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MORPHOLOGICAL DEFICITS IN AGRAMMATIC APHASIA:
A COMPARATIVE LINGUISTIC STUDY

by

Eva Kehayia

A Thesis Submitted to the
Faculty of Graduate Studies and Research
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

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Ithaka

As you set out for Ithaka
hope your road is a long one,
full of adventure, full of discovery
Laistrygonians, Cyclops,
angry Poseidon—don't be afraid of them:
you'll never find things like that on your way
as long as you keep your thoughts raised high,
as long as a rare excitement
stirs your spirit and your body.
Laistrygonians, Cyclops,
wild Poseidon—you won't encounter them
unless you bring them along inside your soul,
unless your soul sets them up in front of you.

....

Keep Ithaka always in your mind.
Arriving there is what you're destined for.

....

And if you find her poor, Ithaka won't have fooled you.
Wise as you will have become, so full of experience,
you'll have understood by then what these Ithakas mean.

Constantine P. Kavafy

ABSTRACT

MORPHOLOGICAL DEFICITS IN AGRAMMATIC APHASIA: A COMPARATIVE

LINGUISTIC STUDY

In this thesis, a comparative linguistic investigation of morphological deficits in two English-speaking and two Greek-speaking agrammatic aphasic patients is presented. Adopting the Strong Lexicalist Hypothesis, the study focuses on the subjects' ability to repeat, comprehend and produce nominal and verbal inflections. The hypotheses investigated concern the effects of language-specific features in agrammatic performance and the role of morphological principles in the two languages. Finally the implications of the data for linguistic theory are investigated.

The data show that language-specific features are crucial in determining aphasic performance. Principles of well-formedness of lexical items appear to remain unaffected. Morphological deficits are found to manifest themselves at different levels: the lexical and the postlexical. A Storage Hypothesis which reflects the word structure of complex lexical items in the brain is proposed. Finally, it is proposed that only through a Strong Lexicalist framework can one achieve uniform interpretations of morphological deficits in aphasia.

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<u>RÉSUMÉ</u>

P ERTURBATIONS MORPHOLOGIQUES CHEZ L'APHASIQUE AGRAMMATIQUE:

ÉTUDE COMPARATIVE

La présente thèse a pour objet l'étude linguistique comparative des perturbations morphologiques chez deux aphasiques agrammatiques anglophones et deux aphasiques agrammatiques héllénophones. La capacité des sujets à répéter, comprendre et produire les flexions nominales et verbales est investiguée dans le cadre de l'Hypothèse Lexicaliste Forte. Les hypothèses de l'étude portent, d'une part, sur les effets des traits particuliers à la langue sur la performance du sujet aphasique et, d'autre part, sur le rôle des principes morphologiques propres aux deux langues étudiées. Sont enfin examinées les retombées théoriques des résultats obtenus.

Les données cueillies montrent que les traits particuliers à la langue jouent un rôle prépondérant dans la performance du sujet aphasique. Les principes de bonne formation des items lexicaux semblent demeurer intacts. Les perturbations morphologiques se révèlent à deux niveaux distincts: le niveau lexical et le niveau postlexical. Une Hypothèse de Stockage reflétant la structure interne des items lexicaux complexes est proposée. Enfin, il est soutenu que seul un cadre lexical fort permet de formuler des interprétations systématiques du langage aphasique.

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Chapter I

Introduction

The study of linguistic deficits in aphasia has become of increasing importance in recent years. Researchers, neurolinguists and psycholinguists, are investigating aphasic syndromes, in the pursuit of two major goals: to acquire meaningful interpretations of linguistic deficits in aphasia in terms of specific theoretical linguistic models as well as to use aphasic data for the testing of models of normal linguistic capacity.

A large body of neurolinguistic research has concentrated on the study of the syndrome of agrammatism. 'Agrammatism' signifying the absence of the knowledge of grammar or grammatical rules, "a- *grammatismos* " in Modern Greek, has been associated with: a) the deletion of function words, that is, prepositions, articles, conjunctions, pronouns and auxiliary verbs and copulas, b) the predominance of nouns at the expense of verbs and copulas, c) the loss of inflections and of some derivations and d) the loss of agreement markers, most evident in richly inflected languages. To date, linguistic investigations of agrammatism have employed syntactic, phonological or morphological theories in order to interpret specific linguistic deficits. Agrammatic patients have been described as having a syntactic deficit and more rarely as having a morphological deficit. The smaller number of morphological investigations

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of agrammatism can be partly attributed to the fact that, for some time linguistic theory did not acknowledge the separate existence of a morphological component of grammar; it can also be attributed to the fact that a large body of research was conducted only on English, a language with a relatively poor morphological system.

The goal of this thesis is to conduct a comparative linguistic study of morphological deficits in agrammatism. Assuming a specific theoretical linguistic framework, we will compare the use of nominal and verbal inflections in two languages, Greek and English, which differ in terms of the richness of their inflectional systems as well as in terms of the representation of the internal structure of words. Our research focuses on the repetition, comprehension and production abilities of four agrammatic subjects (two in each language), tested on stimuli that require attention to specific morphological markers .

Chapter 2 presents a brief overview of previous studies of morphological deficits in agrammatism, particularly stressing those conducted within specific theoretical linguistic frameworks.

Chapter 3 outlines the theoretical framework underlying our study and explores features of Modern Greek grammar, especially with reference to the organization of the morphological component in Modern Greek.

Chapter 4 contains the hypotheses, methodology and subjects tested in the two experiments of this study. The first experiment investigating nominal inflections in the performance of Greek- and English-speaking agrammatic aphasics is then presented, followed by the results and discussion of findings.

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Chapter 5 focuses on the investigation of verbal inflections in the same subjects. The actual experiment, the results and discussion of findings are again presented. Both experiments investigate the effect of language-specific features in the assignment of number, gender, case and tense. Finally, the relevance of specific morphological models for an adequate description of aphasic data is also examined.

Chapter 6 is devoted to summarizing the findings of the two experiments and discusses the implications of the data for linguistic theory, as well as for further neurolinguistic research of aphasia in general.

Chapter 2

Investigation of Morphological Errors in Agrammatism

The investigation of errors related to the presence or absence of bound morphemes in the speech of aphasic patients has been the target of research ever since aphasia was described in linguistic terms. Studies initially examined the occurrence or non-occurrence of morphological errors alone or in combination with syntactic errors. The performance of patients was mainly characterized by the omission of function words and/or grammatical inflections and derivations. Traditionally, characterizations such as these have been used to describe the syndrome of agrammatism, a type of Broca's aphasia which exhibits loss of function words (e.g., prepositions, articles), dropping of certain bound morphemes (e.g., inflectional affixes like the English past tense marker and the third person singular marker on verbs), and "the simplification of syntax to a string of grammatically and prosodically disconnected utterances which contain mainly content words" (Goodglass, H., 1973). Even though the attempts to provide unified, linguistic explanations of clinically defined disorders such as agrammatism have been widely criticized, (see Badecker and Caramazza, 1985; Caramazza, 1986), 'agrammatism' is still extensively used to characterize all or some of the linguistic deficits found in Broca's aphasia.

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One of the first to provide us with some kind of linguistic interpretation of agrammatism was Jakobson (1956). He defined the syndrome as an actual dissolution of grammatical rules resulting, in the most severe cases, in the reduction of an utterance to nominal forms--nouns and nominalized verbs. In an attempt to provide an explanation for a possible order of the dissolution of inflectional affixes he stated that what makes a difference is whether an inflectional affix has a syntactic role in the sentence or not. He thus distinguished between the possessive marker '-s' which has a syntactic role and the plural marker '-s' which does not and proposed that the former is more likely to be omitted. He concluded by stating that in the agrammatic patient there is a tendency to abolish syntactic rank which leads to the reduction of speech to primaries.

An extensive study of the English inflectional endings and their order of dissolution was conducted by Goodglass and Berko (1960) in a 'Grammatical Inflection Test' where an oral sentence-completion technique was used to test the production of the following items (1).

(1) plural   /-s,-z/
     plural   /-iz/
     past   /-t,-d/
     past   /-id/
     third person   /-s,-z/
     third person   /-iz/
     possessive   /-s,-z/
     possessive   /-iz/
     comparative   /-er/
     superlative   /-est/

The study measured the presence or absence of the above shown morphemes in complex words and the results yielded an order of difficulty similar to the one hypothesized in Jakobson (1956). Furthermore, it appeared that Broca's aphasics omitted the non-syllabic more often than the syllabic variants (i.e. /-iz/ and /-id/. Even though this study revealed the order of difficulty in the production of the syllabic/non-syllabic variants of the morphological markers tested, there was no attempt to interpret the results in terms of an explicit linguistic theory.

Along the same lines, DeVilliers (1978) used a corpus of aphasic speech collected by Howes (1964) to examine the occurrence or non-occurrence in the speech of aphasics of 14 morphemes in contexts in which their occurrence would be obligatory in the speech of normals. The results revealed the following order of difficulty, numbers from I - 8 show the increasing difficulty, (2).

(2)   present progressive   1
       plural -s   2
       contractible copula   3
       uncontractible copula   4
       articles 'a' 'the'   5
       past regular   6
       past irregular   7
       3rd person singular   8

De Villiers proposed that prosodic features of the target sentence, together with other factors such as semantic complexity, redundancy and frequency, can be used as explanatory factors for the order of difficulty observed in her study. For example, the redundancy of the 3rd person singular marker in the interpretation of a sentence such as 'Mary eats an apple', as well as the homophony of the 3rd person singular to the plural '-s' marker may contribute to the order of difficulty found.

In the studies reviewed up to now, the main objective has been to discover the order of difficulty, for agrammatic patients, of the grammatical morphemes tested. However, even though these studies provided the researcher with a corpus of data, their goal has been mostly descriptive. As research in linguistic aphasiology advanced, the necessity for theoretically based linguistic investigations of aphasic speech became more evident. Thus, morphological, syntactic or phonological frameworks are being used as a means for the interpretation of language deficits in aphasia. At the same time, aphasic data provides information useful to the construction of theoretically based linguistic models of the organization of language in the brain.

In recent studies of linguistic aphasiology, there is a noticeable tendency to try to establish a role for linguistic theory in aphasic research. The major questions in current research revolve around issues of the extent to which agrammatic speech reflects aspects of a particular language system as well as how it can contribute to the understanding of specific features of language processing.

The first detailed linguistic interpretation of agrammatism appears in Kean (1977). Along with previously mentioned researchers she also noted that elements that tend to be omitted in agrammatic speech are the function words, all inflectional affixes and some derivational affixes. Working within the general framework of Generative Transformational Grammar, she proposed an analysis, the basic idea of which is that affixes are omitted selectively depending on the type of morphophonological boundary they carry. Affixes that carry a "strong" word boundary (#) are more likely to be omitted than affixes that carry a "weak" morpheme boundary (+). The former, in contrast with the latter, do not affect the placement of stress or other phonological features of individual words. Adopting Aronoff's (1976) model of morphology, she attempted an investigation of agrammatism from the point of view of morphology. She concluded that agrammatism cannot be interpreted in terms of syntactic, semantic or morphological structure. For her, the only uniform and systematic interpretation of agrammatism is in terms of phonological structure; the apparent lack of well-formedness found in agrammatic speech arises from a reduction of the phonological structure of a sentence. She concluded that what is retained in agrammatism are the phonological words of the language. A phonological word is a string of segments marked by boundaries which function in the assignment of stress to a word (in English). For example, we find a retention of a word such as 'definitive', where the affix -ive plays a role in the assignment of stress in contrast with a word such as 'definiteness', where -ness is absolutely neutral to stress assignment. Phonological words in English are considered to be the following:

(3) a) simple nouns, adjectives, verbs and -ly adverbs
     b) polysyllabic prepositions
     c) complex words containing just (+) boundaries

"A Broca's aphasic, therefore, tends to reduce the structure of a sentence to the minimal string of elements which can be lexically construed as phonological words in his language. Embodied in this is the claim that there is no impairment to the grammatical structure of the lexicon"(Kean, 1977). On the other hand, one finds a relative impairment in what Kean calls 'phonological clitics' which consist of:

(4) a) determiners, auxiliaries, etc.
     b) monosyllabic prepositions
     c) inflectional # boundary affixes
     d) derivational # boundary affixes

According to Kean, a factor that might influence the possibility of omission or retention of an affix in agrammatic speech is "sonorance". This claim is also found in previous studies by Goodlgass (1973), Goodglass and Berko (1960) and Gleason et al. (1975) who observe that among the three variants of the plural marker -s, -z, -iz the latter one was found to be mostly retained due to its syllabic structure. Kean finally concludes by stating that agrammatism can be accounted for on the basis of the sound structure which exists between a word and its affixes. Any 'deviant' aspects in the speech of a Broca's aphasic are not inherently deviant, but arise rather as a consequence of the interaction of normal intact components of the linguistic system

with the impaired phonological component.   Thus, the possibility of correlating agrammatic phenomena with morphological or syntactic deficit is ruled out.

In an attempt to re-evaluate the issues put forth in Kean (1977), from the point of view of a generative theory of morphology, Kehayia (1984) examined the relative retention of complex words containing 'strong' and 'weak' boundary affixes in two repetition tasks . The model of morphology used in her study was the one proposed by Walsh (1981). According to this model, a) both derivational and inflectional affixation processes are part of the morphological component, b) words are either listed in the lexicon and related by redundancy rules or formed by word formation rules (WFRs), and c) the words formed by rules may be distinguished according to the level at which they are formed, as determined by the principle of level ordering adopted by Walsh (1981). The types of affixes tested and their classification according to the theoretical framework presumed are illustrated in (5).

(5)   Lexicon   WFRs

	Level I	Level II	Level III	Level IV
+ity	+ity	#ness		#iz
+al (N)	#able	#ment		#s
+al (A)		#less	compounding	#z
#ment				
#less		#un		
(irregular		#re		
plurals)				

The results were generally consistent with Kean's hypotheses regarding the phonological determinants of the treatment of affixes by agrammatic patients. There was an interesting difference in performance of patients with respect to the difference between (+) and (#) boundary affixes, whereby (#) boundary affixes were more frequently omitted than (+) boundary affixes. The results also showed an interesting correlation between the patients' ability to repeat words and the distinction between listed and non-listed words on the one hand and different levels of word formation on the other. Idiosyncratic complex words (both derivational and inflectional) listed in the lexicon were largely retained, while derived words became increasingly problematic as one moved from Level I to IV. For example, derived complex words formed at Level IV, and thus, including an inflectional affix, yielded a higher error-rate than words derived at Level II which in turn were more problematic from those derived at Level I. This result implies the existence of different levels of processing and the selective impairment of these levels in agrammatic repetition and probably speech planning. Furthermore, this study points to the possibility of a distinct impairment of morphological component of grammar. Such an idea was initially presented in Tissot, Mounin & Lhermitte (1973) and further elaborated in Miceli, Mazzucchi, Menn, & Goodglass (1983) who proposed a two-dimensional model where the morphological and syntactic components of grammar can be independently affected. Similar conclusions are reported by Saffran, Schwartz & Marin (1980) and Gleason et al. (1980).

Reflecting on the above mentioned issues, one may observe that, since the study of aphasic syndromes appealed to specific linguistic analyses, the nature of linguistic

theory determined the way in which neurolinguistic investigations were conducted. Thus, during the years when linguistic theory regarded morphology as a subcomponent of syntax, aphasic data was analysed in terms of morphosyntactic deficits. However, once the existence of a separate morphological component of grammar had been acknowledged by the linguistic models of natural languages, the possibility of distinct morphological deficits in aphasia could be investigated.

The question arising here is the following: How can one distinguish between specific lexical and syntactic deficits in morphological processing? One of the first to address this issue were De Bleser, R. & Bayer J. (1986) who, apart from investigating the role of semantics in lexical reading and repetition, also addressed the issue of the organization of the lexicon with respect to inflectional morphology. The inflectional markers of case, number and gender were tested in the performance of two German-speaking patients with transcortical aphasia. Testing involved reading, repetition, semantic and syntactic tasks. In order to investigate more closely the internal structure of the functioning lexicon, tasks were assigned in which two patients had to pay attention to morphological markers such as number, gender and case. The morphological tests used for the second patient further included compounding and derivational morphology. The results showed that although phrase-level syntactic processing was largely affected, the formal structure of the lexicon remained mostly intact. The relatively good performance on tasks that require attention to markers of derivational and inflectional morphology, in the near absence of phrase-level syntax (and the total loss of semantics), showed that word formation (including inflection)

can be selectively preserved (De Bleser & Bayer, 1986:34). This observation strengthens the hypothesis that word formation, whether derivational or inflectional, must be taken care of in the same component, that is the morphological component and, therefore, it can be selectively spared or impaired.

Miceli & Caramazza (1988), working within a Strong Lexicalist framework of morphology, readdressed the issue of identification of morphological deficits in aphasia. They proposed a solution to the difficulty of isolating morphological deficits from syntactic ones by testing morphological phenomena on words both in context - in sentences - as well as in spontaneous speech and single-word processing. Since morphological errors found in inflected words within sentences can often be considered as morphosyntactic errors, especially in cases of verb-noun agreement, Miceli and Caramazza suggested that if their patient were to make morphological errors in single-word processing, they would be able to conclude that at least one factor contributing to the patient's impairment would be a deficit of the lexical processing system. Their experimental study included detailed analyses of samples of spontaneous speech and of two repetition tasks: single-word repetition and single non-word repetition. The results showed morphological processing difficulties both in spontaneous speech and single-word repetition. Even though the patient's spontaneous speech and repetition of sentences and single words contained phonological errors (phonemic paraphasias), the overall pattern of errors suggested that the functional locus of the damage was at the morphological processing component of the lexicon. After methodically examining the possible explanations for the errors found in spontaneous speech and repetition in

terms of a phonological or a syntactic deficit, they concluded that the morphological errors produced by their patient in spontaneous speech and repetition could be characterized as resulting from damage to a morphological processing mechanism. They thus attributed the impairment to damage to the inflectional component of the lexical system. Such an explanation rules out a possible impairment of different components of grammar, namely the one involved in the production of spontaneous speech or the one involved in single-word repetition. It appears to be highly unlikely that the same error can be the result of a deficit to one component, (the phonological or the syntactic component), when spontaneous speech is produced, and the result of a deficit to a different component, (the morphological component), when single-word repetition is elicited. Thus a unified explanation of errors as resulting from a morphological deficit can be maintained.

The examination of morphological deficits has also been the focus of investigation in studies that have examined cross-linguistic differences, at the level of morphology, and the reflection of such differences in aphasic speech. In these studies, a major distinction is drawn between languages with rich inflectional systems like Hebrew, Italian and German and languages with poor inflectional systems like English. Grodzinsky (1982), reporting on Hebrew, states that one finds substitution errors to be more common than omission errors in richly inflected languages. A similar conclusion is reached by Miceli et al. (1983) who found that roots, such as 'camin-' are never produced in Italian, but are instead affixed with an inappropriate inflectional form. Such was never the in English where root morphemes are commonly produced

instead of the properly inflected form. Miceli et al. (1983) further observed that when an agrammatic makes an inflectional error, the inflection produced is a possible form for the particular target noun or verb. That is, agrammatics never produce a word that consists of a root morpheme and a possible, but inappropriate, bound morpheme (Caramazza and Berndt, 1985: 35).

This observation is consistent and supports the conclusions of later cross-linguistic investigation of aphasia, namely, that by Bates, Friederici & Wulfeck (1987) who investigated aspects of grammatical morphology in Broca's and Wernicke's aphasia in English-, Italian- and German-speaking patients. The results obtained showed that the patients tested in each language group respected the specific rules and principles of the respective language and, although they made errors in their productions, those errors were not violations of their grammar. For example, the Italian-speaking patients did not produce bare roots with an accompanying suffix which would have been considered ungrammatical. These results supported the authors' hypothesis that in brain damage the major rules and principles governing the well-formedness of lexical items are not lost. Rather, brain damage seems to affect either the patients' ability to process morphologically complex words, or their ability to access the lexicon. Therefore, respecting the specifications of each language system, the English-speaking subjects, when in difficulty with inflected words, produced the uninflected form of the same lexical item, while Italian-speaking subjects, instead of the elicited item, produced another more frequent or less marked form, which, however, always consisted of a root and an affix. In an attempt to provide a unified

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explanation of agrammatic subjects of different language backgrounds, Carammazza and Berndt (1985), after considering the errors reported by English, Italian and Hebrew-speaking agrammatics concluded that patients, in general, seem to have difficulty in selecting the correctly inflected lexical items, and thus, produce other more frequent forms of the same lexical item. This would be manifested in the choice of a word inflected for nominative instead of genitive case in Hebrew, or in the production of a singular instead of a plural (word + affix) in English. The authors conclude by stating that a similar strategy to the one found in highly inflected languages, would be observed in English, whereby the omission of inflectional affixes would probably reflect the same tendency to select the more frequent form by default.

Reflecting on the issues reviewed up to now, one notes that the focus of recent research in agrammatism is not only on describing morphological errors found in aphasic speech but also on characterizing morphological deficits in terms of specific linguistic theories. Such studies have depended on results of either intra-linguistic or cross-linguistic investigations. However, in order for a morphological investigation of agrammatism to be complete, the results from cross-linguistic studies informed by a deep understanding of the grammar in each of the languages tested, have to be taken into account.

The present investigation sets out to examine the performance of Greek- and English-speaking agrammatic aphasic patients on tasks that require attention to morphological markers. The initial goal of this study is to conduct an intra-linguistic

investigation establishing the types of morphological errors found in the performances of the two language groups under study. A cross-linguistic study then follows which examines how the comparison of patterns of language breakdown in aphasic speech in two different languages can illuminate the influence of language-specific factors on aphasic performance. Finally, the possible contribution of aphasic data to an understanding of the universal aspects of language processing will be examined.

Before proceeding, in the chapter that follows, with an outline of the actual experiments conducted, a brief review of the current descriptions of the morphological component of Grammar is presented, and the specific linguistic theory assumed as a point of departure in the present investigation is outlined in greater detail. Finally, a brief analysis of the organization of the morphological component of the Modern Greek grammar, is presented , particularly in those aspects that are of interest to the study.

Chapter 3

3.1 Theoretical Framework

It is by now generally accepted that in order to address questions pertaining to the ways in which morphological processing may be affected in various conditions of brain damage or how lexical information is represented and accessed, one must properly characterize the organization of the morphological component, as well as the principles that govern the well-formedness of lexical items.

