the theory of partially ordered grammars: the child uses a subset of developmental orders until it reaches the target grammar (Tzakosta 2004). The SLI child showed evidence for normal phonological development (e.g. devoicing) and deviant (higher percentages of correct use of dorsals than coronals and labials) as well. Therefore, the issue of typical vs. deviant development in this child is still an open question. Obviously, further research is necessary in the domain of phonology in SLI in order to make conclusions on the phonological development.

Furthermore, the effect of early phonological deficits on the development of morphology and syntax should be investigated. As shown by research on L1 development, phonological constraints interact with the development of early morphology and syntax. For example, children's early omission of grammatical morphemes has been attributed to rhythmic production constraints (Demuth 1994, 2001). A research program for SLI that would incorporate parallel investigations into phonology, morphology, and syntax would advance our knowledge of the linguistic source and locus of the deficit (e.g. see van der Lely 2005 for such an approach to SLI).

3.1.2 *Morphology and morphosyntax*

Issues related to the morphological and morphosyntactic deficits in Greek SLI children have been the focus of the Greek SLI research.

Dalalakis (1994) was the first to carry out a study on Greek SLI children within the framework of the McGill's pioneering project on Genetic Dysphasia. Her Greek SLI screening test for dysphasia showed that Greek SLI children performed below chance on tasks examining inflectional and derivational morphology (Dalalakis 1994).

Moreover, Dalalakis (1996, 1997) has investigated the morphological competence of Greek SLI children and their ability to produce real and novel words, such as plurals, compounds, and diminutives, was particularly examined. Her findings strongly suggest that SLI children do not use the same word formation strategies as non-impaired controls. More specifically, in the plural formation task the SLI children, unlike their controls, disregarded noun gender constraints and chose the most frequent plural allomorph. Specifically, the *-es* plural ending was the most prominent one for all three grammatical genders (masculine, feminine, neuter). The SLI children also differed from their controls in that the plural allomorph */-dhes/* used as a default form by controls was absent from the SLI children's responses. Concerning the compound for-

mation task, errors of root boundary accounted for the majority of errors in the compounding attempts of SLI subjects (e.g. *pontanthropos* instead of *pontikanthropos* “mouse-man”), but, nevertheless, were rare for controls. Finally, in the diminutive formation task, SLI subjects had difficulties in judging root and stem boundaries in complex words (e.g. *polithroula* instead of *polithronoula* “little armchair”), as also observed in the compounding task. Based on that evidence Dalalakis has argued in favour of the rule deficit account (Gopnik & Crago 1991) according to which SLI children do not have the sub-lexical features that encode the inflectional information, consequently, they cannot construct the rules that operate on these features.

Lack of sensitivity to bound morphemes in lexical decision tasks was also found in Kehayia’s (1997b) cross-linguistic study. Kehayia used lexical decision tasks and tested English-, French-, and Greek-speaking SLI subjects. As far as the Greek language is concerned, the stimuli comprised real words and non-words: simple, inflected and compound words (e.g. *grafo* “I write”, *egrap-sa* “I wrote”, and *grafomihani* “typewriter”, respectively). Furthermore, novel compounds, that is, possible but non-existing compounds (e.g. *migofagos* “fly eater”), were also included in the experimental material. The results indicated that the SLI subjects performed similarly on inflected versus uninflected words and non-words, whereas a significant increase in reaction times for inflected non-words was exhibited by the controls. Furthermore, the SLI subjects did not show significantly longer reaction times for novel compounds than real ones, whereas the controls did. Kehayia (1997b) has argued that the control subjects performed in accord to the type of representation processed and so used either whole-word access or decomposition, whereas the SLI subjects only used the whole-word access.

A considerable amount of research has also dealt with functional categories in the spontaneous speech of Greek SLI children (Stavrakaki 1996 & 1999, Clahsen & Dalalakis 1999, Stavrakaki & Tsimpli 1999, Tsimpli & Stavrakaki 1999, Diamanti 1999, Stamouli 2000, Varlokosta 2000a & 2002a, Tsimpli 2001, Mastropavlou 2003). The issue of whether tense or agreement is impaired in SLI has motivated a number of studies (Clahsen & Dalalakis 1999, Stavrakaki 1996 & 1999, Stavrakaki & Tsimpli 1999, Tsimpli & Stavrakaki 1999, Diamanti 1999, Stamouli 2000, Varlokosta 2000a, Tsimpli 2001). Based on spontaneous speech data, all those studies, except for the study by Diamanti (1999) and Stamouli (2000), indicated correct use of past tense marking and selective problems with the subject-verb agreement. Interestingly, Varlokosta (2000a) pointed out that the use of past tense forms in spontaneous speech data was limited to particular verbs, e.g. *epese* “it fell down”.