The present study is conducted within the general framework of Generative Morphology. In this framework, two approaches are current: a) the Strong Lexicalist Hypothesis assumed by Jackendoff (1975), Lapointe (1980), Lieber (1980), Williams (1981), Selkirk (1982), Walsh (1986), and DiSciullo & Williams (1988), which requires all morphological relations, both derivational and inflectional, to be expressed in a morphological component:

(6)

```
┌─────────────────────────────────────────────────┐
│           MORPHOLOGICAL COMPONENT               │
│                                                 │
│                                                 │
│    LISTED ITEMS        PRINCIPLES/RULES         │
│                                                 │
│                        OF WORD STRUCTURE        │
└─────────────────────────────────────────────────┘
                         │
              ┌─────────────────────────┐
              │   SYNTACTIC COMPONENT    │
              └─────────────────────────┘
                         │
      ┌──────────────────────────────────────┐
      │     POSTLEXICAL PHONOLOGICAL         │
      │                                      │
      │              RULES                   │
      └──────────────────────────────────────┘
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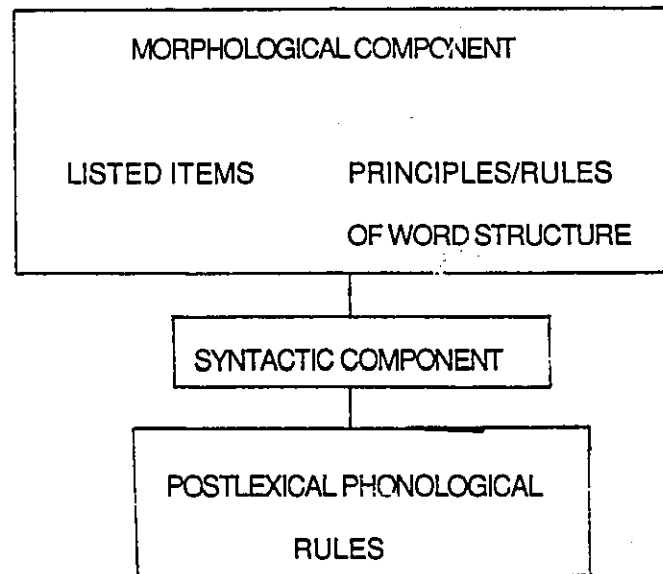
and, b) the approach to morphology according to which all words, whether derived pre-syntactically or built up by the operation of syntax, have a representation at the level of syntax. Within the latter framework, Baker (1985) proposed the existence of a 'Morphology theory' parallel to other subtheories of the Government-Binding theory, like Case theory or the Government theory. The Morphology theory includes principles which determine level ordering effects, principles of strict cyclicity, principles of morphological subcategorization and feature percolation. Finally, Morphology theory will have access to a simple list of forms in order to deal with phonological exceptions and suppletions of various kinds.

(7)   LEXICON

MORPHOLOGY THEORY ⟶   SYNTACTIC COMPONENT

POSTLEXICAL PHONOGICAL

RULES
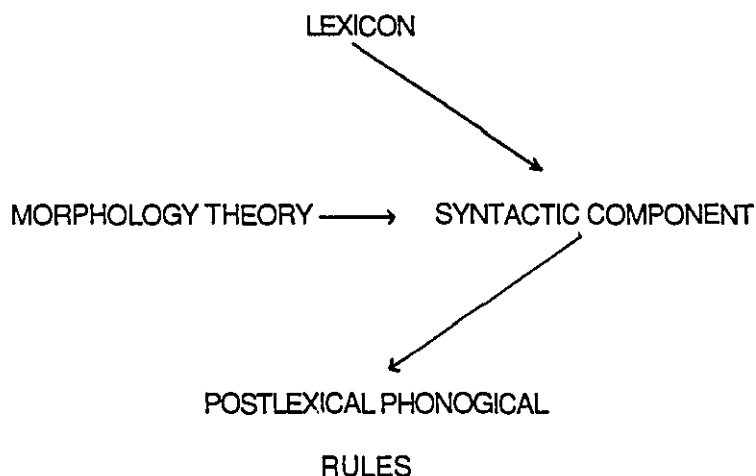
Whether one assumes a 'lexicalist' or a 'non-lexicalist' framework, one finds that they both presume a) the existence of word structure - be it expressed in the morphological component or through the principles of a Morphology theory operating in the syntactic component - as well as b) the existence of a lexicon and of a set of principles, specific to the theory of morphology, which determine the well-formedness of complex lexical items.

Even though both frameworks will be discussed with respect to the data, the present investigation assumes, as a point of departure, Walsh's (1986) Lexicalist model of the morphological component which incorporates the extension of X-bar theory into the description of word structure. Following Selkirk's (1982) proposal, word structure is characterized in terms of a set of word structure rules analogous to phrase structure rules. The level of X^0 which is considered to be the lowest bar level in syntactic structure is shared by word structure and is the level of the word. Within

the morphological component, however, the X^0 level is considered to be a maximal projection, with lower levels (X^{-1}, X^{-2}, etc.) being associated normally in morphological theory with labels such as stem and root, respectively. Examples of English affixed words involving the suffixation of one derivational or inflectional suffix proposed by Selkirk (1982) are:

(8)   a.   Word ---> Root   'cat'

        b.   Word ---> Word Af   'cat-s'

        c.   Word ---> Root Af   'nation-al'

A basic assumption for Walsh is the distinction between listed and derived words; words whose properties, such as meaning or morphological form, cannot be predicted are listed, while those whose properties can be determined on the basis of their parts would be derived. Derived words are formed by the insertion of listed items into structures generated by a set of word structure rules similar to those proposed by Selkirk (1982). The combination of the sets of listed words and the derived ones comprise the set of words which are available for insertion into structures generated by the syntax. The model of morphology proposed by Walsh (1986) can be represented as follows:

(9)   The Model of Morphology

Lexicon   Rules

Listed   of

Words   Word

Affixes   Structure

Morpholexical

Insertion

Possible Words
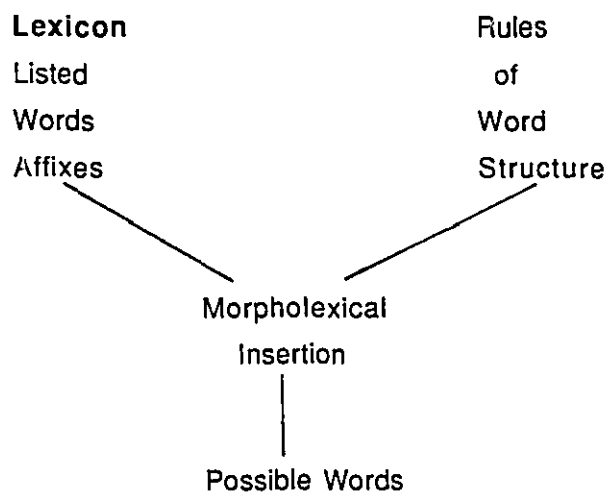
(Walsh, 1986:75)

Each lexical entry would include a complete specification of the form, meaning and internal composition of a word. However, while the properties of listed words are fully specified in their lexical entries, the properties of derived words are determined on the basis of the properties of their constituents. The formation of words is achieved through rules of word structure which generate structures appropriate to both affixation and compounding. For example to account for the formation of the word 'cats', it is assumed that a word structure rule provides the following structure:

(10)   X

        Y   Af
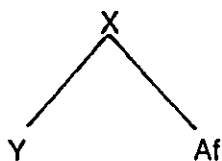
the word 'cat' and the affix '-s' taken from the lexicon are inserted giving a representation such as:

(11)   cats

```
              N
             / \
            /   \
           /     \
          N       Af
         cat      -s
```
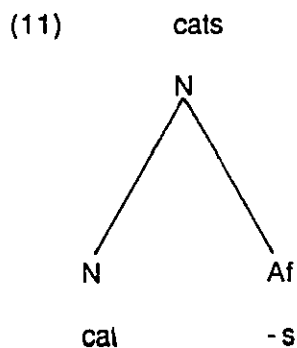
In the entry for each listed item, including affixes, a certain amount of information must be incorporated.   This includes the phonological shape of the affix, a representation of its meaning and, where pertinent, membership in a lexical category (inflectional affixes are not specified for lexical category).   When a lexical entry is inserted into word structure, the features of that entry would play a role in determining the properties of the word in which it is contained.   Williams (1981) claimed that every complex word consists of a head, functioning like the head of a phrase with respect to the percolation of features, and at least one non-head.   He proposed the head of a word be the right-most constituent of a word.   One of the features that would percolate through the head would be the category of the word.   This would predict that suffixes (such as '-er' in the word 'writer') which would determine the category of the word would also be considered heads.   However, as Selkirk (1982)

pointed out this could not be the case with inflectional affixes which are not marked for category, even though they appear at the right-most position of a word. She, therefore proposed a revision of Williams' Right-Hand Head Rule given in (12):

(12) Right-hand Head Rule

In a word-internal configuration

$$X^n$$

$$P \qquad X^{n-l} \qquad Q$$
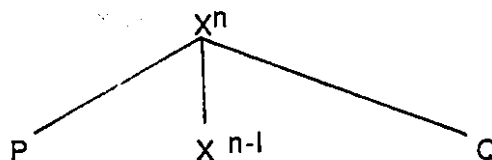
where X stands for a syntactic feature complex and where Q contains no category with the feature complex X, X^{n-l} is the head of X^n.

(Selkirk, 1982:20)

Given the above revision, the head of the plural form 'cats' will be 'cat' since it is this constituent which determines the category of the word. However, both head and non-head will allow for features to percolate to the mother node following the Feature Percolation Principle given in (13):

(13) Feature Percolation Principle

a. If a head has a specification Fi its mother node must be specified Fi.

b. If a non-head which is an affix has a feature specification Fi, and the head is unspecified for that feature, then the mother node must have the feature specification Fi.

(Walsh, 1986:126)

Thus in a word such as 'cats' 'cat' would be the head, according to the Right-head Hand Rule in (12) and '-s' would transmit its +pl feature to the mother node.

(14)   cats

              N
              +pl

              N   Af

        cat   -s
                   +pl

Finally, with respect to the attachment of affixes, in Walsh's model, no external ordering of the type given in Kiparsky (1982) is presupposed.

Kiparsky (1982) claimed that affixation as well as compounding processes are organized in a series of extrinsically ordered levels, where each level is associated

25

with a set of phonological rules. The following representation outlines the organization
of the lexicon in English, as proposed in Kiparsky (1982).

(15)

+ 'boundary inflection and derivation → stress, shortening		Level I
# 'boundary' derivation and compounding → compound stress		Level 2
# 'boundary' inflection → laxing		Level 3

underived lexical entries

syntax →	postlexical phonology
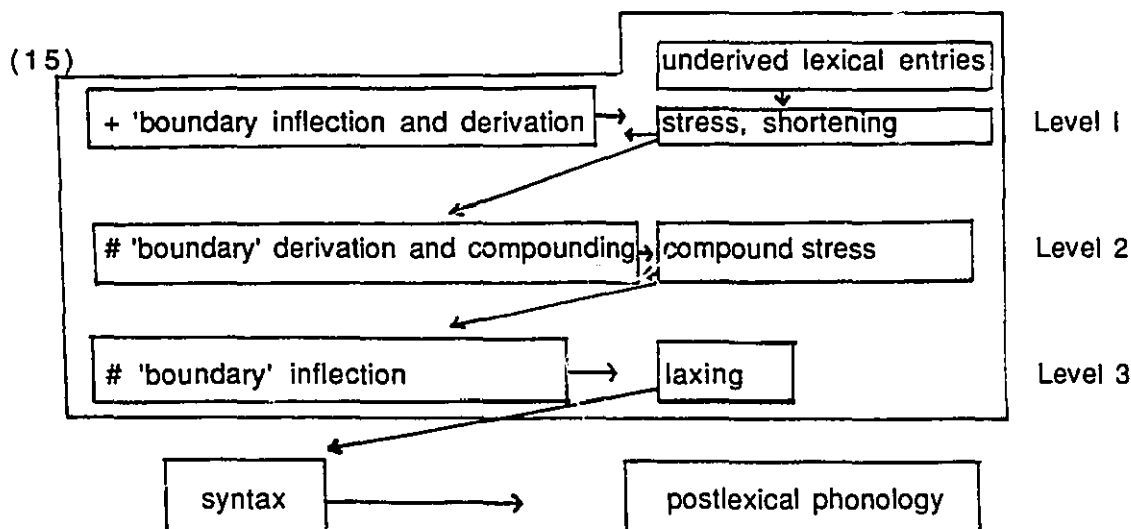
(Kiparsky, 1982:3)

According to Selkirk (1982) the ordering of affixation processes should be encoded
in the rules which generate word structures. To capture the difference established by
Siegel (1977) between 'neutral' affixes (i.e., those that do not affect the placement of
stress) and 'non-neutral' affixes (i.e., those which affect the placement of stress),
Selkirk draws a distinction between two levels of morphological categories - root and
word and assumes that non-neutral affixes are attached to roots, and neutral affixes are
attached to words. Selkirk assumes that the distinction between neutral and

non-neutral affixes would be indicated in the subcategorization frame of the lexical entry for each affix. Non-neutral affixes are subcategorized to attach obligatorily to roots while neutral affixes are subcategorized to attach obligatorily to words (Walsh, 1986:59). Thus, by assuming two distinct levels in word structure, Selkirk characterizes the ordering of neutral and non-neutral affixes.

In Walsh (1986), no external ordering of the type proposed in Kiparsky (1982) is assumed. However the ordering of affixation is encoded in the word structure rules. Furthermore, no ordering distinction between neutral and non-neutral affixes is recognized. This does not imply that there is no ordering of affixes in her model. On the contrary, the distinction is reflected in the fact that words containing non-neutral affixes tend to be listed while words containing neutral affixes are often derived. Thus, there is a tendency for non-neutral affixes to be "ordered" before neutral affixes (Walsh, 1986:166-167). The model that she proposed is organized in such a way that words listed in the lexicon serve as input to word formation processes, the nature of which is such that they have the effect of "ordering" affixation before compounding. The schematization of the ordering she proposed is as follows:

(16) Lexicon (i.e. listed items)---> Affixation ---> Compounding.

3.2 An Analysis of the Morphological System of Modern Greek

Modern Greek (MG) is a highly inflected language as revealed by the forms of nouns, adjectives and verbs. More specifically nouns are always marked for gender, number and case and are preceded by a definite or indefinite article. They can be modified by adjectives and may be followed by pronouns. Examples of Greek nouns are given below, (17).

(17) o   kip-os   'the garden' -   masculine-singular-nominative

      i   miter-a   'the mother' -   feminine-singular-nominative

      to paidh-i   'the child'   -   neuter-singular-nominative

In the above examples all three nouns are marked for gender, number and case, and are preceded by a definite article which agrees in gender, number and case with the noun. In MG there are three genders: masculine, feminine and neuter. Although gender usually correlates with the sex of animate referents, it is to be regarded as an arbitrarily assigned grammatical category. The unpredictability or arbitrariness of gender in nouns entails that it would be one of the features accompanying every noun listed in the lexicon. Nouns are also inflected for case. There are four cases in MG: nominative, accusative, genitive, and vocative. These four cases occur both in the singular and in the plural. Most nouns are inflected in both numbers except for some which exist only in the plural, such as names of places.

Adjectives modify the nouns and occur in the prenominal position. They always agree with the noun in gender, case and number.

(18) o   kal-os   fil-ɔs   - -   masculine-singular-nominative

      the   good   friend

      i   omorf-i   pol-i   - -   feminine-singular-nominative

      the   beautiful   city

      to   psil-o   voun-o   - -   neuter-singular-nominative

      the   high   mountain   .

or as in

      o   fil-os   einai kal-os

      the   friend   is   good/nice

Finally, verbs in MG are marked for voice, mood, tense, person and number. The Greek verb has three voices: active, middle, and passive. The middle generally signifies that the subject performs an action on himself or for his own benefit. The passive is formed by the same affix as the middle, except in the future and aorist tenses of some verbs. Compare (19a) and (19b).

(19) a.   skotonomai (I kill myself)   **skotothika** (I killed myself)

            skotonomai (I get killed)   **skotothika** (I got killed)

      b.   vrehomai (I wet myself)   **vrehtika** (I wet myself)

            vrehomai (I get wet)   **vrahika** (I got wet)

There are four moods: the indicative, the subjunctive, the optative and the imperative. In the indicative, there are seven tenses in the active and passive voice: the present, imperfect, future, aorist (simple past), perfect, pluperfect, and future perfect. Among these tenses, the imperfect and the aorist express the aspectual differences between past continuous and simple past. Verbs are inflected for three persons (first, second and third) in the singular and the plural. They may be preceded by personal pronouns just as in English. However, this is not usually the case since the inflectional suffix denotes person, as well as number and tense, Greek being a pro-drop language. For reasons of simplification and taking into account the stimuli used in this study, verbs are initially classified into the following three types:

(20)   Category A

       Active verbs ending in   -o   grá f-o   I write

       Category B

       Active verbs ending in   -ó   mil-ó   I speak

       Category C

       Reflexive verbs ending in   -omai   plén-omai   I wash myself

       Passive verbs ending in   -omai   vréh-omai   I get wet

The verbal system of MG is much more complex than what is presented here. However, a simplified version is shown above for the purposes of this study.

What is of particular interest in this study is the formation of the simple past and of the future tense. These two tenses are formed by the addition of one of the relevant affix/affixes to the aorist stem of the verb. For every MG verb, two stems are listed in the lexicon: the present stem which is involved in the formation of the present and imperfect tense and the aorist stem which is involved in the formation of all the other tenses. The aorist stem may be homophonous with the present stem or may involve suppletion (21).

(21) **Present stem**   **Aorist stem**

pez-   paix-   (to play)   Category A

metr-   metr-   (to count)   Category B

vreh-   vrah-   (to get wet)   Category C

vlep-   eidh-   (to see)   Irregular

Thus, the derivation of any verb form involves the affixation of an inflectional suffix or a suffix and a prefix (in the case of the past tense in verbs of Category A) to one the two possible stems (present or aorist). For example, two category A verbs 'to play' and 'to draw' have the following forms in the present, aorist and future tense:

(22)   **Present tense**   **Aorist tense**   **Future tense**

       paíz-o   é-paix-a   tha paíx-o

       (I play)   (I played)   (I will play)

       zografíz-o   zografís-a   tha zografís-o

       (I draw)   (I drew)   (I will draw)

In the formation of the present tense, the suffix -o marking, number and person is added to the present stem of the verb. In the formation of the aorist tense, the prefix e- and the suffix -a, marking number and person are added to the aorist stem of the verb. Finally in the formation of the future tense the suffix -o marking number and person is added also to the aorist stem of the verb. Similar affixation processes as those just presented are also involved in the formation of the Aorist and the Future tense of verbs of category C, as well as of irregular verbs, (23).

(23)   Category C

       Present tense   **Aorist tense**   **Future tense**

       vréh-omai   vráh-ik-a   tha vrah-ó

       (I get wet)   (I got wet)   (I will get wet)

       Irregular

       Present tense   **Aorist tense**   **Future tense**

       vlép-o   eídh-a   tha dh-o

       (I see)   (I saw)   (I will see)

It must be noted, however, that in verbs of category C an added affixation process takes place in the formation of the aorist; that is the stem vrah- is first affixed with the affix -ik and then the addition of affix -a marking tense takes place. Mackridge (1985) describes the process as one of infixation of -ik into the sequence vrah- -a . In the absence of evidence favoring an infixation process over a sequence of two suffixation processes, we will consider forms such as vrah-ik a to be the output of two suffixations, one following the other.

Finally, in verbs belonging to Category B the aorist stem is the same as the present stem:

(24)	Present tense	Aorist tense	Future tense
	metr-ó	métr-is-a	tha metr-ís-o
	(I count)	(I counted)	(I will count)

In the above verbs, similarly to those belonging to Category C, the aorist stem is affixed with the affix -is as well as with the affix -a in order to form the simple past tense. In this study the feature "+/- present" will be used to identify the type of stem used in derivations, and "+/- plural" will be used to mark number. Case features will also be marked.

Looking at the above descriptions of nouns, adjectives and verbs, one notes that these classes of words always contain an inflectional affix. This is not the case with classes of words such as prepositions, conjunctions, or underived adverbs which

resemble their English counterparts and never undergo suffixation. It is thus
hypothesized that words in Modern Greek may be divided into two classes: Class I
always comprising a root and one or more affixes, derivational and/or inflectional, and
Class II including monomorphemic words which do not undergo any inflectional or
derivational processes, (25).

(25)   **Class I**   **Class II**

                 graf-o   (I write)   kai   (and)

                 V   pano (up)

                 +V   meta (after)
                 -N
                 +present
                 1st person
                 -plural

         V-I   Af

         graf-   -o
         +V   1st person
         -N   -plural
         +present   -past
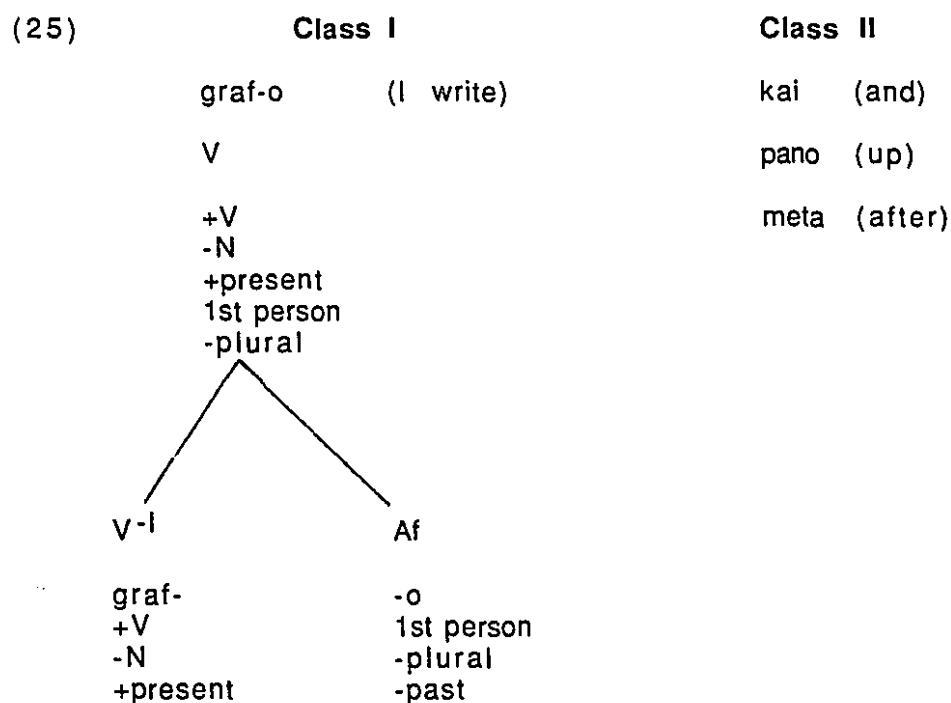
The difference in the inflection of the above mentioned types of words is
reflected in the different lexical representation. Words belonging to Class I will have
the subcategorization requirement shown below:

(26) (X)Root   (+.......Af)

The above subcategorization requirement would entail that a root appear with a branching structure as is shown in (27).

(27)

```
        /\
       /  \
      /    \
   Root    Af
```
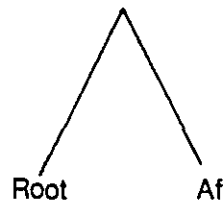
Assuming the above hypothesis, a noun such as 'kip-os' (garden) would have the following representation, (28).

(28) kip-   kip-os   (garden)

    (-----Af)   N
                                +N
                                -V
                                masc. I
                                nominative
                                -plural

```
              /\
             /  \
            /    \
           /      \
        N -I        Af
        kip-        -os
        +N          masc. I
        -V          nominative
        masc. I     -plural
```
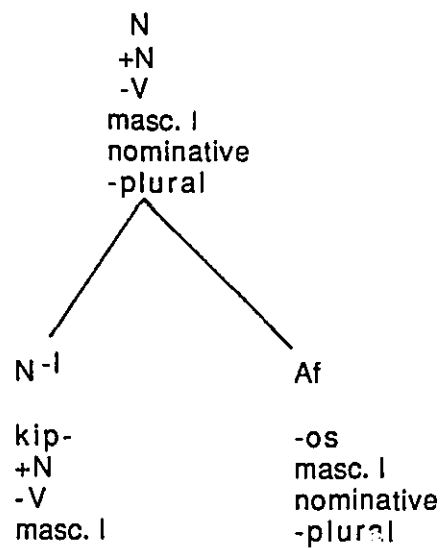
As has been already proposed by Kehayia (1987), MG is a right-headed language obeying the Right-hand head rule given in (12). Thus in a word such as kip-os the root will project its categorial specifications while the suffix filling the right-hand branch will allow the features of gender, case and number to percolate to the top. Furthermore, the suffix also provides the root with the lexical specification necessary for it to project to the word level since in MG, roots of major lexical categories are not specified for lexical properties. However, the type of affix that may appear on the right-hand branch of a root is not entirely free. Compare the construction in (29) with the one in (28).

(29)   dhiavazmen-   (read, adjective)

```
              A-I
              +N
              +V
             /\
            /  \
           /    \
          /      \
         /        \
        /          \
      V-I           Af

   dhiavaz-        -men
   +V             +N
   -N             +V
   +present
```
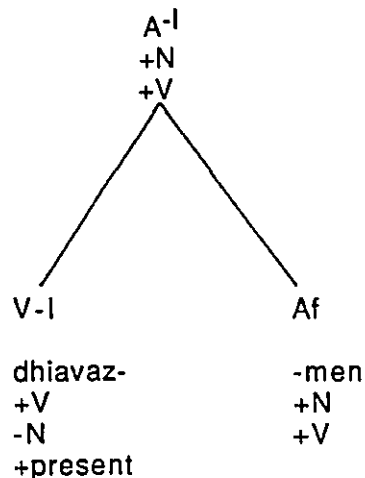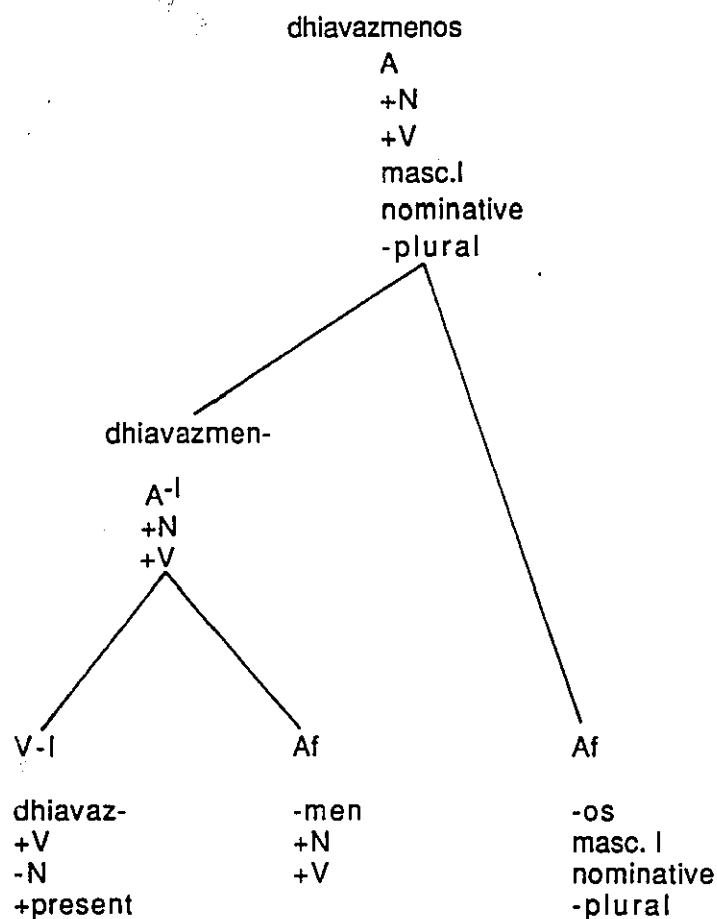
in the construction presented in (29) even though the right-hand is filled with a derivational affix, the root does not project to the word level and remains at the level of the root, unlike the case shown in (28) where the inflectional affix -os allows the root

to project the word level. The root <u>dhiavazmen-</u> will project to the word level only after an inflectional affix attaches to it, (30).

(30)

```
                              dhiavazmenos
                              A
                              +N
                              +V
                              masc.l
                              nominative
                              -plural
                                 /\
                                /   \
                               /      \
                              /         \
                   dhiavazmen-            \
                                           \
                      A-l                    \
                      +N                       \
                      +V                         \
                      /\                           \
                     /   \                           \
                    /      \                            \
                   /         \                             \
                 V-l          Af                           Af