Stamouli (2000) has extensively tested a young SLI child aged 4.3, Alexia, who had problems only with the perfective past tense forms that have been referred to as ‘regular’ in terms of traditional grammar. Subject-verb agreement errors were not reported by Stamouli (2000). However, Diamanti (1999) reported errors with subject-verb agreement that are mainly limited to the 2nd plural forms of the verb. Since the same child has been tested approximately during the same period by both Stamouli (2000) and Diamanti (1999), one would not expect such a discrepancy in the results. The limited performance that the SLI child showed in the 2nd person plural in Stamouli’s study might be the result of the few obligatory contexts of the 2nd person plural in Stamouli’s corpus (just three). Selective problems with 2nd person singular and 2nd person plural have been shown by Agni,¹⁰ the SLI child in Stavrakaki’s (1996, 1999a) and Clahsen and Dalalakis (1999) studies.

An SLI child, younger than Agni and Alexia, aged 3.3, has been tested by Varlokosta (2000a, 2002a) five times over a period of thirteen months. The data indicated that while the child’s language production was limited to lexical categories after receiving language therapy services for about four months, the child produced indefinite (but not definite) articles, strong personal pronouns but not clitics, wh-words and verbal forms with correct past tense marking but incorrect agreement. Gradually, the child coped with his difficulties with definite articles, subject-verb agreement, object clitics, and was able to produce the markers *na* and *tha* ‘will’ at the age of 4.4.

Similar linguistic characteristics with those reported by Varlokosta (2000a, 2002a) have been widely attested in the Greek SLI literature, for example, problems with the definite article and the object clitics, especially the 3rd person of object clitics (Tsimpli & Stavrakaki 1999, Diamanti 1999).

Based on Agni’s excessively low performance in both definite articles and object clitics, Tsimpli & Stavrakaki (1999) have claimed that problems with those grammatical categories reflect problems with non-interpretable features, since the definite article and object clitics bear case and *phi*-features. On the other hand, Agni did not have any problems with strong pronouns, genitive clitics, and indefinite articles that are specified for (in)definiteness and referentiality (interpretable features). With respect to wh-pronouns, a compensatory strategy was adopted by Agni. In particular, she omitted them, but used an exceptional syllable-stress on the first verbal syllable.¹¹ The omission of *what* was argued to be a result of its non-interpretable features, while the assignment of focal stress was suggested to be a strategy for marking the interpretable [wh-] feature. A follow-up study of the same SLI child, who participated in Tsimpli and Stavrakaki’s study (1999) a year later, showed that different developmental

paths were followed with respect to definite articles and object clitics, since the child performed at ceiling on the production of definite article, but not of object clitics (Stavrakaki & Tsimpli 1999). Problems with those categories consisting of the realization of non-interpretable features, i.e. definite articles and clitics, were attested in a group of seven preschool children with SLI aged 3.5–7 (Tsimpli 2001). The better performance of SLI children on tense rather than agreement was also confirmed by Tsimpli's (2001) study.

The use of the article and the pronominal paradigm by Greek SLI children was tested again by Tsimpli and Mastropavlou (in press). Overall, the SLI performance on clitics and articles was not homogenous: the younger SLI children had problems with both definite articles and clitics, but not with indefinite articles and genitive clitics — showing evidence for differential SLI performance of interpretable vs. uninterpretable features. By contrast, older SLI children performed on target on 3rd person clitics and the definite article, showing that SLI performance can significantly improve over time.

Another study motivated by the question of whether the non-interpretable features of grammar are impaired in SLI is by Mastropavlou (in press). Specifically, she has investigated the accessibility of the features of gender, case and number as well as agreement in two children with Specific Language Impairment. She predicted that the children's performance would be related to the features' LF (Logical Form) interpretability. Specifically, she assumed that the gender in nouns, but not in adjectives or articles, is an interpretable feature because it is a feature of the stem in nouns (but not in adjectives and articles). On the other hand, number and case are non-interpretable features because they belong to inflection (Mastropavlou in press:2).¹² The results from elicited production tasks indicate that gender is more accessible in nouns than number and case. Mastropavlou (in press:14) suggested that this might be due to the fact that "gender is interpretable on nouns, whereas number and case are not". Selective problems with genitive case marking in SLI children have also been reported by Mastropavlou (2003). The distinction between interpretable vs. non-interpretable features was suggested to be a principal one in SLI grammar by Mastropavlou (in press).

3.1.2.1. Discussion of the findings and directions for further research. In sum, studies of the morphosyntax in Greek SLI revealed multiple deficits in SLI grammar, but also particular areas of strength: most preschool children with SLI appear to have selective problems with subject-verb agreement but not tense marking — a finding contrary to the predictions of the influential ex-

tended optional infinitive hypothesis (Rice et al. 1995) that postulates deficits in the domain of tense.

The findings concerning the nominal domain show problems with definite articles and clitics and, therefore, are in accord with findings from other languages with rich morphology (cf. Leonard 1998). Moreover, the pattern of Greek SLI performance on verbal vs. nominal elements is compatible with that shown in other languages with rich morphology: better performance in bound rather than freestanding morphemes (for a review of the literature, see Leonard 1998). However, developmental dissociations have been shown within the nominal domain, e.g. better performance on definite articles than object clitics (Stavrakaki & Tsimpli 1999); and also ceiling performance on clitics and definite articles by some SLI children (Tsimpli & Mastropavlou in press). Furthermore, a deficit in core morphological abilities of word formation was found as shown by the children's strategies with on-line word recognition and difficulties with derivational morphology (Dalalakis 1996, 1997, Kehayia 1999).

The overall data indicate a highly selective deficit limited to particular grammatical features and operations, which is differentially manifested in SLI grammars. Issues such as heterogeneity in SLI children and individual variation in language development in SLI have not been addressed by Greek SLI researchers. Although most of the existing studies constitute studies of single individual cases and very small groups of children, the clinical profile of the SLI children has not been presented in detail. This may be due to the fact that clinical measures such as grammar, vocabulary and memory tests have not been standardized for Greek, and thus the SLI research reflects the limitations imposed by the absence of psychometric measures for Greek. However, conclusions regarding the SLI deficit can only be made for children whose clinical profile has been described in detail; otherwise, any characterization of the SLI deficit is rather pointless, especially due to the heterogeneity of the SLI population.

Furthermore, these studies of the Greek SLI children have also been bound to methodological restrictions: first, in most of them just one method of data collection was used, i.e. the spontaneous speech (Stavrakaki 1996 & 1999, Clahsen & Dalalakis 1999, Varlokosta 2000a, Stavrakaki & Tsimpli 1999, Tsimpli & Stavrakaki 1999, Tsimpli 2001, Stamouli 2000, Diamanti 2000), hence the subjects' performance has not been tested systematically across different methods; second, the effect of non-linguistic factors that might play a role in the correct/incorrect performance of the SLI children has not been systematically investigated: for example, the effect of verb frequency on the correct agreement and tense marking; third, in most of these studies, statistical analysis has been limited to descriptive statistics (e.g. mean correct performance), whereas in-

ductive statistical analysis that could further illuminate the SLI performances has been completely absent; finally, most of those studies deal with preschool and school age SLI subjects except for Kehayia's (1997b) study in which the subjects' ages ranged between 14 and 40 years, hence it is unknown how the SLI deficit is manifested in adult SLI subjects.

3.1.4 Syntax

In addition to morphosyntactic approaches to SLI grammar, Greek SLI research has also employed current syntactic theory to interpret the significant deficits that the SLI children were found to have with complex syntactic operations.

Varlokosta (2000b, 2002b) has studied the acquisition of pronominal reference in typically developing and SLI children. She used the Truth Value Judgment task that was also employed to test the aphasic patients' performance on the pronominal reference. The test conditions included different types of pronouns (clitics vs. strong pronouns) in structures that differed in terms of syntactic complexity (e.g. *O Goofy skepase afton* "Goofy covered him", and *O Goofy ton ide demeno* "Goofy saw him tied up") (Varlokosta 2000b & 2002b). The results indicated that typically developing children performed at ceiling on all structures except for those that involve a passive participle like *O Goofy ton ide demeno* "Goofy saw him tied up". The SLI children showed heterogeneous performance: one group showed the same pattern of performance as typically developing children, that is, no DPBE effect for both clitics and strong pronouns except for those structures that involved a passive participle. The other group showed a DPBE effect in other contexts, too. Varlokosta (2002b, 2000b) argues, contrary to Jakubowicz et al. (1998), that for some SLI children the comprehension of clitics is severely impaired.