                 dhiavaz-     -men                         -os
                 +V           +N                           masc. l
                 -N           +V                           nominative
                 +present                                  -plural
```

It appears from the above that a root can project to the word level only when the root or the stem is affixed with an affix carrying no categorial specifications, (i.e., an inflectional one). To account for the above, Kehayia (1987) proposed the following Root Projection Principle:
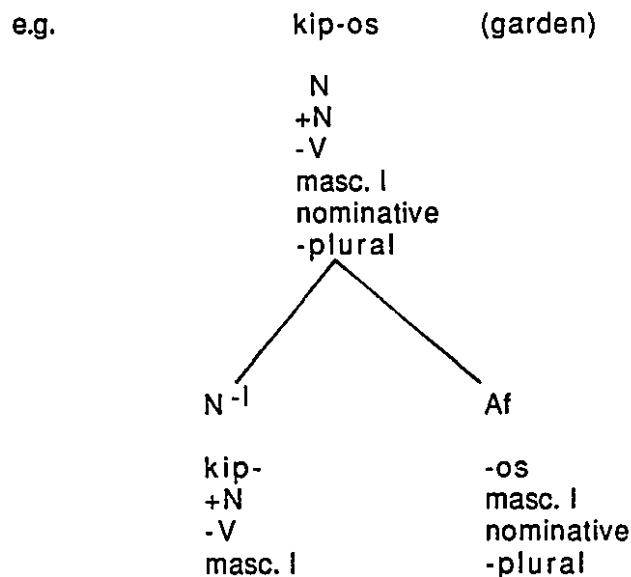
(31)   Root Projection Principle

A lexical entry will project to the level of the word if and only if its right-hand branch is filled with an affix having no categorial specifications.

(Kehayia, 1987:27)

This presupposition gives inflectional affixes in MG a particularly important role since without them a root may not surface to the word level.
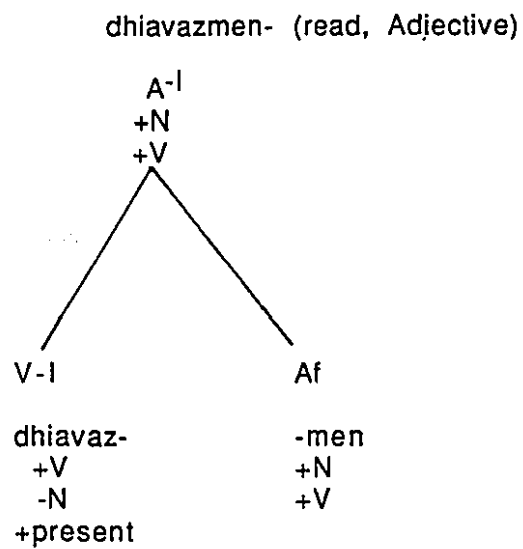
In line with the above, the rules for describing the structure of MG, would be the following, (32); these are similar to those proposed by Selkirk (1982) for affixed words in English.

(32)   a.   Word ----> Root   Af

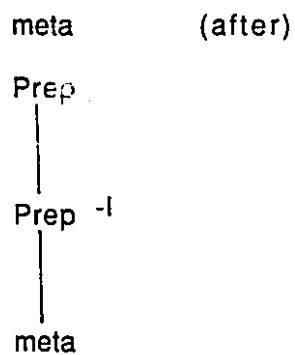e.g.   kip-os   (garden)

N
+N
-V
masc. I
nominative
-plural

N -I   Af

kip-   -os
+N   masc. I
-V   nominative
masc. I   -plural

38

b.   Root ----> Root   Af

e.g.

dhiavazmen- (read, Adjective)

A^{-I}
+N
+V

/ \

V-I   Af

dhiavaz-   -men
+V   +N
-N   +V
+present

c.   Word ---> Root

e.g.

meta   (after)

Prep
|
|
Prep $^{-I}$
|
|
meta

The rules presented above will cover the types of affixation occuring in the Modern Greek language for both Class I and Class II words.

Having presented the theoretical framework assumed in our investigation, an outline of the organization of Modern Greek and English morphological components, and an analysis of specific morphological features in each language, we will now present the issues under investigation and the hypotheses underlying our study. A description of the methodology and of Experiment I will then follow.

Chapter 4

4.1 Issues under investigation

In summarizing the discussions of chapter 3, we may note that a comparison of the language systems of English and Modern Greek yields the following considerations:

a. The two languages differ significantly in the organization and the importance of their inflectional systems, Modern Greek being a richly inflected language and English having a relatively poor inflectional system.

b. The way in which lexical items are listed in the lexicon is also different in the two languages. More specifically, the Greek lexicon contains two distinct sets of words, Class I including all major category words, and Class II including monomorphemic words such as prepositions, conjunctions, etc. The English lexicon, however, does not reflect a systematic distinction between types of words similar to the one found in the Greek lexicon. The English lexicon comprises a set of listed words and affixes which may undergo morpholexical insertion and thus produce the possible words of a language, as proposed in Walsh (1986).

c. Derivational and inflectional processes are governed by different parameters which determine the well-formedness of complex lexical items in each language. Although both languages respect the Right-hand Head Rule and the Feature Percolation Principle given respectively in (12) and (13) above, in Greek, a 'major class category root', having the subcategorization requirement mentioned in (27) above, will project to the word level only if the root is affixed with a suffix having no categorial specifications. This implies that only inflectional and not derivational affixes allow a root to project to the word level, a fact which has the following implications: i) inflectional affixes attain a different role and importance in languages such as Greek, ii) roots affixed with a derivational affix must always undergo the inflectional affixation requirement which results in complex word structures.

These considerations lead us to the following questions:

1. How are the differences in the inflectional systems of Greek and English reflected on the linguistic performance of agrammatic aphasic patients?

2. What are the implications of the 'Root Subcategorization Requirement' (27) and the 'Root Projection Principle' (31) for the performance of agrammatic aphasic patients on simple and complex words in Greek, when compared to the performance of English-speaking aphasic patients on similar word structures?

3. How do the data bear on the issues of lexical access and morphological processing discussed in the literature?

4. What are the theoretical implications of our findings, specifically in relation to the lexicalist and non-lexicalist approaches to morphology?

4.2 Hypotheses

The present study aims at investigating the questions put forth earlier under the following two hypotheses:

4.2.1 Hypothesis I

The performance of agrammatic aphasic patients of different language groups on the same tasks and similar sets of stimuli will be largely determined by the specific features of each language system.

4.2.2 Hypothesis 2

Although agrammatic speech is known to manifest linguistic deficits, these phenomena do not violate the principles of the language systems under investigation.

The testing of these hypotheses comprised two parts. The first part, presented in this chapter, examined inflectional marking on nouns; the markers under study were number, gender and case for Greek and number for English. The second part, presented in chapter 5, investigated the performance of Greek- and English-speaking agrammatics on verbal inflections.

4.3.0 Methodology

In addition to the questions raised earlier in this chapter, a major goal, of this study was to get as complete a picture as possible of the linguistic deficits in the subjects' performance. In order to achieve this, each subject was tested on three different tasks which, however, included the same set of stimuli. While the results in the repetition, the comprehension and two production tasks may show trends significant for the performance required in each task, an overview of the results in all three tasks can provide us with a more accurate picture of the overall linguistic performance. For example, if in the production of a string such as 'the mother is feeding the chickens' the patient instead instead of 'chickens' says 'chicken', the following question may arise: was the plural marker problematic only in production or also in comprehension and/or repetition? If not, was it that only the production ability of the subject was affected? Being able to compare the patient's performance on different tasks allows us to situate better and to classify the deficit observed.

4.3.1 Repetition task: 144 sentences for Greek and English were tested. Each sentence included one of the complex lexical items under investigation. For the testing of nominal inflections, the same sentence was used for both the singular and the plural while the same noun was tested four times reflecting the singular/plural and subject/object distinction, as shown in (33):

(33)   The mother is feeding the **chicken**.

        The mother is feeding the **chickens**.   .

        The **chicken** is eating corn.

        The **chickens** are eating corn.

For the testing of verbal inflections, each sentence was tested in the present (simple/progressive for English), the past and the future. Sentences for each language, in both experiments, were randomly ordered (see Appendix I and III for a complete list of the sentences used).

4.3.2 Comprehension task: A sentence-picture matching task including the same set of stimuli as the ones used in repetition was administered. For the testing of nominal inflections, each stimulus included two line drawings, presented vertically, depicting the singular/plural contrast in the various conditions under investigation. For the testing of verbal inflections each stimulus included three line drawings, presented vertically, depicting the present/past/future distinction. The order of pictures within

each set varied randomly (see Appendix !! and IV for a complete set of the pictures used for the comprehension task).

4.3.3 Production task I: The same set of pictures used for the comprehension task was presented to the subjects in an adaptation of the WUG test. The examiner would prime the production of the target sentence (for example,'the girls are playing') by pointing to the picture corresponding to the sentence 'the girl is playing', saying it aloud, and then eliciting the production of the target sentence by saying, 'and here...'. The subject would thus be provided with all the necessary lexical items, in an attempt to diminish the possibility of word finding difficulties, while being expected to produce the proper morphological markers in accordance with the picture presented to him.

4.3.4 Production task II: The subjects had to describe 72 single pictures (for the nominal inflections) and 144 single pictures (for the verbal inflections) selected from the stimuli used for the comprehension task and production task I. No cues of any sort were provided. The morphological distinctions investigated were tested in equal numbers.

4.4.0 Subjects

The subjects for this study were two Greek-speaking males, G1 aged (50) and G2 aged (55) and two English-speaking patients, E1 a 60 years old male and E2 a 78 years old female; all four subjects were right-handed non-fluent aphasics who had suffered a Cerebrovascular accident (CVA) causing left-hemisphere damage. The

subjects were classified as Broca's aphasics with agrammatism on parts of the Boston Diagnostic Aphasia Examination (Goodglass and Kaplan, 1972), or adaptations thereof. At the time of testing, all four subjects showed prototypical features of agrammatism in their spontaneous speech, namely productions of highly reduced sentences, at the levels of both syntax and morphology. Their level of education varied from 6 to 12 years. Post onset, both English-speaking subjects and one Greek-speaking subject had undergone speech therapy, in English. Both Greek patients were functioning mainly in Greek. However, they did have a minimal knowledge of English. At the time of testing, all the patients' repetition ability was intact, and their comprehension was good at the simple sentence level in their respective language. They were all capable of producing simple sentences of the S-V and S-V-O type. All subjects were matched with controls of the same sex, age and educational background in each language.

Testing took place during four different sessions, one for each task. The repetition task was used as a screening measure, while the production tasks, which followed the comprehension task, were administered in the order: production task II followed by production task I.

4.5.1 Investigation of Nominal Inflections in English

As was mentioned in chapter 2, Jakobson (1956); Goodglass and Berko (1960) and De Villiers (1974) were among the first to examine the relative retention of the plural marker on nouns in English, in relation to other inflectional markers such as the possessive marker. They also investigated the variable performance of patients on the three plural allomorphs '-s', '-z', '-iz'. With regard to the latter investigation, they concluded that the subjects tested appeared to have more difficulty with the non-syllabic '-s' and '-z' than the syllabic '-iz' allomorph for reasons of salience and prosody. A similar order of difficulty was found by Kehayia (1984) who examined the ability of five agrammatic patients to repeat simple sentences containing one noun inflected for plural. The difference in performance on the three plural allomorphs is rather striking: 90% of words containing the -iz allomorph, but only 30% containing the -s and 13.3% containing the -z allomorph were repeated successfully. However, the results of the study by Kehayia (1984) were considered inconclusive due to the small number of stimuli, the test on plurals being only a subtest of a larger test on derivational affixes. Furthermore, the results, even though they displayed a significant difference in performance on the distinction syllabic/non-syllabic plural allomorph, could only be considered valid for the repetition abilities of the subjects investigated, since other tasks were performed. In order to obtain a clearer picture of a subject's performance on a linguistic feature such as the plural marker, different linguistic tasks must by used. Furthermore, as was mentioned earlier, investigations

must be conducted within a specific theoretical framework to provide the basis for a proper analysis and interpretation of the data. Therefore, although features such as 'salience', 'prosody', 'sonorance' and others, previously identified by researchers, may account for some aspects of the linguistic deficits found in aphasic performance, they must be supported by linguistically based theoretical explanations.

With the above in mind, the present study re-examines the distinction singular/plural in English. The investigation focuses primarily on nouns, and secondarily, on auxiliaries and copulas. The nouns chosen required either the '-s' allomorph as in [kæt-kæts], the '-z' allomorph as in [dog-dogz] or '-iz' as in [bʌs-bʌsɪz]. Every allomorph was tested in subject and object position. There were 12 occurrences of each allomorph in each of the two positions. The distinction singular/plural on auxiliaries and copulas was also investigated, i.e., in sentences where the noun inflected for plural was in subject position as in 'the chickens are eating' or 'the trees are tall'. The nouns chosen had a frequency between 10 and 242 in the singular and a frequency between 8 and 213 in the plural. The number of syllables of the tested items ranged from 1-2 and the number of syllables of the accompanying non-tested lexical items ranged from 1-3. The nouns were tested in sentences of the type S V, S V O, and S Cop A as can be seen below:

(34)

S-V	[-z]	The **dog** is sleeping
		The **dogs** are sleeping
S-V-O		The mother feeds the **dog**
		The mother feeds the **dogs**
S-Cop-A	[-iz]	The **peach** is small
		The **peaches** are small
S-V-O		The boy is holding the **peach**
		The boy is holding the **peaches**
S-V	[-s]	The **cat** is sleeping
		The **cats** are sleeping
S-V-O		The mother feeds the **cat**
		The mother feeds the **cats**

<u>Table 1</u>

Morphological distinctions and types of sentences tested in English

50

4.5.2 Investigation of Nominal Inflections in Greek

In studying the speech of Greek-speaking agrammatics, I am not aware of any specific research on inflectional morphology having been conducted to date. Although the richness of the morphological component in Greek is inviting for investigation, neurolinguistic research is more or less non-existent and, thus, the present investigation is a first effort to identify and examine morphological errors of Greek-speaking agrammatic aphasics from a linguistic point of view. In this study, reference is made to research on other richly inflected languages such as Italian where Miceli et al., (1983) and Miceli and Caramazza, (1988) reported on the difficulty that patients encountered with nominal, adjectival and verbal inflections. More specifically, in the study by Miceli and Caramazza, (1988) who tested the repetition of adjectives inflected for gender and number, their patient displayed a marked tendency to revert to the production of the masculine singular as the incorrect response for other inflectional endings (80%). Further investigation showed that masculine singular adjectives were repeated correctly a high proportion of the time (94.9%), while the probability of correctly repeating the other forms was 34.2% for masculine plural, 39.8% for feminine singular and 34.2% for feminine plural. The data obtained for nouns mirrored the data obtained for adjectives, however the error rate was much lower. Thus, nouns were repeated 92.9% correctly when given in the singular form and only 65.1% when given in the plural form. This result is consistent with their claim that the "citation form" (that is, the form that would occur in a dictionary) of a

word is relatively spared in comparison to other inflected forms (Miceli and Caramazza, 1988:45). As was mentioned in Chapter 2, in languages such as Italian, morphological errors in aphasic speech are manifested in substitution of one affix for another, while omissions of bound morphemes are not found.

In our study of inflectional markers on nouns in the speech of Greek-speaking agrammatics, the distinction singular/plural was tested, primarily, on masculine, feminine and neuter nouns. Nouns in Greek are always preceded by an article which agrees with the noun in number, gender and case as shown in (17) and (18). Nouns were tested both in subject and object position. Although Greek is a language with relatively free word order, the unmarked order is S V O. Therefore, nouns occurring in subject position are inherently marked for nominative case, while nouns occurring in object position receive accusative case from the preceding verb as shown in (35) below:

(35) O   kirios hereta   ton   filo
      [masc.,sing., nom.]   [masc., sing., acc.]

      The   man   greets   the   friend

In the above sentence, the verb 'hereta' has the argument structure [Agent, Theme], (36).

(36, hereto [A, Th]
      (I greet)

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(36, hereto [A, Th]
      (I greet)

The verb assigns the Theta role Theme to the noun-phrase that follows it, i.e., 'ton filo', which must be inflected for accusative case. Agent is assumed by the noun-phrase in subject position, 'o kirios', and is inflected for nominative case.

In each of the three genders, nouns are categorized in terms of declension. In the present study, nouns from specific declensions within each gender were chosen according to frequency of use, regularity, and degree of 'representativeness' of category. With respect to the criterion of regularity, only regular nouns were chosen. Finally, with respect to the criterion of representativeness of declension, in the case of masculine nouns, a choice had to be made among three sets, (37).

(37) Nouns in -as

    o patéras   'the father'   oi patéres   'the fathers'

    Nouns in -is

    o mathitís   'the student'   oi mathités   'the students'

    Nouns in -os

    o dháskalos   'the teacher'   oi dháskaloi   'the teachers'

Nouns belonging to the first two sets form the plural by the addition of the affix -es which happens to be homophonous to that of feminine nouns:

(38)   oi patéres   'the fathers'   oi mitéres   'the mothers'
        (masculine)   (feminine)

However, masculine nouns of the third type take a distinct suffix in the formation of the nominative plural. In order to ensure the representativeness of noun types in the three genders, the nouns chosen were: masculine nouns ending in -os, -as and -is, feminine nouns ending in -a and neuter nouns in -o and -i. 12 nouns in each of the above genders were tested in subject and in object position, in the singular and the plural, as shown below:

(39)   Masculine in -os

Nominative	O	pilótos	milá		
Singular	The	pilot	speaks		
Nominative	Oi	pilótoi	miloún		
Plural	The	pilots	speak		
Accusative	To	paidhí heretá		ton	pilóto
Singular	The	boy greets		the	pilot
Accusative	To	paidhí heretá		tous	pilótous
Plural	The	boy greets		the	pilots

Feminine in -a

Nominative	I	kóta	trógei	to	kalambóki
Singular	The	chicken	eats		corn
Nominative	Oi	kótes	trógoun	to	kalambóki
Plural	The	chickens	eat		corn
Accusative	I	mitéra	taízei	tin	kóta
Singular	The	mother	feeds	the	chicken
Accusative	I	mitéra	taízei	tis	kótes
Plural	The	mother	feeds	the	chickens

Neuter in -o

Nominative Singular	To The	aftokínito car	eínai is	kainoúrghio new
Nominative Plural	Ta The	aftokínita cars	eínai are	kainoúrghia new

Accusative Singular	O The	ándras man	dhiorthónei is fixing	to the	aftokínito car
Accusative Plural	O The	ándras man	dhiorthónei is fixing	ta the	aftokínita cars

The distinction singular/plural was also implicitly tested on verbs and copulas, as well as on adjectives. For example, even though the test was primarily constructed to test nominal inflections, if the tested plural noun was in subject position then the accompanying verb was also inflected for plural in accordance with the preceding noun. Therefore, the presence of the marker for number could also be examined:

(40)

L [sing] The	kóta [sing.] chicken	trógi [sing.] eats	to	kalambóki corn
OI [pl.] The	kótes [pl.] chickens	trógoun [pl.] eat	to	kalambóki corn

Similarly, if an adjective was in a predicate phrase where the noun was inflected for plural, the adjective had to be inflected for plural as well:

(41) __To__   dhéndro   eînai   psiló
      [sing.] [sing.]   [sing.]
      The   tree   is   t..ll

      __Ta__   dhéndra   eînai   psilá
      [pl.]   [pl.]   [pl.]
      The   trees   are   tall

Apart from being inflected for plural, the adjectives, following the general
behavior of adjectives in Modern Greek, accord with the noun they modify in gender and
case, as it can be seen in the following example:

(42) __To__   dhéndro   eînai   psiló
      [neuter, nom.]   [neuter, nom.]
      The   tree   is   tall

      O   kírios   eînai   kalós
      [masc., nom.]   [masc., nom.]
      The   man   is   nice

Since no formal counts of frequency of words exist in Greek,   judgement on the
choice of lexical items used was based on the intuition of the author.   The number of
syllables of the tested and of the accompanying items varied from 2-5 syllables.

4.6.0 Analysis of the Data and Results

Before reporting on the analysis of the data and the results obtained from the four agrammatic aphasic patients tested, a note must be made on the results obtained from the testing of the controls.   Since the results obtained from all of them were 100%, no further mention of controls versus patients will be made in this chapter.

Turning now to the testing of the agrammatic aphasics, the analysis of the data focused on successful repetition of the complex words tested. Repetition was judged to be succesful if the patient could repeat maximally the whole sentence and minimally the portion which contained the complex word under investigation. Responses were judged to be unsuccessful: a) if the patient's answer was unintelligible or if he/she refused to repeat (e.g. responses like 'I don't know', 'no'); b) if in the repetition of the sentence the patient repeated the part that did not include the complex word tested; c) if in the repetition of the complex word the patient repeated only a part of it, thus omitting the affix tested or if he substituted the affix tested for another. If the patient repeated the complex word in or out of context only after probing or after a second or third attempt, then these responses were counted separately.

4.6.1 Repetition Task

The results, for the repetition task show a difference in the error pattern between Greek, on the one hand, and English, on the other, when nouns had to be inflected for plural.   More specifically, switches from plural to singular were found in both languages with the error rate in Greek being rather low, 15.2%, and rising in English to 37% (cumulative percentage), as can be seen in Table 2, (43).

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(43)   Raw no.   %   Raw no.   %

G1   10/72   13.8%   G2   12/72   16.6%

E1   30/72   41.6%   E2   25/72   30.7%

Table 2

Repetition task: Errors in the singular/plural distinction on nouns

Of the above erroneously produced plural nouns, in Greek, 63.6% and in English 66.7%, were found in object position. Furthermore, of the erroneously produced nouns in English, 90% consisted of omissions of the non-syllabic allomorphs '-s' or '-z', while only 10% consisted of omissions of the syllabic allomorph '-iz'. This finding is consistent with previous findings mentioned earlier, especially when compared with the results of the repetition task reported by Kehayia (1984). Finally, no switches from singular to plural were found.

Switches from plural to singular were also detected in verbs and copulas shown in the table below.

(44)   Raw no.   %   Raw no.   %

         G1   10/36   27.7%   G2   8/36   22.2%

         E1   19/36   52.7%   E2   21/36   56.6%

Table 3

Repetition task: Errors in the singular/plural distinction on
verbs and copulas

The error patterns found in the Greek and English subjects tested can be seen
in Figure 1 below:

(45)
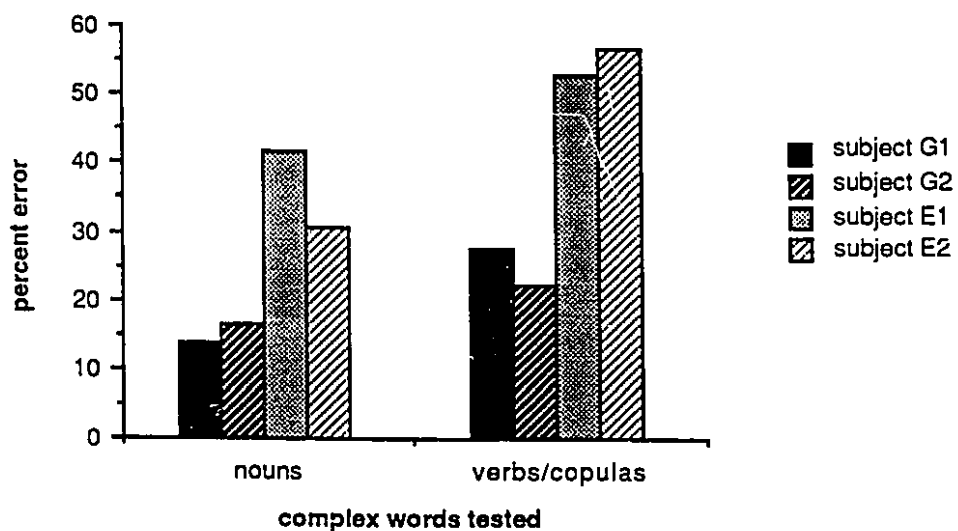
Figure 1

Repetition task: Singular/plural distinction

As can be seen in the above figure, the performance of the Greek- and English-speaking patients manifests similar tendencies; however, a difference in the error rate does exist. This difference may reflect the varying importance of the inflectional system in richly inflected and poorly inflected languages. Such a claim may not be unfounded if one considers that in richly inflected languages, such as Greek, subjects tend to cling to inflections which play an important role in the interpretation of words and sentences. Bearing on the importance of inflections in Greek, it was noted that in this language errors consisted only of substitutions of one affix for another, namely singular accusative for plural accusative and singular nominative for plural nominative. Similarly to the conclusions reached by Bates et al. (1987), erroneous productions of (46a) were not found along more than one dimension, that is, they rarely involved switches in both number and case or number and gender (46d). They were rather of the type shown in (46b) and (46c).

(46) a) To   paidhi   hereta   **tous pilotous**
                                      [masc. plur. accus.]
          The   boy   greets   the pilots

      b) To   paidhi   hereta   ton piloto
                                      [masc. sing. accus.]
          The   boy   greets   the pilot

      c) To   paidhi   hereta   oi pilotoi
                                      [masc. plur. nom.]
          The   boy   greets   the pilots

      d) To   paidhi   hereta   o pilotos
                                      [masc. sing. nom.]
          The boy   greets   the   pilot

In English, errors consisted only of omissions of affixes. A common feature in both languages is that subjects produced more errors in plural nouns found in the object position than those found in subject position; errors found in object position rated 63.6% for Greek and 66.7% for English .

Finally, a feature to be considered in repetition, is the singular/plural distinction in adjectives, which is shown in Table 4, (47).

(47)	Raw no.	%		Raw no.	%
G1	5/36	13.8%	G2	4/36	12.9%
E1	0	0%	E2	0	0%

Table 4

Repetition task: Errors in the singular/plural distinction on adjectives

In Table 4, number switches in adjectives are not relevant in English since the language does not mark number overtly on adjectives.

4.6.2 Comprehension Task

In the analysis of the data in the Comprehension task we focused on the pointing at one of the two pictures presented on each sheet of paper. Comprehension was considered to be successful if the subject correctly pointed to the target picture. If the subject pointed to the fossil/distractor or if he was undecided and responded with: 'I don't

know', the attempt was considered unsuccessful. If the subject initially made the wrong selection but corrected himself, the response was counted as correct.

The results in Comprehension reveal a pattern, similar to that found in repetition, when the distinction of singular/plural in nouns is considered. As can be seen in Table 5, the error rate which is low for Greek, rises for the English-speaking subjects.

(48)	Raw no.	%		Raw no.	%
G1	8/72	11.1%	G2	7/72	9.7%
E1	35/72	48.6%	E2	20/72	34.7%

Table 5

Comprehension task: Errors in the singular/plural distinction

Similar to the tendency found in the repetition of plural nouns in English, in this task, errors are primarily found in nouns which take the non-syllabic plural allomorph, (85%). This tendency, as well as the general difference in error rate observed in the comprehension in Greek and English, will be discussed later in this chapter.

4.6.3 Production Task I

In the analysis of the data in Production task I, performance was considered to be fully successful only if the tested item/items were properly inflected. Production was considered to be successful even if accompanying non-tested items were not present. However, production was considered to be unsuccessful a) if the subject's answer was unintelligible or if she/he refused to speak and responded 'I don't know', 'no', b) if the production of the tested item/items was erroneous and c) if the production included only the accompanying non-tested items. If the subject produced the correct sentence only after prompting, his production was counted separately.

The results for the production task show that the overall strategy, in both languages, and in both tasks, was to add numerals in the singular as well as in the plural. The number of occurrences of numerals in the plural and the singular in object and subject positions can be seen in Table 6.

(49)	Subject		Object	
	Singular	Plural	Singular	Plural
Greek	7	25	9	20
English	8	24	13	27

Table 6

Production tasks: Occurrence of numerals

As it can seen in Table 6, numerals were produced in both singular and plural,

with a higher occurrence when the target structure demanded was in the plural. In Greek, all the numerals produced were properly inflected for number, gender and case. Numerals were also found in the productions of French-speaking and Polish-speaking agrammatic aphasics as reported by Jarema and Kehayia, (1988). It was then suggested that the introduction of numerals is some kind of strategy used by the aphasics to cue themselves for the production of a plural noun. It is interesting to note that a very small percentage of errors was found in plural nouns that were accompanied by numerals. What this demonstrates is that the agrammatic aphasics studied knew that a plural noun was being elicited and were introducing the numeral to cue themselves and, possibly, gain processing time. The introduction of numerals was especially noted in the performance of Polish-speaking agrammatics, (Jarema, 1989, personal communication) who would go as far as to omit the noun which the numeral was to have accompanied; Polish patients would, thus produce only the numeral, properly inflected for plural. However this tendency was found only in the minority of the cases. Most of the times, when a numeral was introduced, the following noun was correctly inflected for plural, as is the case with the Greek and English subjects tested.

Apart from the introduction of numerals, in Production I task, there were switches from plural to singular in nouns and verbs and omissions of nouns and verbs inflected for plural. Errors were also observed in verb-noun agreement and adjective-noun agreement (in Greek only) which can be seen in Tables 7 and 8:

(50)

	G1		G2	
	Raw no.	%	Raw no.	%
nouns				
plural-->singular	30/72	40.2%	28/72	38.8%
verbs				
plural-->singular	15/36	44.7%	12/36	36%
omissions				
nouns in the plural	10	.	11	
omissions				
verbs in the plural	11		9	
verb-noun				
agreement	20		25	
adjective-noun				
agreement	8		10	

Table 7

Production Task I (Greek)

(51)

	E1		E2	
	Raw no.	%	Raw no.	%
nouns				
plural-->singular	36/72	50%	28/72	38.8%
verbs				
plural-->singular	10/36	27.7%	12/36	36%
omissions				
nouns in the plural	8		10	
omissions				
verbs in the plural	11		14	
verb-noun				
agreement	20		23	
adjective-noun				
agreement	0		0	

Table 8

Production Task I (English)

4.6.4 Production Task II

The analysis of the data in Production task II followed, more or less, the analysis of the data for Production task I. The results in this task show similar switches from plural to singular to those found in Production task I, as can be seen in Tables 9 and 10 below:

(52)   G1   G2

                    Raw no.   %   Raw no.   %

nouns

plural-->singular   15/36   44.1%   10/36   27%

verbs

plural-->singular   10/18   55.5%   8/18   44.4%

Table   9

Production Task II (Greek)

(53)   E1   E2

                    Raw no.   %   Raw no.   %

nouns

plural-->singular   18/36   50%   14/36   39.1%

verbs

plural-->singular   6/18   33.3%   9/18   50%

Table   10

Production Task II (English)

The figure that follows displays the error patterns found in the performance of all subjects tested.

(54)

percent error (y-axis): 0, 10, 20, 30, 40, 50, 60

complex words tested (x-axis): nouns, verbs/copulas

Legend:
- subject G1
- subject G2
- subject E1
- subject E2
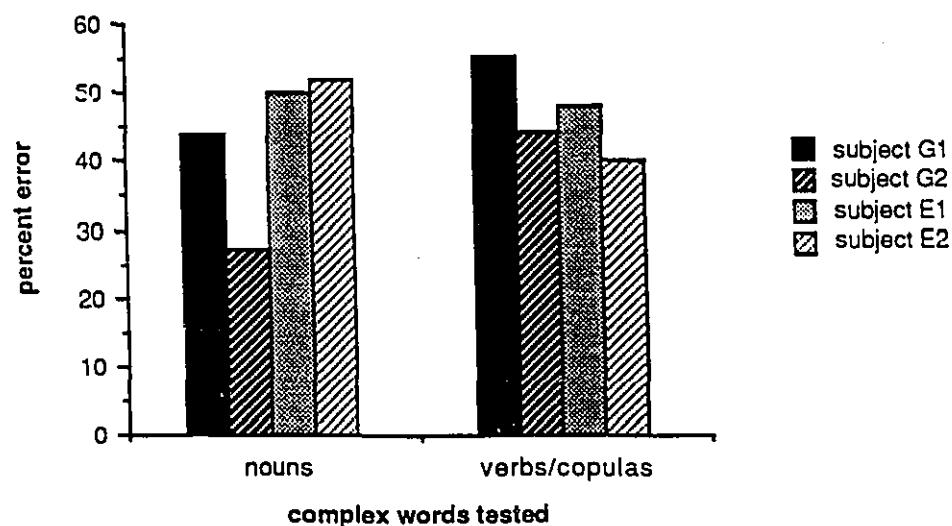
<u>**Figure 2**</u>

Production task II: Singular/plural distinction

Looking at Figure 2, we find a lower error rate for verbs/copulas, as compared to the nouns, in the English-speaking subjects. The case is not the same with the Greek-speaking subjects who seem to be encountering more difficulty with verbs/copulas than with nouns.   The performance of the Greek-speaking subjects on production task II is consistent with their performance in the repetition task, however

significantly more deficient in production than in repetition (p<0.001 for GI and p<0.0I for G2). A comparison of the results found in the two tasks can be seen in Figure 3:

(55)

Figure 3 bar chart showing percent error across tasks/complex words tested (rep. nouns, rep. verbs, prod. nouns, prod. verbs) for subject G1 and subject G2.
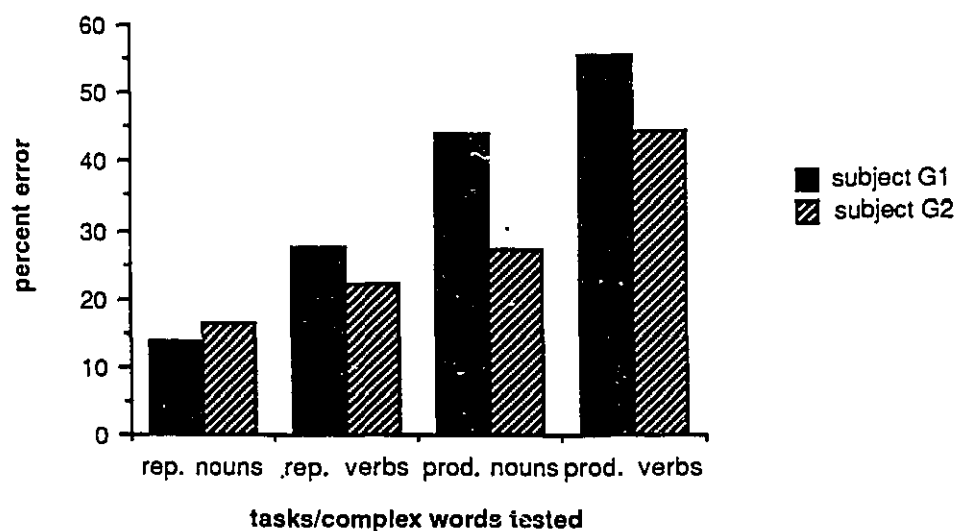
Figure 3

Repetition/Production task II: Comparison

With respect to the syllabic/non-syllabic plural allomorph distinction in English throughout the four different tasks the performance on the non-syllabic allomorphs was consistently and significantly (p=0.014 for Repetition, p=0.002 for Comprehension, p=0.014 for Production II) more problematic than on the syllabic allomorph. We thus do not find a task effect on the performance, but rather an effect of the type of affix attached to the noun under investigation:

(56)
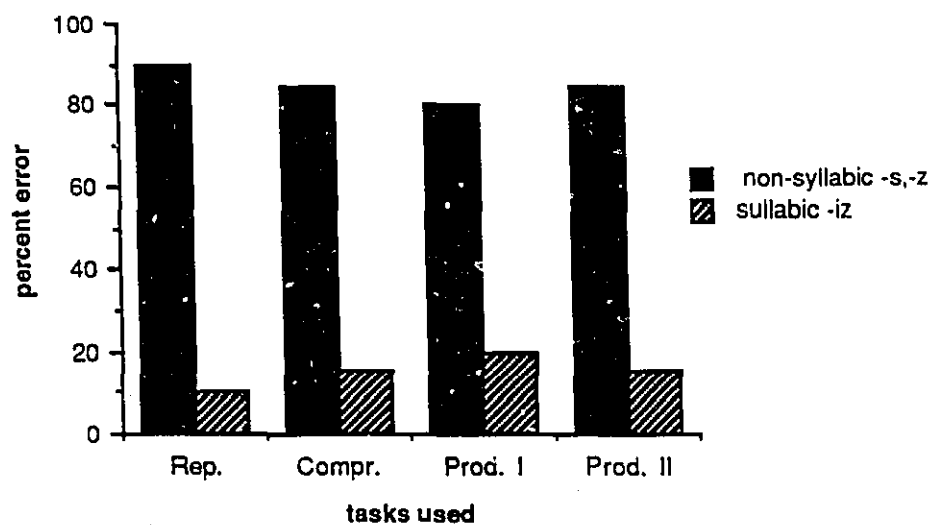
Figure 4

Comparative performance on the syllabic-non-syllabic
plural allomorph distinction

A final point to be investigated concerns the possibility of a difference in

performance between the two production tasks resulting from limitations of short-

term memory mentioned earlier in this chapter.   In the two figures that follow, the

performance of G1 and G2 in Figure 5, and E1 and E2 in Figure 6, can be compared:

(57)
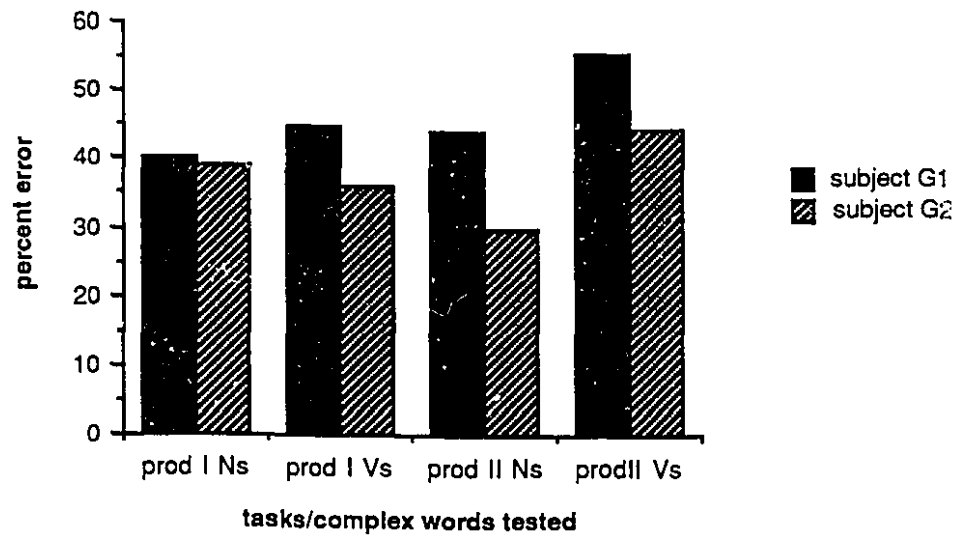
Figure 5

Comparison between Production tasks I and II in Greek

(58)
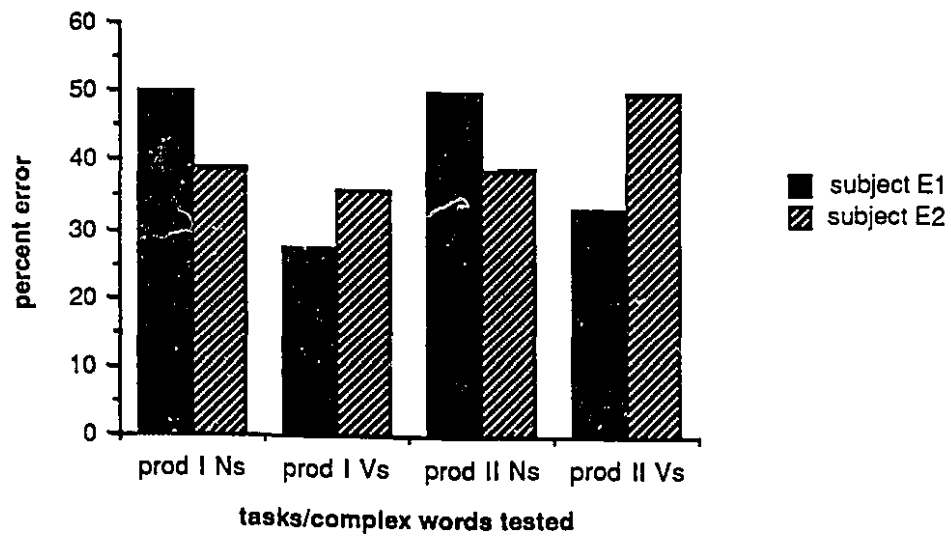
Figure 6

Comparison between Production tasks I and II in English

As can be seen in the above figures, no task effect was found. Performance is quite comparable for both Greek and English subjects studied.

4.7.0   Discussion

Having presented the description of the results , certain issues are worth discussing in further detail. First, as was mentioned earlier, with respect to the distinction singular/plural, in Greek and English, the subjects showed a tendency to switch from plural to singular in nouns, articles+nouns, adjectives, as well as in copulas and verbs in the tasks used. In English, both subjects tended to omit the inflectional plural marker on nouns with a significant preference in their omissions for the non-syllabic [-s] and [-z] plural allomorphs; the syllabic plural allomorph [-iz] was largely retained. This finding coincides with that of Goodglass et al. (1972) who attribute the phenomenon to the saliency of the syllable. Although we acknowledge the importance of salience and 'sonorance' in the retention of morphological markers in aphasia, a deeper theoretical explanation is sought here. More specifically, if all +plural nouns are derived in the lexicon, then all of them should be equally accessible or inaccessible, unless there is some feature that differentiates the different allomorphs.

Let us hypothesize that the two phonological rules relevant to the derivation of the non-syllabic plural allomorph, on the one hand, and of the syllabic plural allomorph, on the other, occur at two different levels. We propose, that the rule of epenthesis creating the syllabic allomorph [-iz] takes place lexically, while the rule of voicing assimilation s-->z takes place postlexically. Such a proposal is not unfounded, if we hypothesize that words containing the epenthetic -i- will be derived

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lexically since rules of epenthesis do not apply postlexically. On the other hand, words affixed with the non-syllabic plural allomoph will undergo the rule of assimilation at a postlexical level where, according to Kiparsky (1982), only regular, non-idiosyncratic operations occur across word boundaries. Thus, in the production of a word like 'buses' the affixation of the plural allomorph, as well as the application of the appropriate phonological rule, will take place in the morphological component. On the other hand, in the production of a word like 'cats' or 'dogs', after accessing the lexical item from the morphological component, 'voicing' agreement at the postlexical phonology level would have to apply. Similar would be the case of the voicing of the contracted copula: contrast the 'the cat 's sleeping', and 'the dog 's sleeping' where voicing of '-s' occurs depending on the preceding consonant. The consequence of such a proposal is that, in the processing of complex words, although such words can be successfully accessed from the morphological component, a breakdown may occur at the postlexical phonology level, thus creating the differing results on the plural allomorphs found in our data for the English-speaking subjects. Adopting an interpretation such as the one presented above, it can be seen how through predictions that linguistic theory makes concerning the possibility of application of phonological rules at different levels, one can explain the aphasic performance discussed above.

Turning to the performance of the two Greek-speaking subjects, although no omissions of articles were found except when they accompanied a missing noun, there were omissions of verbs, as well as a small percentage of omissions of nouns in the

plural. In particular, erroneous productions were found in masculine nouns in -os such as, 'ánthropos' (man) when plural accusative 'anthrópous' (to the men), was asked for. Such cases were especially problematic for the patients, for two possible reasons: first, in the formation of the plural accusative apart from the addition of the 'accusative' affix -ous, the accent also changes place from the antipenultimate to the penultimate position, as it can be seen in (59):

(59)   oi ánthropoi   tous anthrópous

        (men, nom.)   (men, acc.)

This accent change is triggered by the suffix -ous which has the particularity of attracting the accent from an antipenultimate positions to a penultimate ones, (60).

(60) oi ántrop#oi   tous   anthróp#ous
      (the men)   (the men, accusative)

      oi dháskal#oi   tous   dhaskál#ous
      (the teachers)   (the teachers, accusative)

Such a stress change is not manifested in any of the feminine or neuter nouns tested, (61). Both the feminine and the neuter plural nouns have a lower error rate than the masculine plural nouns.

(61)   oi   ánthropoi   oi mitéres   ta dhéndra
       (the men)   (the mothers)   (the trees)

       tous anthrópous   tis mitéres   ta dhéndra
       (the men, accusative) (the mothers, accusative) (the trees, accusative)

A second factor that may have contributed to added difficulty with the masculine nouns is that they are the only ones that take a different inflection marking the nominative case and a different one marking the accusative case in both the singular and the plural. Compare masculine nouns in -os and feminine in -a below:

(62)   o   ánthropos   i   mitéra
        (the man)   (the mother)

        ton ánthropo   tin mitéra
        (the man, accusative)   (the mother, accusative)

        oi   ánthropoi   oi   mitéres
        (the men)   (the mothers)

        tous anthrópous   tis mitéres
        (the men, accusative)   (the mothers, accusative)

It is possible, therefore, that homophony of the nominative and accusative of the feminine nouns in -a may have been an access- facilitating factor for the subjects. A question accompanying such a claim concerns the way one can differentiate the production of a nominative from an accusative if the affix marking both of them is the same. The only way to distinguish one case from the other is, in fact, through the article which changes, depending on case marking, as can be seen in (62). Therefore, the possibility of the subjects' production of a nominative for an accusative, in this case, is ruled out, since when the accusative was produced correctly, it had to be accompanied by the article, properly inflected. We can thus be sure that an accusative

was aimed for. Since the facilitating effect of homophony between case endings does not exist in the masculine nouns in -os, switches from accusative plural into nominative plural and from accusative plural into accusative or nominative singular were observed in 70% of the cases.

The general results on the distinction singular/plural are comparable to those of Miceli and Caramazza (1988), at least for the nouns. No comparison of the results on adjectives can be made, since in our present study adjectives were only investigated secondarily. However, concerning both articles+nouns and adjectives, it is interesting to note that, as mentioned earlier, and similar to the findings reported in Bates et al., 1987, the subjects tested here seemed to produce errors along one dimension at a time; they would either produce an error in number, or case, or much more rarely in gender. Specifically with respect to gender, the Greek subjects' performance was not overly problematic. Some errors were found in switches of gender mainly from masculine and feminine to neuter when the noun concerned was in the plural and, furthermore, occurred in object position.

With respect to the added difficulties experienced when the plural nouns elicited were found in object position, it is believed that in a sentence like 'the woman feeds the goats', where the first NP as well as the agreeing verb are in the singular, the patient starts interpreting the first NP marked [+singular] until he reaches the second NP. At that point, the thematic role Theme has to be assigned to the second NP and at the same time the feature [-singular] or [+singular] has to be observed. It is possible, that at this stage, when the second NP is marked [-singular] if a breakdown

occurs then the feature [+singular] of the first NP in subject position will extend and to the NP in object position, thus yielding erroneous productions. Note that the subjects had no difficulty interpreting S-V-O sentences where both NPs are in the singular. A smaller number of errors was found in sentences where the plural noun occurred in subject position. In such cases, the patient starts with the interpretation of an NP marked +plural and is reinforced by the verb which is also marked +plural in agreement with the preceeding noun. An added factor to be considered here was that of case marking. Although case marking does not appear to be a hindering factor in NPs marked [+singular], or even in plural NPs in subject position, it seems to add to the grammatical load in sentences where the plural NP occurs in object position and must therefore be inflected for accusative case. An increased number of errors was found in such sentences.

Finally, a feature to be discussed is that of the type of errors found in the two languages, as these errors reflect specific features of the language systems described earlier in this chapter. More specifically, in Greek , substitutions (rather than omissions) of the inflectional affix marking the plural with the one marking the singular were found. Such an observation (see also Grodzinsky, 1982) can be easily explained if one considers the subcategorization frames of words in the lexicon of the languages under investigation. As mentioned earlier, in a language like Greek, in order for a root to surface at the level of the word, it must be affixed with an inflectional affix:

(63)

gátes (cats)
+N
-V
+plural
feminine
nominative