The question of whether SLI children have specific deficits in clitics has been raised by Petinou and Terzi (2002) on the basis of Cypriot-Greek data. They adopted a pure syntactic framework to account for clitic misplacement in early and SLI Cypriot Greek. Their study has been motivated by the following linguistic data: in adult Cypriot Greek clitics must follow the finite verb in various syntactic contexts: (*ida se saw.1SG you.CL* "I saw you"). However, when the finite verb is preceded by some functional head, clitics must immediately precede the verb: *den to efaga NEG it.CL ate.1SG* "I did not eat". Cypriot Greek children tend to place clitics after the verb in contexts that are not allowed in adult language. Petinou & Terzi (2002) have tested five SLI children matched to typically developing children for mean length of utterance in words (MLU-W) on the basis of spontaneous speech data.

The results indicated that both groups showed clitic misplacement, although the SLI group showed a significantly larger proportion of clitic misplacement when compared to typically developing children. To account for the results, Petinou and Terzi have claimed that Cypriot Greek children overgeneralize V-to-M movement in contexts not allowed in adult language. As far as the adult language is concerned, Terzi (1999) has suggested that the post-verbal position of clitics in finite contexts is the result of verb movement to M, the head of the mood phrase: the finite verb movement to M leaves the clitics behind because clitics adjoin to a lower functional head than M, the empty functional head F. In child grammar, verb movement passes over the clitics, although this is not allowed in adult grammar. Therefore, clitic misplacement in child language has been attributed to the incomplete knowledge of the properties that the functional category M has. Although there were quantitative differences between the SLI and normal performance, no qualitative differences have been found, and thus Petinou and Terzi (2002) have argued in favour of the view that treats SLI as a case of language delay, rather than a language disorder.

The issue of the status of syntactic abilities in Greek SLI children alongside typical development has also been addressed by Stavrakaki (2001a, 2001b, 2002a, 2002b, 2002c). She has provided a detailed examination of the syntactic performance of a group of eight Greek SLI children and their language age counterparts across different modalities, i.e. production and comprehension. First, she has tested the SLI syntactic comprehension of simple active sentences with SVO word order, simple active sentences with clitics, structures formed by operator movement, i.e. focus constructions, subject and object clefts and pseudo-clefts, subject and object long-distance *wh*-questions, and A-movement, i.e. actional passives. All of them were semantically reversible. Toy-manipulation tasks were employed.

The test structures have been described in terms of processing and syntactic characteristics. It has been claimed that the more the preferences of the parser are violated, the more difficult the processing of the structures will be (Stavrakaki 2001a, 2001b). The relative independence of parsing from grammar was hypothesized behind that claim. In other words, parsing was assumed to involve the following preferences: (1) preference for local associations (Frazier 1987), (2) reliance on morphological contrast cue, that is, the morphological case — specifically, the nominative case is associated with the agent theta-role, and the accusative case with patient theta-role, as shown by on-line sentence interpretation experiments in Greek (Kail & Diakogiorgi 1994), (3) preference for the first NP marked for the nominative case to be the agent, as indicated by the same on-line experiments (Kail & Diakogiorgi 1994). Within

this framework, when a structure is not compatible with parsing preferences, then the interpretation of that structure can be exclusively based on syntax.

The results indicated a significant effect on the processing properties on the SLI performance: (1) same level of performance with LA and CA controls on structures completely compatible with the parsing preferences (simple active sentences, subject clefts and pseudo-clefts), (2) lower, but not significantly different performance than LA controls on structures that violate to some extent the parsing preference (who-S LD questions and focus constructions), (3) significantly lower performance than LA controls on all structures that violate the parsing preferences and require a pure syntactic analysis in order for them to be interpreted (simple active sentences with clitic, object clefts and pseudo-clefts, passive constructions, and who-O questions). Crucially, all of them are formed by movement except for the simple active sentences with clitic, the interpretation of which requires the identification of the appropriate referent for the clitic pronoun on the basis of the clitic's morphosyntactic properties, i.e. case and *phi*-features. Moreover, Stavrakaki (2002a) argues that the SLI children's lower performance in processing demanding structures¹³ is due to grammar, and not a processing deficit, as the finding is that the SLI performance was qualitatively different than that of the LA controls since different hierarchy in the difficulty of the structures was shown by SLI children and LA controls. Further evidence from the SLI comprehension of relative clauses confirmed the hypothesis of deviant linguistic development in SLI (Stavrakaki 2001b), since the SLI showed a qualitatively different pattern of performance than LA controls. For example, the SLI performance was characterized by the predominance of reversal of the theta-roles in relative clauses in clear contrast with normally developing children who produced few theta-role errors.