```
                    /\
                   /  \
                  /    \
                 /      \
                /        \
          N-I              .  Af
          gat-               -es
          +N                 feminine
          -V                 nominative
                             +plural
```
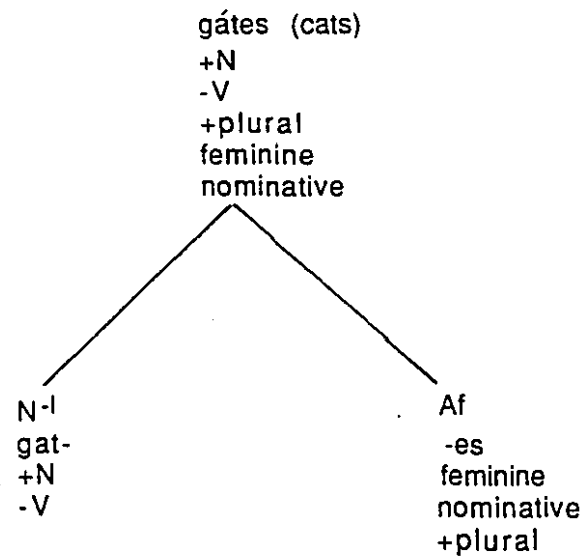
Tree structure 1

Only after the affixation of the inflectional suffix can the root be realized as a word of

the language. Thus, the production of a bare root would violate the subcategorization

requirement of roots in the lexicon.

Unlike Greek, English roots may surface to the level of the word regardless of the

presence or absence of an inflectional affix.

(64)