Stavrakaki (2002b) has also investigated the production abilities of the same children. Specifically, the SLI children and their controls have been tested on the production of (1) simple active sentences, (2) object focus constructions, (3) wh-questions, (4) relative clauses, and (5) passive voice through elicitation tasks. The SLI children were able to produce simple active sentences with SVO word order, and also they have overused that word order in focus structures in contrast with typically developing children who produced the SVO word order neither in simple contexts nor in focus structures. The SLI children showed severe grammatical problems with wh-questions, relative clauses, and passive sentences. As far as the wh-questions are concerned, the SLI children performed significantly better on the production of subject than on object wh-questions, whereas the typically developing children showed ceiling and near ceiling performance in the subject and object wh-questions, respectively.

Grammatical errors were the hallmark of SLI performance: e.g. gap-filling errors. These errors showed problems with operator movement, since only the *wh*-pronoun moved leaving the nominal *in situ* (*o andras pion htipise ton pith-iko?* the-man.NOM-who.ACC-hit.3SG.PAST-the-monkey.ACC “Which did the man hit the monkey?”, target: “which monkey did the man hit?”).

Based on the overall performance of SLI children, Stavrakaki (2002b) has suggested that the SLI performance was conditioned in terms of the following rule: “If a structure is not at all compatible with the parsing preferences and interpretation is purely dependent on syntactic cues, then a significant drop in SLI performance is expected”. Therefore, the SLI performance was conditioned by the parsing preferences, and some movement operations (at least *A*-movement and *A*-bar movement) should be missing from the grammar of SLI children. Furthermore, Stavrakaki followed a developmental perspective to account for the attested deficits in SLI: assuming that at an early stage the SLI children show severe deficits with grammatical features that lack interpretability (cf. Tsimpli & Stavrakaki 1999), she suggested that morphological aspects of the non-interpretable features can be susceptible to explicit memory processes, but syntax is rather impenetrable to explicit learning procedures due to its strictly modular status. Therefore, the SLI children’s deficits with the syntactic component of language should be attributed to the nature of developmental process that take place in SLI grammar, described better in terms of explicit rather than implicit procedures.

3.1.4.1 Discussion of the findings and directions for further research. In sum, the findings of the studies on the syntactic abilities of SLI children show that there are particular areas of deficits associated with syntactic complexity that is defined in terms of the syntactic theory employed. An interesting aspect of these studies is that they are methodologically ‘advanced’ compared to most of the SLI studies that used spontaneous speech data: in most of them, a language age control group has been included that has been matched with the SLI group in ways which have been explicitly reported.

An issue that all these studies raise, either in a direct or indirect way, is the way that language acquisition takes place in SLI, as well as the mechanisms involved in language development in SLI. Varlokosta (2000b, 2002b) has identified a subgroup of children who show qualitatively different performance from that of typically developing children; similarly, Stavrakaki (2001a) observed that the SLI children produced errors that were not produced by the language age controls and hypothesized that explicit memory strategies might play a role in SLI language development. On the other hand, Petinou & Terzi (2002)

have presented a study that only showed quantitative differences between the SLI and typical development. A question for further research is to what extent adult SLI subjects show qualitative and/or quantitative differences in their performance when compared to their language age counterparts. Another issue that has not been systematically addressed by Greek SLI research is whether the SLI deficit can be considered as a deficit that affects different linguistic domains, e.g. phonology, morphology, and syntax, and their interface, or if it is limited to particular domains of grammar.