```
                          _cats
                          +N
                          -V
                          +plural
                         /        \
                        /          \
              N-1                    Af
              cat                    -s
              +N                     +plural
              -V
```
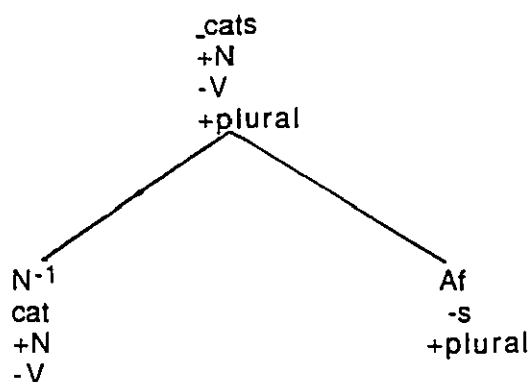
Tree structure 2

Taking the above into consideration, it is possible to explain why English subjects tend to omit affixes, while in Greek they tend to substitute one affix for another. Furthermore, what is most interesting is that the subjects do not violate the subcategorization features and principles of well-formedness of words in either language.

4.8.0   Conclusion

The results of this cross-linguistic experiment investigating the performance of agrammatic aphasic subjects on tasks requiring attention to morphological markers indicate that accessing inflected lexical items can prove to be difficult for aphasic subjects at different levels. That is, subjects may either have a problem in accessing the complex lexical item from the lexicon, and/or encounter difficulties with the application of phonological rules at the surface level of postlexical phonology.

An effect of the role of inflection in the language (rich/poor inflectional systems) was found at least for the repetition and comprehension tasks. Along the same lines, the type of language including the specific principles governing the well-formedness of lexical items in Greek and English was also found to play a role in the type of errors found throughout the tasks examined. Thus, in a language like Greek, where roots have no specification for lexical category, substitutions rather than omissions were observed.

Investigating the implications of the data for the two different theoretical frameworks outlined earlier, as has been already stated, a unified interpretation of errors can only be achieved through a framework which acknowledges all operations pertinent to morphology to be taken care of within the morphological component.

In conclusion, this experiment along with the studies mentioned earlier points towards the generally proposed hypothesis that principles of morphology are not lost in aphasia, since none of the tested subjects produced any such violations. Rather access to lexical items is inhibited to a varying extent depending on the internal structure of these items, and the requirement for the application of postlexical phonological rules.

Chapter 5

5.1 Background Literature

In the previous chapter, the treatment of nominal inflections by agrammatic aphasic patients was investigated. Another issue that has been the target of research in the literature is the treatment of verbal inflections in the spontaneous speech and the elicited productions of agrammatic aphasics. For example, agrammatic aphasics have been quoted to produce either the uninflected form of verbs such as 'open' or the 'V + -ing' form such as 'opening' (Jakobson, 1964; Goodglass, 1968; Myerson and Goodglass, 1972; Goodglass and Geschwind, 1976). Myerson and Goodglass (1972) described the uninflected forms as infinitives, bare stems or '0-morph' default forms, and the '-ing' forms as participles (adjectival) or gerundive (nominalized) forms. Goodglass and Geschwind (1976) and Saffran, Schwartz and Marin (1980b) suggest that V + ing forms are used "to name" the action which would normally be expressed by a predicate. Having identified some of the problems surrounding the production of verbal inflections, research focused on ways of interpreting these problems within specific linguistic or psycholinguistic theoretical frameworks.

More specifically, in an attempt to differentiate between nominal '-ing' forms and gerundive ones, Kehayia (1984) tested the repetition by five agrammatic aphasic patients of sentences such as 'I like the singing of birds' and ' Mary is singing' where 'singing' can be either a noun or a predicate. The results showed that nominal '-ing' forms were better repeated than progressive '-ing' forms, however with a small difference (14.4%). Even though the difference was not big, it was in accordance with Kean's (1977) predictions according to which affixes depending on the syntactic features of the sentence are more likely to be omitted than what she calls non-syntactic affixes. In this case, the progressive '-ing' seemed to be dependent on the syntactic configuration of the sentence and therefore would be more likely to be omitted. The results also provided evidence for the representation of inflectional and derivational affixes in terms of the theory of word structure adopted in Kehayia (1984), and for the hypotheses put forth in this study, according to which inflectional affixes (progressive -ing) would be more vulnerable than derivational ones (nominal -ing).

Even though the study by Kehayia (1984) provides us with some information on agrammatic performance on verbs, it only examines one specific problem, the 'V + -ing' forms. Lapointe (1985) rejects pure grammatical descriptions of agrammatic performance on verb-phrases. He claims that such descriptions cannot properly account for all the facts about English and Italian agrammatism, which he studied. He instead proposes a unified account of the verbal system in terms of a psycholinguistic

model, and in particular an elaboration of Garrett's (1980) model.   He proposes normal sentence production to involve the accessing of two stores during syntactic processing, one containing phrase fragments, the other function words.   A unified representation of V fragment stores in English and Italian is given below:

(65)   English V fragment store

V	Aux V + ing	Aux V + ed	Aux being V + ed
V +s	Aux been V + ing	Aux been V + ed	Aux been being V+ed
V + ed			
Aux V + ed			

Italian V fragment store

V + are	Aux V + ato	Aux V + ato	Aux stato V + ato
V + a			
V + i			
V + o			

Lapointe   (1985:132)

In order to explain the agrammatic patients' preference for verb forms such as, 'V' and 'Aux V +ing' while at the same time taking into account the grammatical, processing and psycholinguistic factors that are at play in agrammatic performance, Lapointe hypothesizes a preference of agrammatic patients for V forms of the upper left-hand corner as presented in (65).   He concludes that such patients suffer from a specific

inability to access specific fragment stores or partial information within these stores. Apart from the conclusion on the inadequacy of pure grammatical descriptions of agrammatism and the importance of psycholinguistic accounts of agrammatic performance, Lapointe also stresses the importance of studying languages other than English. He states that in order to investigate, more thoroughly, questions raised by the difficulties that agrammatics have with bound morphemes in verb phrases, one must conduct cross-linguistic research involving languages with verbal inflection systems more elaborate than English. Two studies, one by Bates, et al. (1987) and another by Lorch (1989) pursued cross-linguistic investigations of linguistic deficits in aphasia not only in order to extend their studies to languages with linguistic systems different from English, but also to investigate the possible correlation between linguistic deficits in English to those found in other languages. The general goal in these studies, as in many others, is to investigate the correlation between differing linguistic systems and the linguistic deficits observed in the performance of patients of variable language backgrounds. Such investigations can provide us with a clearer understanding of linguistic deficits in aphasia .

Bates et al. (1987) examined, among other issues, the availability of morphology in Broca's aphasics who were native speakers of either English, German or Italian. The results of the study showed that although word order was not affected, morphology was selectively impaired in all three languages. More specifically, morphology was found to be consistently and markedly impaired in all three language, whether or not the patient had to depend on morphological cues in his premorbid state.

They pursue a detailed analysis of aphasic spontaneous and elicited speech in order to identify the factors of morphological and syntactic processing, as well as the linguistic and non-linguistic strategies that influence aphasic productions. They conclude that morphology is indeed vulnerable even in highly inflected languages and that the vulnerability is qualitatively different depending on the type of language affected. Unfortunately, the Bates et al. study is conducted without reference to linguistic theory. Thus no meaningful interpretation can be offered of the results which are otherwise interesting .

Lorch (1989), who also conducted a cross-linguistic study of the agrammatic impairment in verb inflections, examined three highly inflected languages, Icelandic, Hindi and Finnish, which differ significantly in the expression of various grammatical functions. She attempted to clarify the ambiguity surrounding the productions of agrammatic aphasics in English, presented earlier in this chapter and examined texts of several hundred words, consisting of four spontaneous narrative speech samples. The goal of the analysis was to construct a profile of quantitative and qualitative performance for each patient, as compared to the matched normal control, in order to determine whether verb inflections are differentially affected in each language. The study focused on lexical and inflectional omissions and on lexical and inflectional substitutions. The results show that verb phrases and the requisite grammatical formatives appear to be highly susceptible to impairment in the speech production of the agrammatic aphasics studied. The manifestation of the deficits was distinctly different in each language studied, a finding which was attributed to language-specific

factors. For example, although in Icelandic, performance was described as tending towards use of non-finite forms and difficulty in finite inflections, the pattern found in Hindi seemed to reflect a tendency toward more stative and less active, relational predicates. The omission of verbs in Finnish could be inferred to be the results of difficulty with selection of inflections (and/or stems), but a more specific characterization did not seem to be obtainable (Lorch, 1989:40). Lorch concluded that although the types of errors found in bound grammatical morphology were largely determined by language-specific factors, free grammatical morphemes appeared to be affected similarly in the three languages studied. Although the study seems to fulfill some of the goals that it set out to investigate, it still leaves the reader with unanswered questions specifically with respect to the possible correlation of deficits in English agrammatism and deficits of agrammatic speakers of other languages. Furthermore, no attempt is made to provide a universal account on the treatment of verbs and verb phrases in agrammatic speech, on accessing strategies of verbs as well as on the processing of verbs. Finally, no attempt is made to provide a theoretical explanation of the performances of the subjects studied.

In the present cross-linguistic experiment on verbal inflections in agrammatic aphasic speech, the two languages under investigation are Greek and English, which, as was shown in the previous chapter, differ to a great extent in the expression of grammatical functions and the representation of inflections. These differences are even more profound when one considers verbal inflections (see chapter 2, pp, 29-34). In spite of Lapointe's predictions that a purely grammatical description of agrammatic

phenomena is not possible without the aid of a psycholinguistic model and without discrediting his approach, in the present cross-linguistic study of verbal inflections, a linguistic investigation is initially pursued. We strongly believe that it is impossible to conduct any psycholinguistic or neurolinguistic investigation of linguistic deficits in aphasia in the absence of a theoretical linguistic framework. Psycholinguistic information may follow and complement linguistic analyses and interpretations of linguistic deficits in aphasia.

5.2.1 Investigation of Verbal Inflections in English

In view of the hypotheses presented earlier, our study of verbal inflections focused particularly on tense, the present (simple and progressive) the past and the future. In English, both regular and irregular verbs were tested. Within the first category, we chose verbs taking each of the three past tense allomorphs, as shown in (66):

(66) chase--chased   [tʃeis]--[tʃeist]

        open--opened   [owpn]--[owpnd]

        plant--planted   [plænt]--[plæntəd]

Testing of all three allomorphs was judged to be necessary in order to see whether the results confirmed the conclusions reached by previous researchers.

According to Goodglass (1968), the syllabic allomorph -əd was found to be better retained than the non-syllabic allomorphs -t and -d.

Within the irregular category two types of verbs were tested:

(67) a. verbs that use the same form in the present and past participle

      feed--fed--fed

  b. verbs that use a different form for the present and the past participle **write--wrote-written**

Both types of irregular verbs were tested in order to investigate whether the fact that the verb paradigm of (67) b. which includes the different past participle form would influence the performance of the agrammatic patients tested.

Each category of regular verbs was tested in 6 instances, amounting to 18 verbs. 12 irregular verbs of the type shown in (67) were also tested. Every verb was tested in each of the three tenses. In the present tense, half of each set were tested in the simple present and the other half in the progressive form, (68).

(68) The woman **opens** the box.

     The woman **is feeding** the chicken.

The verbs chosen for the stimuli were matched for length, complexity and frequency. The frequency of the verbs in the present tense form varied between 15 and 204 In the past tense form frequency varied between 5 and 181 (Kuchera & Francis, 1967). The number of syllables in uninflected verbs varied between 1-2 syllables and of the inflected verbs varried between 1-3.

5.2.2 Investigation of inflected verbs in Greek

In Greek, as for English, the present, past and future tenses were investigated. The distinction between the simple present and the present progressive tested for in English is not reflected in the Greek stimuli, since such a distinction does not exist in the Greek verbal system. The verbs chosen were grouped into four categories according to internal word structure of the verbs in the three tenses investigated:

(68) a.

Present tense	Aorist tense	Future tense
paíz-o	é-paix-a	tha paîx-o
(I play)	(I played)	(I will play)

b.

metr-ó	mé tr-is-a	tha metr-ís-o
(I count)	(I counted)	(I will count)

c.

hteníz-omai	hteníst-ik-a	tha htenist-ó
(I comb my hair)	(I combed my hair)	(I will comb my hair)

d.

tróg-o	éfag-a	tha fág-o
(I eat)	(I ate)	(I will eat)

The above types of verbs were chosen not only because they cover (more or less) all the existing types of verbs in Modern Greek, but also because each type differs structurally from the other, a fact which may influence the performance of aphasic patients. Thus, as mentioned in Chapter 2, in verbs of the type (68) for the formation of the past tense, the prefix e- marking the past tense and the suffix -a, marking number and person, are added to the aorist stem of the verb. In the formation of the future tense, the suffix -o marking number and person is added also to the aorist stem of the verb, as shown in (68). The future tense is formed in a similar way in the irregular verbs of type d., with one exception. Whereas in verbs of type a. the

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aorist stem resembles the present stem with a change only at the last stem consonant, in verbs of type d. the stem may be different from the present tense stem:

(69) Present tense   Aorist tense   Future tense

        trog-o   e-fag-a   tha fa-o
        (I eat)   (I ate)   (I will eat)

        compare :

        Present   Past   Present   Past

        paiz-o   e-paix-a   trog-o   e-fag-a
        (I play)   (I played)   (I eat)   (I ate)

Verbs of type b. use the same stem as the one for the present tense for the formation of all tenses:

(70) Present tense   Aorist tense   Future tense

        metr-o   me tr-is-a   tha metr-is-o
        (I count)   (I counted)   (I will count)

However, the above verbs differ from those of type a. and d. in that they involve an added affix -is . Compare the following:

(71) Present   Past

        paiz-o   e-paix-a

        trog-o   e-fag-a

        metr-o   metr-is-a

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In verbs of type c. an added affixation process also takes place in the formation of the aorist, i.e., the stem htenist- is followed by the affix -ik and the affix -a .

(72) Present tense   Aorist tense   Future tense
      hteníz-omai   hteníst-ik-a   tha htenist-ó

      (I comb my hair)   (I combed my hair)   (I will comb my hair)
      plén-omai   plíth-ik-a   tha plith-ó
      (I wash myself)   (I washed myself)   (I will wash myself)

The above verbs not only involve the added affix -ik in parallel to verbs of type b., but they also exhibit a partial stem change, (e.g. 'hteniz- --> htenist-' or complete as in 'plen- --> plith-'). Keeping in mind the above, it is hypothesized that the internal structure of the verbs will play a major role in the performance of the patients.

In Greek, each verb type was tested in six instances. Every verb was tested in each the three tenses under investigation. Verbs chosen were matched for length, complexity and frequency. Just as for the nouns (see chapter 3), the frequency of the verbs was based on personal intuition of the author and judgments of native speakers. The number of syllables of both inflected and uninflected verbs varied between 2-4 .

5.3.0 Analysis of the Data and Results

Before reporting on the analysis of the data and the results obtained from the four agrammatic aphasic patients tested. a note must be made on the results obtained from testing of the controls. The responses were l00% correct; therefore, we will not be making any specific reference to the control results in the analysis of the aphasic data.

Turning now to the results of the agrammatic aphasics, the analysis of the data focused on successful repetition of the complex words tested. Repetition was judged to be successful if the patient could repeat at best the whole sentence or at least the portion which contained the complex word under investigation. Responses were judged to be unsuccessful: a) if the patient's answer was unintelligible or if he/she refused to repeat (e.g. responses like 'I don't know', 'no'); b) if in the repetition of the sentence the patient repeated the part that did not include the complex word tested; c) if in the repetition of the complex word the patient repeated only a part of it thus omitting the affix tested or if he substituted the affix tested for another. If the patient repeated the complex word in or out of context only after probing or after a second or third attempt, then these responses were counted separately.

Throughout all the tasks and for both languages the subjects were almost fully successful when verbs were inflected for the present tense. However, problems arose when the simple past or the future (particular in Greek) were elicited.

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5.3.1 Repetition task

In Repetition, the English-speaking subjects performed similarly to one another. Their results were also comparable to reports previously encountered in the literature. More specifically, in the repetition of verbs inflected for simple past tense, the error rate was higher in those verbs affixed with the non-syllabic allomorphs '-t' or '-d'. There were very few errors on the verbs affixed with the syllabic allomorph '-id'.

(73)   Regular Vs.   Irregular Vs.

	[-t]		[-d]		[-id]			
	Raw n	%	Raw n	%	Raw n	%	Raw n	%
E1	3/6	50%	3/6	50%	1/6	16.7%	6/12	50%
E2	3/6	50%	4/6	66.7%	2/6	33.3%	8/12	66.7%

Table 11

Repetition task: Detailed results on errors in the simple past tense

Errors in the regular verbs consisted of omissions of the past tense marker. Hence, the present tense of the verb was produced. No substitutions of one allomorph for another were found. With regard to past tense marking in irregular verbs the subjects in seven cases omitted the whole verb while on three occasions they produced the

present tense form of the verb. The future as well as the present tense presented no problems, except in the second English-speaking subject who consistently omitted the auxilliary 'will', and thus produced ungrammatical sentences. Cumulative and detailed results can be seen in Table l2 below:

(74)	Present		Simple Past		Future	
	Raw n	%	Raw n	%	Raw n	%
E1	0/30	0%	13/30	41.6%	0/30	0%
E2	2/30	6.6%	17/30	54.17%	3/30	10%

Table 12

Repetition task: Errors in the present, simple past and future

In Figure 7 that follows the complete picture of the subjects' performance is presented.

(75)
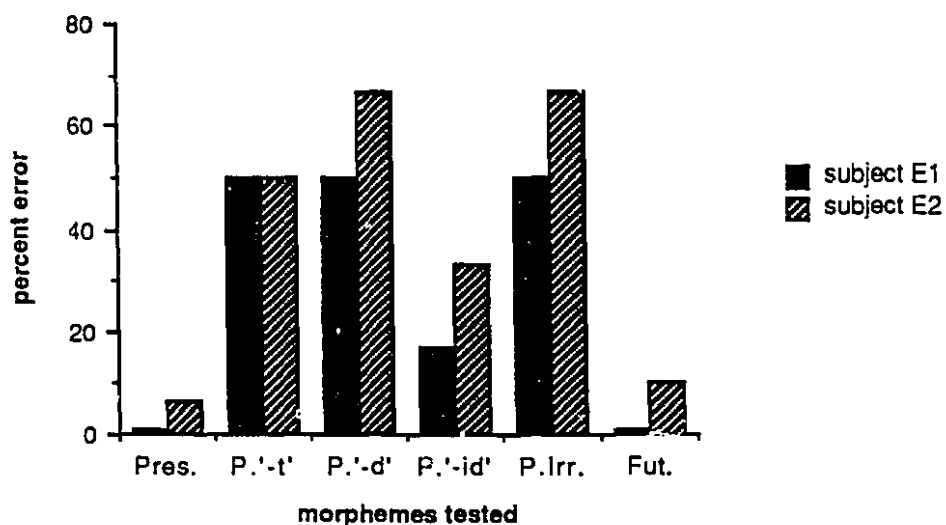
Figure 7

Repetition task in English

The parallel performance of the two English-speaking patients can be well observed in the above figure.

In Greek, in the present tense, the subjects performed successfully with the exception of one category of verbs. Problems were more evident when verbs were inflected for the past tense or the future. The general performance on the three tenses tested is illustrated in Table 13, (76).

(76)

	Present		Simple Past		Future	
	Raw n	%	Raw n	%	Raw n	%
G1	4/24	16.7%	8/24	37.5%	8/24	37.5%
G2	3/24	12.5%	7/24	30%	7/24	30%

Table 13

Repetition task: Errors in the present, simple past and future

Errors in the present tense consisted of omissions of the verb or of productions of one verb for another. For example, instead of producing the sentence in (77a), subject G1 would produce the sentence in (77b).

(77) a.   I   kopela   htenizetai

          The   girl   is combing herself

       b.   *I   kopela   htenizei

          The   girl   is combing

In the above example, the subject does not produce the reflexive '-omai' verb; instead, he produces the active counterpart, 'htenizo' (I comb).   However, a sentence of the type (77*) is ungrammatical since the thematic role Theme of the verb 'htenizo' [Agent, Theme] is unrealized. In the sentence in (77*), Agent is realized in the first

NP in subject position, 'i kopela' (the girl). However, Theme cannot be assigned, in the absence of a second NP. Therefore, the sentence is ungrammatical. Such responses were not frequent, and when they occurred, they were counted as wrong. In the past tense, errors consisted of substitutions of the present tense form for the past tense form, and of omissions of the whole verb. It is interesting to note that substitutions were mostly found in the forms of the first two categories of verbs, while omissions were observed in the two others (the significance of these results will be discussed later in this chapter). Table 14 and Figure 8 that follow give a detailed account of the errors found according to verb category:

(78)   Regular Vs.   Irregular Vs.

	A		B		C			
	Raw n	%	Raw n	%	Raw n	%	Raw n	%
G1	0/6	0%	2/6	33.3%	3/6	50%	3/6	50%
G2	0/6	0%	1/6	11.6%	4/6	66.7%	3/6	50%

Table 14

Repetition task: Detailed results on errors in the simple past tense
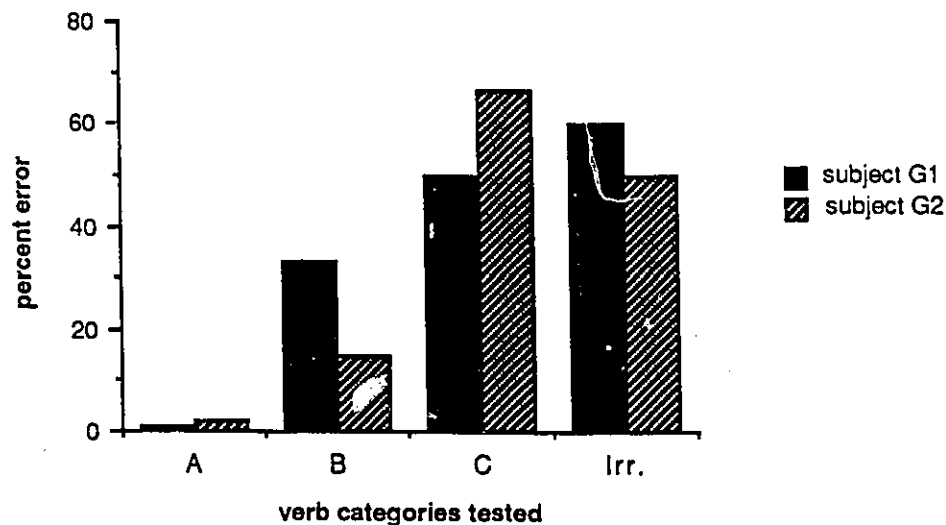
Figure 8

Repetition task: Detailed results on errors in the simple past tense

In the future tense, a similar distribution of errors to the one found in the past tense was observed. Thus, substitutions of the present for the future were found in verbs of categories A, B and C, while omissions were only found with irregular verbs. A common feature throughout all categories was that the subjects tended to omit the particle/auxiliary 'tha'.

It has been shown so far that, unlike the English-speaking subjects, the Greek-speaking ones encountered difficulties with some verbs in the present tense, and more so in the future tense. A comparison of the performances of the two sets of subjects can be seen in Figure 9.

(80)
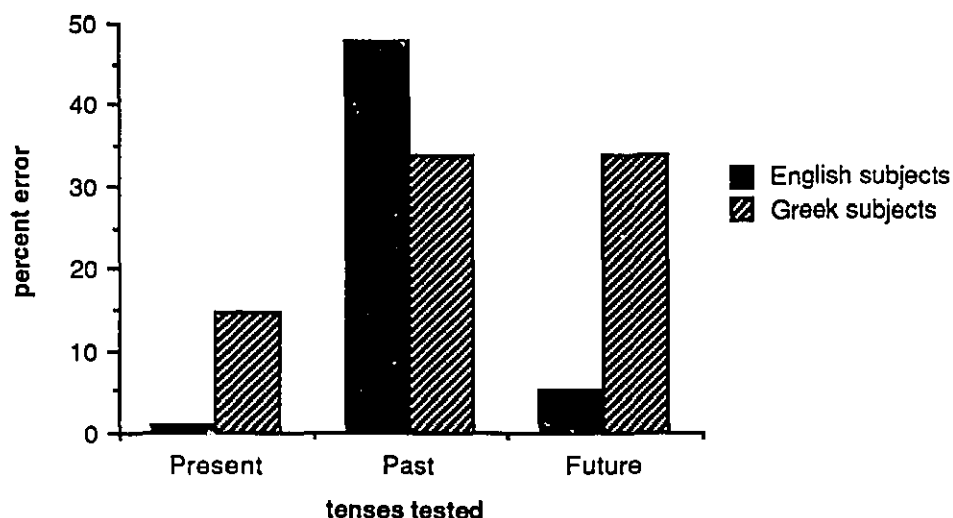
Figure 9

Repetition task: Comparison English/Greek

5.3.2 Comprehension task

The Comprehension task required the subject to point at one of the three pictures presented on each sheet of paper. Comprehension was considered to be successful if the subject correctly pointed to the target picture. If the subject pointed to one of the other pictures or if he was undecided or said 'I don't know', his attempt was considered unsuccessful. If the subject corrected him/herself unprompted then his answer would be counted as correct. The results in Comprehension in the two English-speaking subjects follow the same pattern as the results in Repetition. However, the error-rate was lower:

(81)	Present		Simple Past		Future	
	Raw n	%	Raw n	%	Raw n	%
E1	0/30	0%	8/30	26.7%	0/30	0%
E2	0/30	0%	7/48	23.6%	1/30	3.3%

<u>Table 15</u>

Comprehension task: Errors in the present, past and future in English

Figure 10 compares, the results in the comprehension task with those in the repetition task:

(82)
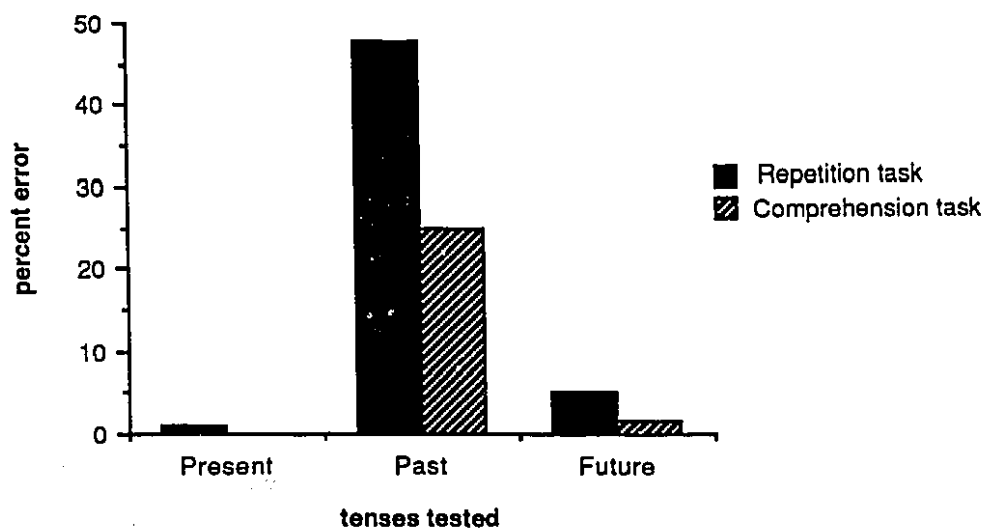
<u>Figure 10</u>

Repetition vs. Comprehension: A comparison

n the case of the two Greek-speaking subjects, as for the English-speaking subjects, the general error trend followed the one in the repetition task:

(83)   Present   Simple Past   Future

        Raw n   %   Raw n   %   Raw n   %

G1   0/24   0%   624   24.6%   0/24   0%

G2   0/24   0%   2/24   8.4%   2/24   8.4%

Table 16

Comprehension task: Errors in the present, past and future, in Greek

.

The error-rate in comprehension, especially for the future tense, is lower than the error-rate in repetition as seen in (84):

(84)
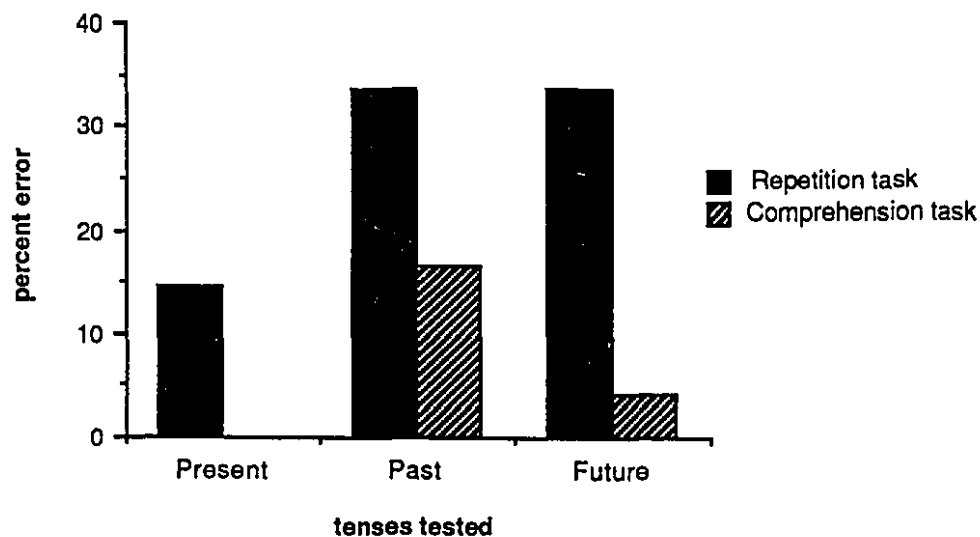
Figure 11

Repetition vs. Comprehension: A Comparison (Greek)

However, since the existing difference in performance between repetition and comprehension was not found to be significant, it will not be further discussed.

5.3.3 Production tasks

In the analysis of data from Production tasks I and II, performances were considered to be fully successful only if the elicited item/items properly inflected for tense and person, were produced. Production was considered to be successful even if accompanying non-tested items were not present. If the subjects used alternative ways of expressing the tense awaited, that is, if they produced an active verb for a reflexive, yet properly inflected and in a grammatical sentence, then their response was counted as correct, but calculated separately. An example of an alternative correct production of the type described above is shown in (85b) and compared to (85a) which is the elicited construction.

(85) a.   I   kopela   **htenizetai**

          The   girl   is combing herself

      b.   I   kopela   **htenizei**   ta malia tis

          The   girl   is combing   her hair

Production was considered to be unsuccessful if the subject's answer was unintelligible or if she/he refused to speak and responded 'I don't know', 'no', if the production of the tested item/items was erroneous or if the production included only the accompanying

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non-tested items. If the subject produced the correct sentence only after prompting, the production was counted separately.

The results in Production task I show the same overall error trends as the ones found in Repetition, but with a lower degree of success. Therefore, in English, error-rate in both the present and the future tense was quite low; however, significantly lower success rates (p<0.001) were observed in verbs inflected for the past tense:

(86)	Present		Simple Past		Future	
	Raw n	%	Raw n	%	Raw n	%
E1	2/24	8.4%	10/24	43.7%	3/24	12.5%
E2	1/24	4.2%	9/24	37.6%	4/24	26.7%

Table 17

Production task I: Errors in the present, simple past and future in English

Erroneous productions in both the present and the future tense consisted of omissions of the auxiliary 'is' for the present and 'will' for the future:

(87) The girl ...... feeding the chicken.

The girl ...... feed the chicken.

It must be noted here, that although the future auxiliary 'will' was in fact produced, E1 especially, preferably used the construction 'is gonna V', such as 'The woman **is gonna open** the box'. Sentences such as these were counted as correct. In the cases where the future auxiliary was omitted (e.g. the woman .... open the box), the possibility of an incorrect substitution of the present for the future tense, instead of the auxiliary omission, was investigated. However, the possibility of an incorrect substitution rather than an auxiliary omission was ruled out, since none of the subjects ever produced the present tense in other but the gerundive construction of the type 'is V-ing'. It, therefore, could not be the case that the subjects instead of producing the future construction (e.g., will + V) reverted to an incorrect production of the simple present as in *'The woman open the box'.

Turning to the chance performance observed on the elicited past tense, a high error-rate was found, particularly when irregular verbs were involved. In Table 18 a detailed analysis of the performance on the past is presented:

(88)			Regular Vs.				Irregular Vs.	
	[-t]		[-d]		[-id]			
	Raw n	%	Raw n	%	Raw n	%	Raw n	%
E1	3/6	50%	3/6	50%	2/6	33.3%	5/6	83.3%
E2	3/6	50%	2/6	33.3%	2/6	33.3%	4/6	66.7%

Table 18

Production task I: Detailed results in the simple past tense

As can be seen from Table 18, although production of the past tense of regular verbs followed, more or less, the same error pattern as the one seen in the repetition task, problems were more pronounced when irregular verbs were concerned. These results were further strengthened by those obtained from Production task II, which can be seen in Table 19 below:

(89)		Regular Vs.				Irregular Vs.	
	[-t]		[-d]		[-id]		
	Raw n	%	Raw n	%	Raw n	%	Raw n	%
E1	2/6	33.3%	3/6	50%	2/6	33.3%	10/12	83.4%
E2	3/6	50%	3/6	50%	2/6	33.3%	8/12	66.6%

Table 19

Production task II: Detailed results in the simple past tense

A comparison of results presented in Tables 18 and 19 can be seen in Figure 12 that follows:

(90)
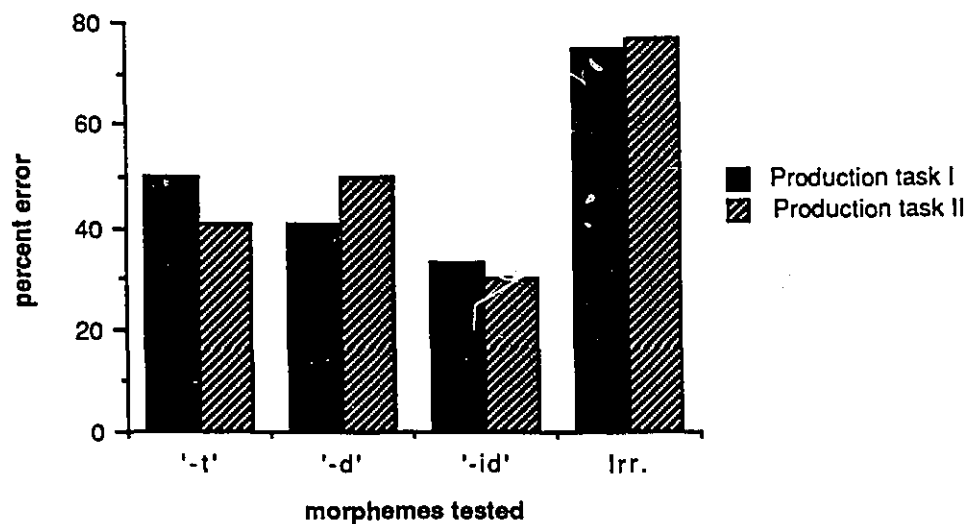
Figure 12

Production tasks I and II: A Comparison

The overall performance of the English-speaking subjects on production task II is shown in Table 20 below:

(91)	Present		Simple Past		Future	
	Raw n	%	Raw n	%	Raw n	%
E1	3/30	10%	17/30	56.6%	12/30	42%
E2	3/30	10%	16/30	48%	9/30	30%

Table 20

Production task II: Errors in the present, simple past and future in Greek

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Again, the success rate in performance in the past tense is significantly lower (p<0.001) than the performance in the present tense. It is interesting to note that in Table 20 the error-rate in the future tense is higher than the one found in Production task I. This result, together with the difference observed in Figure I0, will be discussed later in this chapter. The error tendencies observed in the performances of the English-speaking subjects on the past tense, were similar to those found in the performance of the Greek-speaking subjects. This statement refers particularly to the elicitation of irregular verbs in the past tense which was significantly (p<0.001) more problematic than regular verbs. Before proceeding with a detailed presentation of the subjects' performance on past tense, the overall performance in Production task I is given in Table 21 below:

(92)	Present		Simple Past		Future	
	Raw n	%	Raw n	%	Raw n	%
G1	5/24	21%	14/24	59.4%	14/24	59.4%
G2	4/24	17.7%	10/24	43.75%	9/24	38.5%

Table 21

Production task I: Errors in the present, simple past and future in English

The above error patterns are even more evident in Production task II, as it can be seen in Table 22 below:

(93)

	Present		Simple Past		Future	
	Raw n	%	Raw n	%	Raw n	%
G1	5/24	21%	17/24	69.75%	17/24	69.75%
G2	4/24	17.7%	15/24	62.5%	14/24	58.4%

Table 22

Production task II: Errors in the present, simple past and future in Greek

A comparison of the subjects' performance in Production tasks I and II can be seen in Figure 13 that follows:

(94)
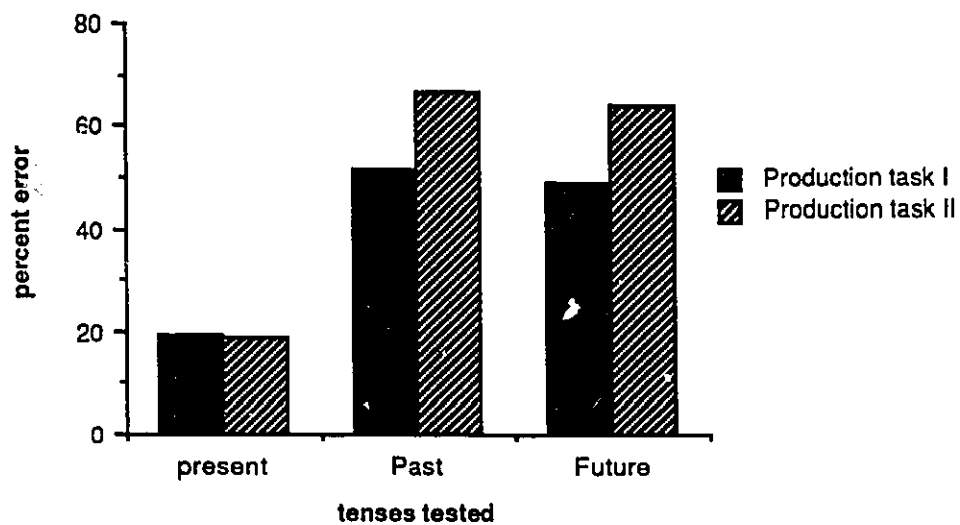
Figure 13

Production tasks I and II: A Comparison

As can be seen in the above figure, the error-rate in both the past tense and the future is quite high especially in production task II. As was mentioned earlier, it is most interesting that in Greek just as in English, in the past tense, as well as in the future (for Greek), irregular verbs were particularly problematic. In both tenses, in Greek, verbs belonging to category A had a much lower error than those belonging to the other categories:

(95)	A		B		C		Irregular Vs	
	Raw n	%	Raw n	%	Raw n	%	Raw n	%
G1	4/6	33.3%	2/6	66.6%	0/6	100%	0/6	100%
G2	5/6	17.7%	2/6	66.6%	0/6	100%	0/6	100%

Table 23

Production task II: Detailed results in the simple past tense

Figure 14 that follows displays the performance of the Greek-speaking subjects on the different verb categories, (96).

(96)
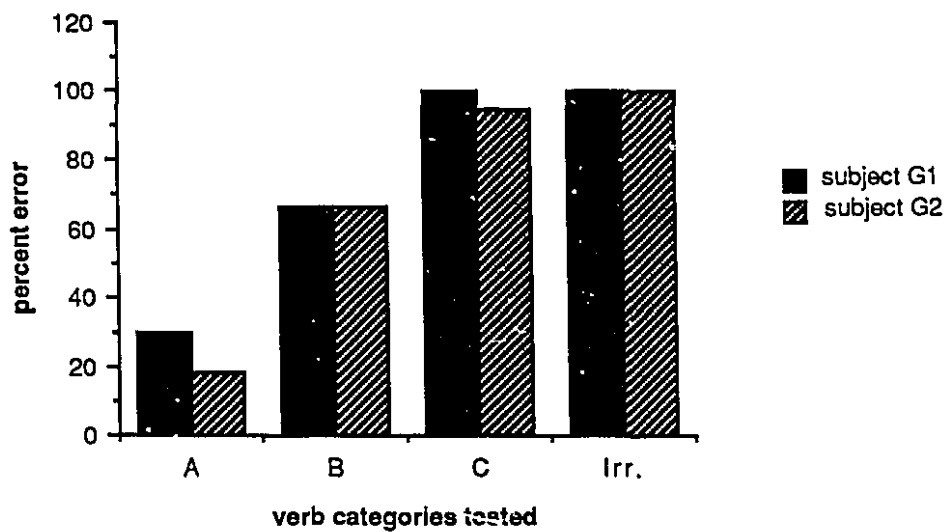
Figure 14

Production task II: Detailed results in the simple past tense

Finally, and before proceeding with the discussion, it must stated that with respect to the distinction between the simple present 'V+-s' and the gerundive 'V+-ing' forms no preference for one form over the other was found.

5.4.0 Discussion

Considering the results presented, several issues are of interest .   However, the most interesting observation is that in both languages subjects encountered significantly (p < 0.001) more problems with the past tense of irregular verbs than with any of the regular verbs.   Figure I5 that follows reflects this observation:

(97)

categories tested
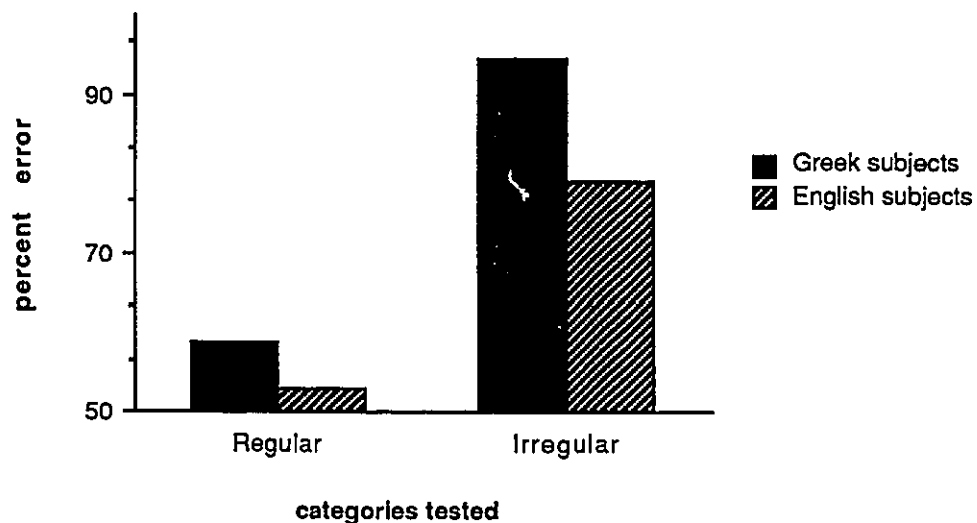
Figure 15

Performance on regular vs. irregular verbs in Production task II

The question that arises is why should the past tense of irregular verbs be so difficult to access not only in a production task, which is seen above, but also in repetition as

shown earlier in this paper. In an attempt to explain this phenomenon, attention is drawn to a strategy employed by all subjects in the two production tasks, and especially in Production Task II. The subjects would first produce the present tense verb-form and would then sometimes produce the past tense form. A closer examination of an excerpt of an actual production by E1 demonstrates the path which the subject is following in order to produce the elicited item. If the elicited form happened to be an irregular past tense, as is shown in (98), in most of the cases, the patient would fail to achieve correct production:

(98)   For the picture depicting a boy who has finished a piece of cake,

            E1: '...the boy eat...no....eat the cake...no...finished...the boy eats the cake...no...the boy was...eh...eh...finished the cake...'

However, when a regular past tense form was elicited, quite often, successful production was achieved, (99).

(99)   For the picture depicting a girl who has finished dusting her room,

            E2:   '...girl dust...no...dust the room...eh...girl dusting the room...no ..finished the room...the girl...dust...dusting...no, dusted the room'

In a preliminary attempt to explain the difference in performance shown in (98) and (99), attention is drawn to the fact that in the first case the past tense form

being irregular is not predictable from the present tense form, while in the second case it is. Differences in verb stems in Greek and English verbs can be seen in (100):

(100)   a.   **dust**   **dusted**

              b.   **eat**   **ate**

              c.   **grafo**   **egrapsa**
                     (I write)   (I wrote)

              d.   **trogo**   **efaga**
                     (I eat)   (I ate)

If one compares the above verbs, one realizes that while, in a. and c., the verb root is transparent in the past tense, this is not the case in verbs of types b. and d. In other words, there is no way to predict that 'ate' or 'efaga' is related to 'eat' or 'trogo'.

If we assume that the difference between verb categories with respect to the root transparency in the verb forms of the same paradigm is reflected in the lexical organization and storage of verbs in the brain, we might propose a differential storage of verbs of the type a. and c. on the one hand, and verbs of the type b. and d. on the other. Thus, verbs in which the root is transparent throughout the verbal paradigm would be organized as shown in (101).

(101)

| chase |
| chases |
| chasing |
| chased |
| ... |

Verbs in (101) would all be stored together in one common storage unit. The form 'chase' is in bold character to indicate that it is the semantic primitive in the storage unit. It also happens that in most of the cases, this is the form with the highest frequency as well as the one used most frequently in substitutions.

Verbs of type b. and d., in which the verb root changes from the present to the past tense, would be stored in the following way:

(102)