3.1.5 *Vocabulary*

The lexical abilities of Greek children with SLI have not been extensively studied. The verb lexicon in SLI has been investigated by Stavrakaki (1999, 2000), who has examined production and comprehension abilities through a picture description and a picture-pointing task, respectively. Four SLI children whose linguistic performance has been compared with that of normal controls matched to the SLI children in chronological age participated in the study. The results indicated that the SLI children had problems with production, but not with comprehension. Therefore, their problems with verb production could be attributed to difficulties in verb retrieval, i.e. the target verb for some reason is not accessible when required. The results have also indicated that the Greek SLI children used a significantly less diverse verb lexicon than their age peers controls; specifically, the SLI children used a smaller set of light verbs including *kano* “to do/to make”, *pao* “to go”, and *ime* “to be”, to a greater extent than the control group. Moreover, the SLI children were found to produce non-adult forms of Light Verb Constructions (LVCs), which were in fact neologisms formed by the rules of LVCs in adult Greek, as described by Stavrakaki (1999b). Stavrakaki (2000) argues that the SLI children used the rules that underlie the LVCs formation in Modern Greek to compensate for their verb-retrieval difficulties.

Vocabulary development has not attracted the SLI researchers’ attention, although it would be theoretically interesting to look at the relation between lexical and morphosyntactic abilities in SLI. Therefore, further studies on lexical abilities of Greek SLI children are required in order to identify whether the SLI children have specific areas of deficits and/or strengths in language acquisition.

4. Conclusion

This paper aimed at presenting an overview of the current research on Greek neurolinguistics, which is a very young discipline. However, it is growing rapidly and offers new insights, as shown by the significant theoretical implications of the research findings. Despite any methodological and/or theoretical drawbacks that could be identified, Greek neurolinguistics has already become a well-established discipline as indicated by the increasing number of studies and publications in international journals.

The next step for the researchers in the field of (Greek) neurolinguistics is to join up with colleagues from other related disciplines, e.g. cognitive neuroscience, psychology, and speech and language therapy, in order to shed light on controversial issues through multidisciplinary approaches to the study of the brain and language. Such a multidisciplinary perspective can further illuminate the contribution of linguistically oriented approaches in the field, and show that progress in neurolinguistics is highly dependent on linguistics. It can also advance our understanding of the very old question of how the brain subserves human communication. Greek neurolinguistics has just started contributing to this exciting line of research.

Notes

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1. There are no studies of phonology in aphasia for Greek.
2. In this brief introduction to aphasia, I aim at presenting the aphasic types that have been studied for Greek.
3. Just one case of a Greek-speaking patient with crossed aphasia has been described by Pita et al. (1997). The description of the patient indicated that oral language abilities were congruent with the classical profile of Broca's patients since he showed severe problems with spontaneous speech.
4. On-line experiments include timed tasks and examine language use as it occurs in real time through reaction-time measures; so they are used to answer questions concerning how linguistic processing is taking place. On the other hand, off-line experiments examine language performance on specific tasks through analysing the correct vs. incorrect responses;

so, they are used in order to answer research questions that take a yes/no form, e.g. Do aphasic patients have knowledge of intransitive verbs? (Gernsbacher 1994).

5. The words' features (e.g. pronunciation, morphemes and morphological structure, syntactic information, meaning, pragmatics) are represented and listed in the mental lexicon as storage units.

6. Priming experiments are on-line experiments in which increase in the speed of the subject's response to one element occurs because of prior exposure to a related element (Gernsbacher 1994).

7. In these on-line experiments, subjects are required to decide whether the presented letter strings constitute existing words or non-words.

8. It should be, nevertheless, noted that the question of how the Greek past tense is represented and processed could not be answered on the basis of these data only. Developmental data would be very crucial for distinguishing between different accounts of past tense, i.e. the dual mechanism accounts, which postulate that regular and irregular forms employ distinct representational and processing mechanisms, and the single mechanism accounts, which postulate that regular and irregular word forms employ the same representational and processing mechanisms (see Pinker 1999, Rumelhart & McClelland 1986).

9. See Alexiadou & Anagnostopoulou (in press) for an alternative analysis of adjectival passives.

10. This child is referred to as "Eva" in other studies (e.g. Tsimpli & Stavrakaki 1999).

11. In particular, when the *wh*-phrase (what) was omitted, there was heavy stress on the initial syllable of the verb, which appeared in clause initial position.

12. This approach to LF interpretability differs from Chomky's (1995) standard notion of features' LF interpretability. In current minimalist terms, the number of nouns is an interpretable feature. This is a well-established characterization in linguistic terms. The feature [+/- plural] of nouns is interpretable at LF because it has semantic content. On the other hand, non-interpretable features are purely grammatical/formal features. Thus, classifying the number of nouns as a non-interpretable feature is highly problematic. I thank Gaberell Drachman for drawing my attention to this point.

13. Processing demanding structures were those that violated the parser's preferences.

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