```
┌─────────────┐   ┌─────────────┐   ┌─────────────┐
│ throw       │   │ threw       │   │ thrown      │
│ throwing    │───│             │───│             │
│ throws      │   │             │   │             │
│ .....       │   │ .....       │   │ .....       │
└─────────────┘   └─────────────┘   └─────────────┘
```
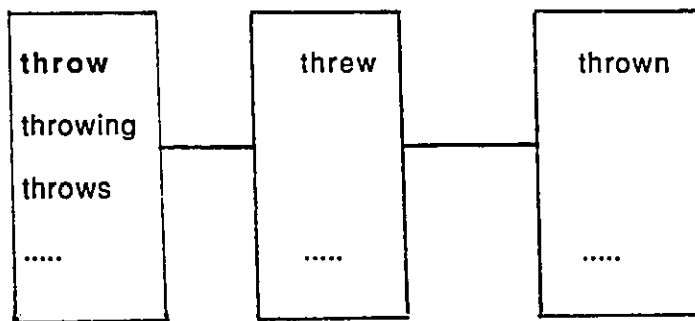
Instead of grouping all forms of the verb 'throw' together in one unit, just as was done with the verb 'chase', the past, and past participle forms of the verb 'throw' are in separate units, but linked with each hother. The verb form 'throw' is again in bold character for the same reasons as those given for the verb presented in (101).

If we presume a picture such as the one presented in (101) and (102) above, we may capture the variability in the internal word structure and the root changes found between regular and irregular verbs in terms of mental representation. At the same time, we are able to propose an interpretation for the differential performance of

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the patients tested in both languages on these verbs. One of the first to investigate the mental representation of morphologically complex lexical items was Mackay (1976) who examined the retrieval of regular and irregular past tense verbs in the light of two views on the organization of the mental lexicon: the Derivational Hypothesis, according to which stems and affixes are separately stored in the brain, and the Independence Hypothesis according to which all words are stored as separate and independent phonological units in the brain. According to the latter hypothesis, forms are generated as fully integrated phonological units in natural speech production. After a series of experiments testing the reaction times and errors in the production of regular and irregular past tense forms, Mackay concluded that the Derivational hypothesis supported the data better than the Independence hypothesis. He states that preterites such as the form 'taught' are not stored as separate and independent lexical units but are formed from the verb stem 'teach' by means of derivational rules.

Re-examining the predictions put forth by the two different hypotheses investigated by Mackay (1976), Lukatela, Gligorijevic and Kostic (1980) proposed yet a third hypothesis concerning the mental representation of complex lexical items: the Satelite-Entries Hypothesis . Pursuing an investigation of the representation of case inflected nouns in Serbo-Croatian through a lexical decision task, the authors found evidence that all cases are individually represented, with the nominative singular functioning as the nucleus. Around this nucleus the other cases cluster uniformly. Thus, they strongly favor a type of satellite organization over the previously proposed Derivational and Independence hypotheses, at least for complex nouns inflected for case.

Stanners, Neiser, Hernon, and Hall (1979) investigated the memory status of inflectional forms of verbs, irregular past tense words, and adjective and nominal derivatives of verbs. Through a series of four priming experiments the authors found that inflections do not have memory representations separate from their base verbs. However, irregular past tense words and both adjective and nominal derivatives of verbs do. What is most important for our proposal is the claim by Stanners et al. (1979) that morphologically related words are near neighbors in the lexicon. Furthermore, although irregular past tense words seem to have separate memory entries for base verbs and their variations, these entries do not appear to be independent. Continuing the investigation of the influence of morphemic relationships on the repetition priming effect, a series of experiments on regularly and irregularly suffixed morphemically related and unrelated verb forms, among others, was conducted in the study by Napps (1989). The results of her study show that morphemic relatives prime each other in most cases regardless of whether they maintain each other's sound and spelling, while suppletive verb forms lead to small amounts of priming in their bases. The author concluded that morphemic relatives are associated in the lexicon while irregular past tense forms are less closely related than other forms .

In all of the above mentioned studies, a mainly psycholinguistic viewpoint of the issue of the mental representation of complex lexical items has been adopted, in order to investigate the importance of morphological relatedness between forms for storage and lexical retrieval. Addressing the issue of the relation of derived lexical items

listed in the lexicon from a linguistic and psycholinguistic point of view were Segui and Zubizarreta (1985). More specifically, the authors suggest that "each morphologically derived form constitutes a lexical entry of its own, but crucially, it is not an isolated lexical entry. It is linked to all those lexical items to which it is morphologically related. What defines a morphological family is the common root that all the members of the family share. This common root, whether bound or free, also constitutes a lexical entry, which perhaps functions as the 'head' of the morphological family as originally proposed by Cutler (1983)". An illustration of the Segui and Zubizarreta (1985) proposal is given in (103):

(103)
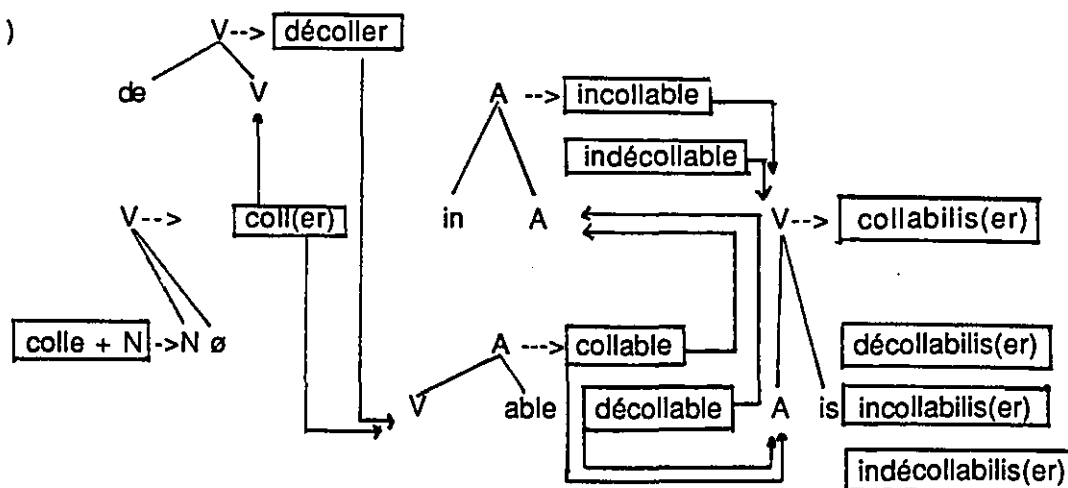
(Segui and Zubizarreta, 1985:765)

Turning to our own proposal on the organization of inflectionally complex verbal items, the notion of morphological family headed by a common root proposed by Cutler (1983), is most pertinent. Such appears to be the organization of the units of storage shown in (99) and (100). An added feature, similar to the one proposed by Stanners et al. (1979), is the existence of a link between the separate units of storage of irregular verb forms, as shown in (100). Having postulated a differential storage of regular, morphologically related verb forms and irregular, morphologically non-related verb forms, the following interpretation of the high error rate in the production of irregular past tense forms is proposed. It is possible that in the cases of problematic or erroneous productions of the past tense of irregular verbs, the two forms (present and past), not being stored in the same unit, have possibly had the link between them disrupted. Therefore, even if the subject is presented with the present tense form of the verb, he has no way of guessing or cuing himself in order to produce it, as it was shown in (96). On the contrary if the root/head of the family (the bold form) is transparent in the past tense verb form (in which case all verb forms are stored in the same unit) the patient has many more chances at predicting the past tense from the present just by running through the list. In fact, that is exactly what both subjects did, (see (97)). Such was not the case when irregular past tense of verbs were elicited. Even if the examiner provided them with the present tense in order to cue them, the production of the past tense verb-form was not facilitated.

Extending the proposal for English to interpret the data obtained from the Greek-speaking agrammatics, but also acknowledging the differences between the organization of the English and Greek verbal systems, the following types of storage units are suggested: A verb of category A is hypothesized to be stored in the following way:

(104)

grafo (I write)	**grapso** (to write)
grafeis (you write)	**egrapsa** (I wrote)
...	...

However the forms of an irregular verb would be stored in different storage units, (105).

(105)

trogo (I eat)		**fago** (to eat)	
trogeis (you eat)		efaga (I ate)	
		tha fago (I will eat)	
...		...	

In the case of (104) even though there is a change in the final stem consonant, the present tense verb root is transparent in the past tense verb-form. The alternation seen between the root final consonants is fully predictable by the phonological features of the root-final consonant of the present tense. This is not the case with (105) above. Neither the form of the past tense nor the form of the future is predictable from the present tense form. Therefore, it is not possible to cue or trigger the production of the

past tense form by scanning through the present tense verb-forms. Thus the particular difficulty that the Greek subjects experience with the past and future forms of irregular verbs can be explained. Only if the past/future stem of the verb is accessible as in (104), can the subjects have a chance at producing them.

The claims about the differential storage of category A and irregular verbs do correlate with the difference in error rate found in the performance of the Greek-speaking subjects. However, difficulties in interpretation arise when the higher error rate found in verbs of categories B and C in Greek must be accounted for.

In verbs of these categories, the past/future tense stem is either identical or exhibits some consonant change similar to the one found in verbs of category A (106).

(106) Category B

metro (I count)	**metriso** (to count)
metras (you count)	metrisa (I counted)
.....	tha **metriso** (I will count)
	...

Category C

htenizomai (I comb my hair)	**htenisto** (to comb my hair)
htenizesai (you comb...)	**htenistika** (I combed...)
...	tha **htenisto** (I will comb ...)
	...

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As can be seen above, the present tense root is transparent in the past and future tense forms of verbs of both categories. The question arises: is why do the Greek-speaking subjects have particular difficulties with these verb-forms, if their representation in the lexicon is similar to those of category A?   In order to address this issue, we shall first compare the internal word structure of the past tense forms of the three verb categories:

(107)   Caterory A   fitepsa (I planted)
                                        V

                              V-I   Af

                            fiteps-   -a

         Category B   metrisa (I counted)
                                        V

                        V-I

                     metris-

                 V-I   Af.   Af.

               metr-   -is-   -a

Category C   htenistika
                             V

                 V-I

              htenistik-

       V-I   Af.   Af.

    htenist-   -ik-   -a
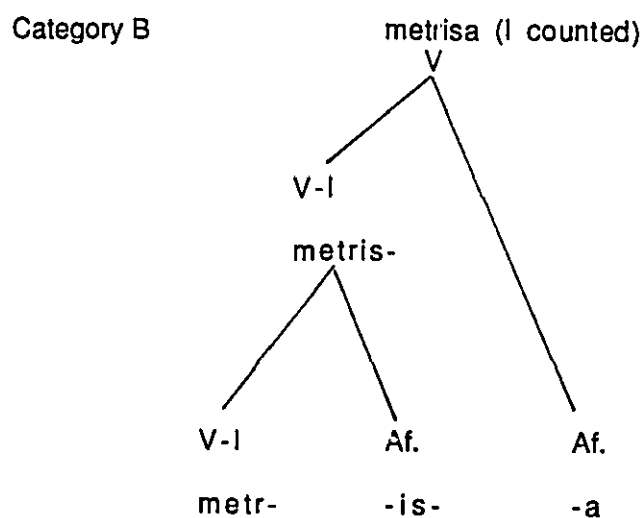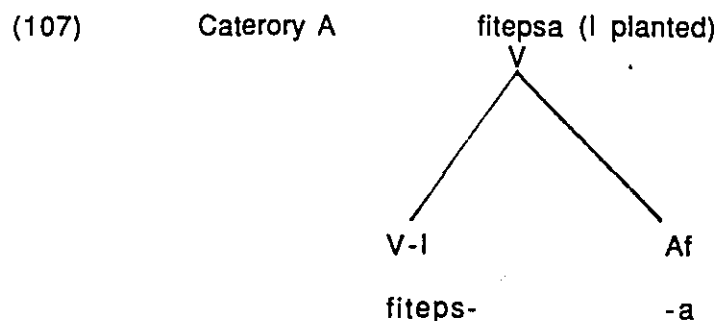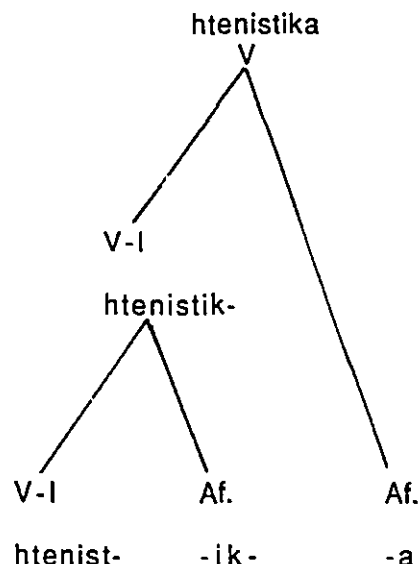
If we look at the structure of the above verbs we note the difference between a category A verb and category B and C verbs. While in verbs of category A the single affixation of the '-a' past tense marker creates the past tense form of the verb, in verbs of the other two categories the addition of two affixes is required. One may hypothesize that the creation of a more complex structure whereby two affixes are added to the verb-stem as opposed to the simpler 'stem-affix' structure, is what causes the difficulties cited in the results. The existence of a higher error rate in the past tense of verbs of categories B and C does not contradict the Storage Hypothesis presented here, (note that the error rate for these categories is yet lower than the one for irregular past tense verb forms). On the contrary, it suggests that lexical entries with the same storage unit may be hierarchically ordered. Such a hierarchical

organization would reflect word-internal complexity of lexical items. It is also possible that the presence of two affixes, attached to the verb root, increases the processing load and hinders accessing. Both the proposal of a hierarchical representation of complex lexical items, as well as that of increased processing load in the interpretation of multiply suffixed words are speculations and thus require further investigation.

Finally, a third factor that may have added to the difficulty encountered with verbs of category C is that, although verbs of categories A, B and D were active verbs, those of category C were reflexive (reflexive verbs in Greek take the affix of passive verbs, but, of course, have an active meaning). What is interesting about these verbs is that they were the only ones that caused the appearence of a small percentage of error in the present tense verb forms. These verbs are also the only ones that have a more complicated word structure in the present tense when compared with the other types of verbs tested:

(108)   Category A   fitevo (I plant)

                                    V

                            V-I   Af

                           fitev-   -o

Category B   metro (I count)

                                    V
                                   /\
                                  / \
                                 /   \
                              V-I   Af.

                              metr-   ·o

Category C   htenizomai (I comb my hair)

                                    V
                                   /\
                                  / \
                                 /   \
                              V-I   \
                                        \
                           htenizom-   \
                              /\   \
                             / \   \
                          V-I   Af.   Af.

                        hteniz- -om-   -ai

Category D   trogo (I eat)

                                    V
                                   / \
                                  /   \
                                 /   \
                               V-I   Af

                              trog-   -o
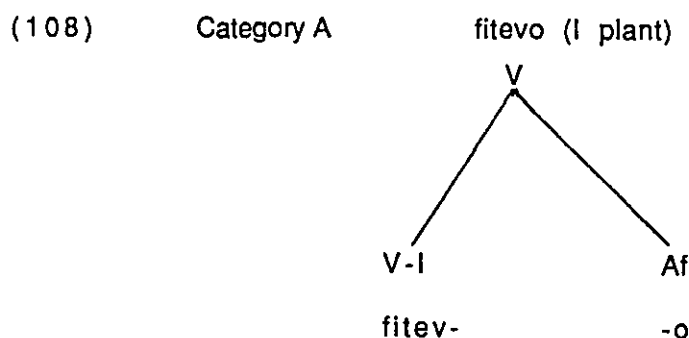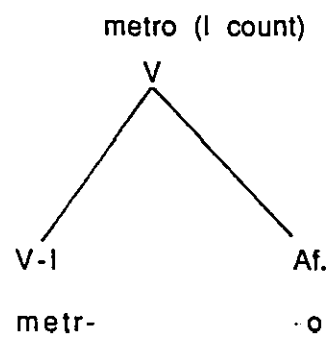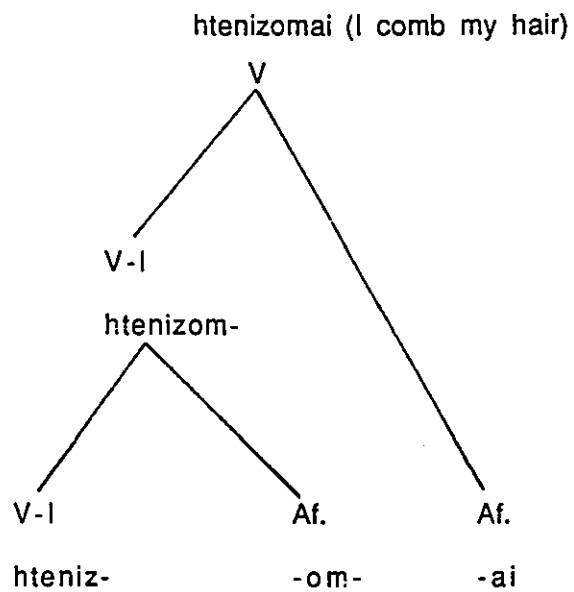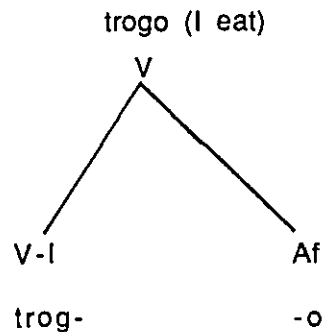
As it can be seen above, only verbs of category C have two affixes. If, as it has been already proposed, the presence of two affixes attached to the verb root increases the processing load which may in turn hinder processing on the whole, we can possibly explain the small percentage of errors found when the present tense verb forms were elicited. It must be noted that it was only verbs of this type that posed problems in the present tense.

Another issue to be considered is the high error rate found especially in the performance of the Greek-speaking subjects when the future verb form was elicited. Although the internal word structure of the verbs may have been responsible for the errors, as was discussed earlier, it is also believed that the presence of the particle/auxiliary 'tha' (will) may have contributed to the processing difficulty. This is not a new nor a recent observation since auxiliaries have been found to have an effect in language dissolution in aphasia from the beginning of neurolingusitic research (see

Goodglass, et al, 1972; De Villiers, 1974; Gleason, 1978). It is interesting to note that, in our study, in the production of the few future tense verb-forms a high number of them did not include the production of 'tha'. Such cases were counted as auxiliary omissions; nevertheless, the verb form, when it was properly inflected, was counted as correct. Comparing the production of 'tha+V' to the English 'will + V', we note that even the English-speaking subjects hardly produced the auxiliary construction. Instead, they preferably used the construction 'is gonna...' which equally transmits the future notion. However, unlike the Greek-speaking subjects, the English-speaking subjects had no difficulty at repeating the auxiliary 'will' when elicited. This suggests an added difficulty encountered by the Greek-speaking subjects possibly linked to the verb internal complexity discussed above.

Turning to English, apart from the difference in the production of regular and irregular past tense verb forms, a difference in error-rate was also noted with respect to the syllabic/non-syllabic past tense allomorph distinction. Thus, as was shown in the repetition and in the two production tasks (87), the error rate was significantly (p<0.001) lower when the verbs were affixed with the syllabic allomorph '-id'. This performance is consistent with the one found for the plural marker allomorphs as shown in chapter 3 in that, in both cases, the syllabic variant of the plural or past tense morpheme is the one most retained in the speech of the subjects investigated. Thus, a similar explanation to the one presented in Chapter 3 for the syllabic plural allomorph is proposed for the retention of the syllabic past tense marker (see Chapter 3 for more details). The results obtained here also

confirm those of previous researchers such as Goodglass et al. (1972) and De Villiers (1974) who state that for reasons of sonorance, salience and syllabicity the syllabic past tense allomorph should be less affected in agrammatism.

With respect to the issue of variability in performance depending on the task used, a comparison of the English-speaking subjects cumulative results can be seen in Figure (16).

(109)
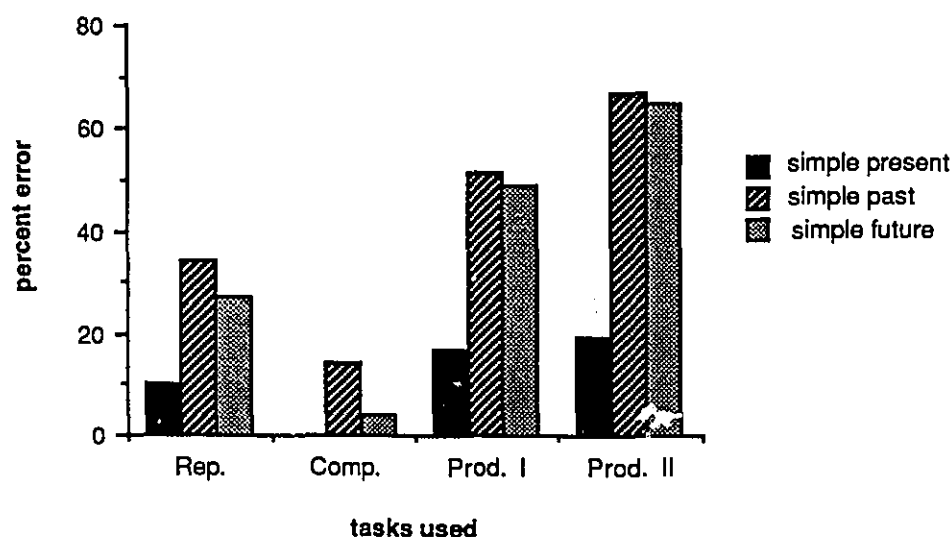
Figure 16

Tasks used vs. tenses tested: A Comparison in English

As can be seen in the above figure, although the general error trends on the tenses tested across the four tasks are similar, there is difference in performance between

repetition and comprehension on the one hand and the two production tasks on the other. This difference is more evident in the production of past tense verb forms, especially in production task II. Such a result may be explained if one considers that in production task II the subject may also be facing word finding difficulty (not present in the other tasks). It appears, therefore, that processing can be hindered by word finding difficulties as well as by all the other factors such as morphological complexity that already are at play in the other tasks. A similar error pattern to the one described for the performance of English-speaking subjects is obtained by a comparison of the performances of the Greek-speaking subjects shown in Figure I7:

(110)
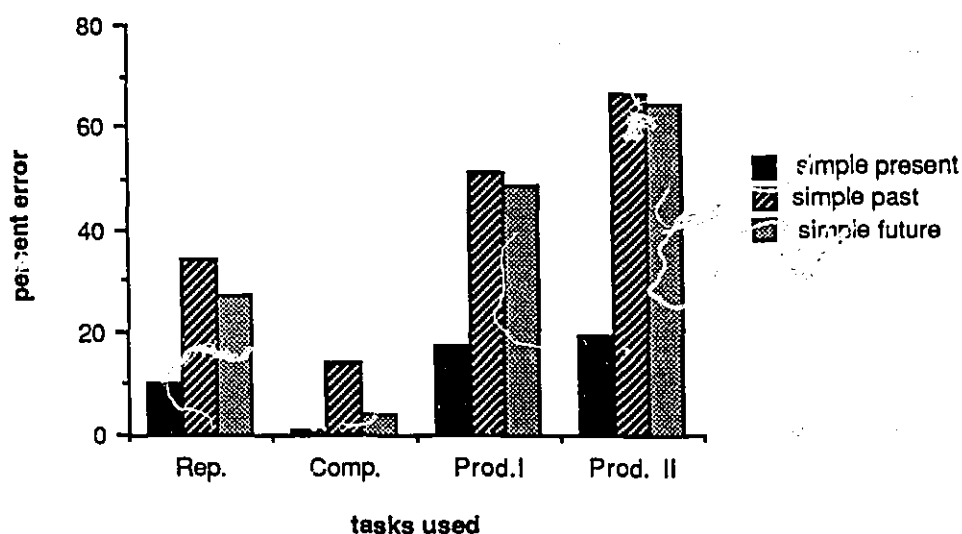
Figure I7

Tasks used vs. tenses tested: A Comparison in Greek

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In the above figure, even though the error rate in the repetition task is higher than that seen for the English-speaking subjects, the increased difficulty, especially in the past and future tenses in the two production tasks, is quite obvious. The subjects are most successful in the comprehension task. Nevertheless, even in this task, we can observe the same general error patterns found in the other tasks. On the whole, therefore, we can state that task specific effects were observed for both English- and Greek-speaking subjects especially between comprehension and production. This finding is consistent with reports mentioned earlier in this thesis, according to which agrammatic aphasic patients are found to exhibit mainly a production deficit with, or without a milder comprehension deficit.

To summarize interpretation of the results of Experiment II on the performance of English-and Greek-speaking agrammatic aphasics, two major issues have been presented. The first one stresses the importance of word-internal structure in accessing complex lexical items from the morphological component. The second one proposes a Storage Hypothesis of inflected verbal lexical items which reflects their internal morphological structure. With respe͏ ͏ to the latter issue, a question arising here concerns the predictions which the Storage Hypothesis about verbal storage makes about data presented in Chapter 4. Namely, would the storage of inflected nominal lexical items be represented in the same way as that of verbal lexical items? A quick overview of the English nominal system reveals a picture quite similar to the the one presented for verbs. Although the distinction regular vs. irregular was not tested in nouns, it is proposed that nouns regularly inflected for plural would be stored in a single storage unit, as are regular verb forms (111).

(111)

kæt	dɔg	haus
kæts	dɔgs	hausəs
.....	.....	.....
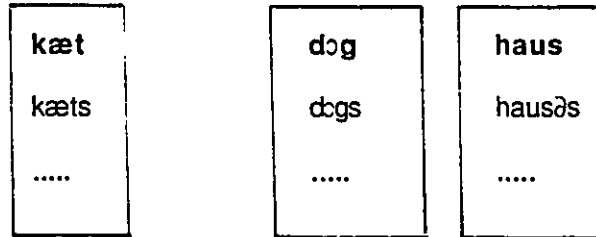
However, irregularly inflected nouns would have a similar representation as irregular verbs, (109).

(112)

man	men
man's	men's
...	...
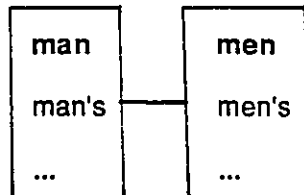
In an attempt to extend the Storage Hypothesis of noun forms to the Greek nominal system, a number of regularly and irregularly inflected forms was studied. However, despite the existence of idiosyncratic affixation processes that may take place, the noun root remains transparent throughout each noun paradigm. This leads us to propose an organization of the storage, at least for the nouns investigated, as shown in (113).

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(113)

Singular Nominative	**pilotos** (pilot)	**kota** (chicken)	**aftokinito** (car)
Singular Accusative	piloto (pilot)	kota (chicken)	aftokinito (car)
Plural Nominative	pilotoi (pilots)	kotes (chickens)	aftokinita cars
Plural Accusative	pilotous (pilots)	kotes (chickens)	aftokinita (cars)

As can be seen above, in the absence of root irregularities, inflected nouns belonging to the same paradigm would be stored in a common storage unit headed by the head of the morphological family to which they belong.

Chapter 6

Conclusion

In this thesis, a comparative linguistic investigation of the ability of two English- and two Greek-speaking agrammatic aphasic patients to repeat, comprehend and produce nominal and verbal inflections has been presented. Three major goals were pursued:

1) To determine the effect of language-specific feature· as manifested in the assignment of number, gender, case and tense in the performance of the agrammatic aphasics tested.

2) To research the importance of and resistance to language breakdown of morphological principles gove.ning the well-formedness of complex lexical items in the two languages studied.

3) To investigate the implications of aphasic data for linguistic theory.

In our investigation we adopted the theoretical framework of the Strong Lexicalist Hypothesis. We proceeded through an outline of the organization of the morphological components in Modern Greek and English, and a thorough description of the morphological features specific to each language, and pertinent to our study. The most

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important observation stemming from the description of the morphological structure of complex lexical items in Modern Greek and English, concerns the status of roots and the subcategorization features they carry in the two languages. More specifically, we have proposed that, in Modern Greek, the roots of major lexical categories are not specified for lexical properties and always subcategorize for an affix. It was further proposed that only an affix having no categorial specifications, i.e., an inflectional affix, would allow the root to project to the word level. This proposal not only captured the distinct status of roots and inflectional affixes in the Modern Greek lexicon, but also allowed us to make certain predictions as to the type of errors expected to be found in the speech of the agrammatic aphasics tested. We thus hypothesized that the Modern Greek subjects would be producing substitutions rather than omissions of affixes since the latter would constitute violations of the subcategorization requirement of roots. On the contrary the production of omissions was hypothesized for the performance of the English-speaking subjects, since in English, roots do not have this subcategorization requirement. The data obtained clearly support our hypotheses and together with the findings of other cross-linguistic studies lead us to the following proposal. Languages may be grouped in at least two categories depending on the subcategorization requirements and the specifications of roots. One category would consist of languages like Modern Greek where roots are not specified for lexical category and require the attachment of an affix in order to project to the level of the word. The other category would consist of languages like English where roots are specified for lexical properties.

Further investigation of aphasic performances of speakers of both types of languages, as well as of a third type, like Polish, in which a combination of both previously mentioned language categories is found in major class words, would be most illuminating for the proposals put forth here.

Our study was conducted through two sets of experiments. The first one, presented in Chapter 4, concentrated on nominal inflections -- number, gender and case -- as they were manifested on nouns (English), articles+nouns, and adjectives (Greek). Secondarily, the feature 'number' was also tested on verbs. The results of this experiment were consistent with the hypotheses and proposals presented above. Language-specific features were found to be most crucial in determining aphasic performance. Furthermore, principles of well-formedness of complex lexical items appeared to remain unaffected despite the existence of other linguistic deficits. Finally, it was shown that morphological deficits can manifest themselves at different levels: the lexical and the postlexical. To explain, difficulties were observed both at the level of lexical accessing of a word, as well as at a later stage, where rules of postlexical phonology apply.

In the second experiment, presented in Chapter 5, we examined verbal inflections. The findings of this experiment also denote the effects of parametric variation which were not only qualitative, but also quantitative. Our investigation concentrated on the feature 'tense', in particular the 'present', the 'simple past' and the 'simple future'. The results on the subjects' performance on regular and irregular verbs inflected for the past tense led us to propose a Storage Hypothesis of lexical

items in the brain. The hypothesis reflected the internal word structure of complex lexical items. Thus, words whose roots were transparent throughout the paradigm were hypothesized to be stored within a common storage unit. On the other hand, words which do not share the same root (as was the case with the irregular verbs) would be stored in separate but linked units. Each storage unit includes members of the same morphological family and has the common root as the head. This proposal of differentially organized storage of complex lexical items reflects the linguistic differences in internal morphological structure and at the same time allows us to interpret the results obtained. The Storage Hypothesis suggested for verbs was also extended to represent the mental organization of inflected nouns.

An added factor that was found to be hindering aphasic repetition and production was that of internal complexity of inflected lexical items. Specifically with respect to the structure of inflected verb forms, in Modern Greek, when more than one affix was attached for the formation of the past tense or the future, a higher error rate in performance was observed.

An issue still remaining to be addressed concerns the implications of the data obtained for linguistic theory and in particular for the theoretical framework adopted here. The study assumes a Strong Lexicalist framework, specifically the one proposed by Walsh (1986). Having interpreted the results of both experiments,we believed, along with Miceli and Caramazza (1988) that, indeed, the only way to achieve a unified linguistic explanation of morphological deficits is, in fact, through such a framework.

For example, considering that errors were found in both idiosyncratically and non-idiosyncratically inflected words, if morphological operations were hypothesized to take place in different components (the morphological and the syntactic component) then, errors in idiosyncratically inflected words would be explained as results of problems occurring within the lexicon while errors in non-idiosyncratically inflected words would be explained as results of errors occurring in the syntactic component. However, having to account for morphological errors by reference to different components would not allow us to achieve a uniform explanation of errors involving the internal structure of words. It is thus believed that it would be maximally economical to hypothesize all simple and complex, inflected and derived words be represented in one and the same component, that is the morphological component.

Finally, we shall consider the implications of the Storage Hypothesis proposed in this thesis for linguistic theory. Among the different proposals on the organization of the morphological component, Aronoff (1976) proposes the existence of the Lexicon conceived as a form of dictionary of a language in which the output of the rules of word formation is entered. Each word in the dictionary is an independent item, fully specified -- a complete sign in itself. Elaborating Aronoff's hypothesis about the lexicon and attempting to capture the distinction between idiosyncratic and non-idiosyncratic lexical items, Allen (1978) proposes the existence of two types of Lexicons: the Conditional Lexicon comprising the set of potential well-formed outputs of word formation rules and compound formation rules and the Permanent Lexicon

comprising a list of exceptional words. Turning finally to Walsh (1986) the Lexicon is hypothesized to comprise only a set of idiosyncratic words and a list of affixes. However, no specific proposal is extended on non-idiosyncratically derived words which according to Walsh are "to be somehow stored in the mind of the speaker". In view of the Storage Hypothesis proposed in this thesis, the existence of a Lexicon as suggested by Walsh is presumed. Furthermore, the existence of a second lexical storage including all productively non-idiosyncratic derived words organized in storage units, as presented earlier, is proposed. The two Lexicons are hypothesized to be linked to one another in a fashion that would allow scanning between them. This model of mental representation of lexical items remains to be further specified in future research.

In conclusion, it is believed that this study has shown the importance of conducting in depth comparative linguistic investigations within a specific theoretical linguistic framework. It has also raised two major issues, one concerning the subcategorization requirements of roots in the two language studies and another concerning the mental representation and storage of complex inflected lexical items. With respect to these issues, there are two proposals suggested for future research. First, it is proposed that comparative linguistic studies, as well as cross-linguistic studies of languages which differ in terms of the subcategorization requirements of roots will provide us with further information about the importance of such requirements through their manifestation in aphasic speech. Second, In order to further confirm the Storage

Hypothesis proposed here, it is suggested that a study of regular and irregular derivationally complex words be conducted. Accounting for variables such as root transparency and regularity or irregularity of derivation, the Storage Hypothesis proposed for inflected complex lexical items can be further tested.

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Appendix I: Sentences testing nominal inflections in English

1. The pilot is standing.
   The pilots are standing.
   I see the pilot.
   I see the pilots.

2. The car is new.
   The cars are new.
   The man admires the car.
   The man admires the cars.

3. The table is round.
   The tables are round.
   I see the table.
   I see the tables.

4. The elephant is drinking water.
   The elephants are drinking water.
   The boy admires the elephant.
   The boy admires the elephants.

5. The key is black.
   The keys are black.
   The girl is holding the key.
   The girl is holding the keys.

6. The goat is standing.
   The goats are standing.
   The boy feeds the goat.
   The boy feeds the goats.

7. The fence is old.
   The fences are old.
   I see the fence.
   I see the fences.

8. The chicken is eating grain.
   The chickens are eating grain.
   The woman is feeding the chicken.
   The woman is feeding the chickens.

9. The orange is big.
   The oranges are big.
   The girl is buying an orange.
   The girls are buying oranges.

10. The cat is sitting.
    The cats are sitting.
    The girl pets the cat.
    The girl pets the cats.

11. The wolf is crying.
    The wolves are crying.
    The hunter shoots at the wolf.
    The hunter shoots at the wolves.

12. The farmer is ploughing the field.
    The farmers are ploughing the field.
    The woman is calling the farmer.
    The woman is calling the farmers.

13. The lamp is beautiful.
    The lamps are beautiful.
    I see the lamp.
    I see the lamps.

14. The teacher is talking to the students.
    The teacher is talking to the students.
    The student is listening to the teacher.
    The students are listening to the teachers.

15. The rose is beautiful.
    The roses are beautiful.
    I see the rose.
    I see the roses.

16. The match is wet.
    The matches are wet.
    The boy is holding the match.
    The boy is holding the matches.

17. The horse is eating hay.
    The horses are eating hay.
    The farmer is selling the horse.
    The farmer is selling the horses.

18. The girl is playing.
    The girls are playing.
    I see the girl.
    I see the girls.

19. The bush is burning.
    The bushes are burning.
    The man is cutting the bush.
    The men are cutting the bushes.

20. The athlete runs.
    The athletes run.
    I admire the athlete.
    I admire the athletes.

21. The house is big.
    The houses are big.
    I see the house.
    I see the houses.

22. The truck is big.
    The trucks are big.
    The man admires the truck.
    The man admires the trucks.

23. The duck is swimming.
    The dicks are swimming.
    The boy chases the duck.
    The boy chases the ducks.

24. The blouse is pretty.
    The blouses are pretty.
    The woman is buying the blouse.
    The woman is buying the blouses.

25. The tree is tall.
    The trees are tall
    I see the tree.
    I see the trees.

26. The nurse speaks to the patient.
    The nurses speak to the patient.
    The doctor speaks to the nurse.
    The doctor speaks to the nurses.

27. The rat eats cheese.
    The rats eat cheese.
    I see the rat.
    I see the rats.

28. The worker is working.
    The workers are working.
    The journalist is speaking to the worker.
    The journalist is speaking to the workers.

29. The box is beautiful.
    The boxes are beautiful.
    The man is carrying the box.
    The man is carrying the boxes.

30. The suitcase is large.
    The suitcases are large.
    The man is carrying the suitcase.
    The man is carrying the suitcases.

31. The hat is black.
    The hats are black.
    I see the hat.
    I see the hats.

32. The dog is sleeping.
    The dogs are sleeping.
    I see the dog.
    I see the dogs.

33. The bus is leaving.
    The buses are leaving.
    I see the bus.
    I see the buses.

34. The student listens to the lesson.
    The students listen to the lesson.
    The teacher talks to the student.
    The teachers talk to the students.

35. The coat is beautiful.
    The coats are beautiful.
    The woman is trying on the coat.
    The woman is trying on the coats.

36. The shoe is big.
    The shoes are big.
    The boy is cleaning the shoe.
    The boy is cleaning the shoes.

Appendix II: Sentences testing nominal inflections in Greek

1. Ο πιλότος στέκεται.
   Οι πιλότοι στέκονται.
   Βλέπω τον πιλότο.
   Βλέπω τους πιλότους.

2. Η πάπια κολυμπά.
   Οι πάπιες κολυμπούν.
   Το παιδί κυνηγά την πάπια.
   Το παιδί κυνηγά τις πάπιες.

3. Το φορτηγό είναι μεγάλο.
   Τα φορτηγά είναι μεγάλα.
   Ο άντρας φωτίζει το φορτηγό.
   Ο άντρας φωτίζει τα φορτηγά.

4. Η βαλίτσα είναι μεγάλη.
   Οι βαλίτσες είναι μεγάλες.
   Ο άντρας κουβαλάει τη βαλίτσα.
   Ο άντρας κουβαλάει τις βαλίτσες.

5. Η μπλούζα είναι ωραία.
   Οι μπλούζες είναι ωραίες.
   Η γυναίκα αγοράζει τη μπλούζα.
   Η γυναίκα αγοράζει τις μπλούζες.

6. Ο εργάτης δουλεύει.
   Οι εργάτες δουλεύουν.
   Ο κύριος ψάχνει τον εργάτη.
   Ο κύριος ψάχνει τους εργάτες.

7. Ο ελέφαντας πίνει νερό.
   Οι ελέφαντες πίνουν νερό.
   Το παιδί θαυμάζει τον ελέφαντα.
   Το παιδί θαυμάζει τους ελέφαντες.

8. Η κότα τρώει καλαμπόκι.
   Οι κότες τρώνε καλαμπόκι.
   Η κοπέλα ταΐζει την κότα.
   Η κοπέλα ταΐζει τις κότες.

9. Η γάτα κάθεται.
   Οι γάτες κάθονται.
   Η κοπέλα χαιδεύει την γάτα.
   Η κοπέλα χαιδεύει τις γάτες.

10. Το παλτό είναι ωραίο.
    Τα παλτά είναι ωραία.
    Η γυναίκα δοκιμάζει το παλτό.
    Η γυναίκα δοκιμάζει τα παλτά.

11. Ο λύκος ουρλιάζει.
    Οι λύκοι ουρλιάζουν.
    Ο κυνηγός σημαδεύει το λύκο.
    Ο κυνηγός σημαδεύει τους λύκους.

12. Η λάμπα είναι ωραία.
    Οι λάμπες είναι ωραίες.
    Βλέπω τη λάμπα.
    Βλέπω τις λάμπες.

13. Το σπίρτο είναι βρεγμένο.
    Τα σπίρτα είναι βρεγμένα.
    Ο άντρας κρατά το σπίρτο.
    Ο άντρας κρατά τα σπίρτα.

14. Το κουτί είναι ωραίο.
    Τα κουτιά είναι ωραία.
    Ο άντρας κουβαλά το κουτί.
    Ο άντρας κουβαλά τα κουτιά.

15. Το αυτοκίνητο είναι καινούργιο.
    Τα αυτοκίνητα είναι καινούργια.
    Το παιδί βλέπει το αυτοκίνητο.
    Το παιδί βλέπει τα αυτοκίνητα.

16. Η κατσίκα στέκεται.
    Οι κατσίκες στέκονται.
    Το παιδί ταΐζει την κατσίκα.
    Το παιδί ταΐζει τις κατσίκες.

17. Το κλειδί είναι μεγάλο.
    Τα κλειδιά είναι μεγάλα.
    Η κοπέλα κρατά το κλειδί.
    Η κοπέλα κρατά τα κλειδιά.

18. Ο μαθητής ακούει το μάθημα.
    Οι μαθητές ακούνε το μάθημα.
    Η δασκάλα μιλά στο μαθητή.
    Η δασκάλα μιλά στους μαθητές.

19. Η νοσοκόμα μιλά στην ασθενή.
    Οι νοσοκόμες μιλούν στην ασθενή.
    Ο γιατρός μιλά στην νοσοκόμα.
    Ο γιατρός μιλά στις νοσοκόμες.

20. Το μήλο είναι μεγάλο.
    Τα μήλα είναι μεγάλα.
    Το κορίτσι αγοράζει ένα μήλο.
    Το κορίτσι αγοράζει μήλα.

21. Ο θάμνος καίγεται.
    Οι θάμνοι καίγονται.
    Ο άντρας κλαδεύει τον θάμνο.
    Ο άντρας κλαδεύει τους θάμνους.

22. Ο αθλητής τρέχει.
    Οι αθλητές τρέχουν.
    Βλέπω τον αθλητή.
    Βλέπω τους αθλητές.

23. Το άλογο τρώει.
    Τα άλογα τρώνε.
    Ο χωριάτης πουλά το άλογο.
    Ο χωριάτης πουλά τα άλογα.

24. Ο χωρικός οργώνει το χωράφι.
    Οι χωρικοί οργώνουν το χωράφι.
    Η γυναίκα φωνάζει τον χωρικό.
    Η γυναίκα φωνάζει τους χωρικούς.

25. Η κοπέλα παίζει.
    Οι κοπέλες παίζουν.
    Βλέπω την κοπέλα.
    Βλέπω τις κοπέλες.

26. Το καπέλο είναι μαύρο.
    Τα καπέλα είναι μαύρα.
    Βλέπω το καπέλο.
    Βλέπω τα καπέλα.

27. Ο σκύλος κοιμάται.
    Οι σκύλοι κοιμούνται.
    Βλέπω τον σκύλο.
    Βλέπω τους σκύλους.

28. Το σπίτι είναι μεγάλο.
    Τα σπίτια είναι μεγάλα.
    Βλέπω το σπίτι.
    Βλέπω τα σπίτια.

29. Το παπούτσι είναι μεγάλο.
    Τα παπούτσια είναι μεγάλα.
    Το παιδί γυαλίζει το παπούτσι.
    Το παιδί γυαλίζει τα παπούτσι.

30. Το τριαντάφυλλο είναι ωραίο.
    Τα τριαντάφυλλα είναι ωραία.
    Βλέπω το τριαντάφυλλο.
    Βλέπω τα τριαντάφυλλα.

31. Ο ποντίκος τρώει τυρί.
    Οι ποντικοί τρώνε τυρί.
    Η γάτα κυνηγά τον ποντικό.
    Η γάτα κυνηγά τους ποντικούς.

32. Η λεύκα είναι ψηλή.
    Οι λεύκες είναι ψηλά.
    Βλέπω τη λεύκα.
    Βλέπω τις λεύκες.

33. Η δασκάλα μιλά στην τάξη.
    Οι δασκάλες μιλούν στην τάξη.
    Η τάξη ακούει τη δασκάλα.
    Η τάξη ακούει τις δασκάλες.

34. Ο φράχτης είναι παλιός.
    Οι φράχτες είναι παλιοί.
    Βλέπω τον φράχτη.
    Βλέπω τον φράχτη.
    Βλέπω τους φράχτες.

35. Το τραπέζι είναι στρογγυλό.
    Τα τραπέζια είναι στρογγυλά.
    Βλέπω το τραπέζι.
    Βλέπω τα τραπέζια.

36. Το λεωφορείο φεύγει.
    Τα λεωφορεία φεύγουν.
    Βλέπω το λεωφορείο.
    Βλέπω τα λεωφορεία.

Appendix III: Sentences testing verbal Inflections test in English

1. The boy is eating the cake.
   The boy ate the cake.
   The boy will eat the cake.

2. The girl is cleaning the room.
   The girl cleaned the room.
   The girl will clean the room.

3. The boy is drinking the juice.
   The boy drank the juice.
   The boy will drink the juice.

4. The woman prepares the salad.
   The woman prepared the salad.
   The woman will prepare the salad.

5. The woman is hanging the clothes.
   The woman hanged the clothes.
   The woman will hang the clothes.

6. The student enters the classroom.
   The student entered the classroom.
   The student will enter the classroom.

7. The man is planting the flowers.
   The man planted the flowers.
   The man will plant the flowers.

8. The car turns the corner.
   The car turned the corner.
   The car will turn the corner.

9. The man is counting the money.
   The man counted the money.
   The man will count the money.

10. The woman is selling the apples.
    The woman sold the apples
    The woman will sell the apples.

11. The man is coming.
    The man came.
    The man will come.

12. The train is leaving.
    The train left.
    The train will leave.

13. The boy posts the poster.
    The boy posted the poster.
    The boy will post the poster.

14. The man is fixing the car.
    The man fixed the car.
    The man will fix the car.

15. The woman dusts the table.
    The woman dusted the table.
    The woman will dust the table.

16. The man is arriving.
    The man arrived.
    The man will arrive.

17. The cat chases the mice.
    The cat chased the mice.
    The cat will chase the mice.

18. The woman mends the pants.
    The woman mended the pants.
    The woman will mend the pants.

19. The athlete jumps.
    The athlete jumped.
    The athlete will jump.

20. The woman cuts the flowers.
    The woman cut the flowers.
    The woman will cut the flowers.

21. The man paints the house.
    The man painted the house.
    The man will paint the house.

22. The grandmother knits the sweater.
    The grandmother knitted the sweater.
    The grandmother will knit the sweater.

23. The girl is writing the letter.
    The girl wrote the letter.
    The firl will write the letter.

24. The athlete is running.
    The athlete ran.
    The athlete will run.

25. The woman opens the box.
    The woman opened the box.
    The woman will open the box.

26. The boy is throwing the papers.
    The boy threw the papers.
    The boy will throw the papers.

27. The girl washes her face.
    The girl washed her face.
    The girl will wash her face.

28. The girl combs her hair.
    The girl combed her hair.
    The girl will come her hair.

29. The airplane is landing.
    The airplane landed.
    The airplane will land.

30. The girl dries herself.
    The girl dried herself.
    The girl will dry herself.

31. The man is taking a book.
    The man took a book.
    The man will take a book.

32. The man dresses himself.
    The man dressed himself.
    The man will dress himself.

33. The girl walks up the stairs.
    The girl walked up the stairs.
    The girl will walk up the stairs.

34. The girl walks down the stairs.
    The girl walked down the stairs.
    The girl will walk down the stairs.

35. The woman is feeding the chickens.
    The woman fed the chickens.
    The woman will feed the chickens.

Appendix IV: Sentences testing verbal inflections in Greek

1. Η κοπέλα κόβει τα λουλούδια.
    Η κοπέλα έκοψε τα λουλούδια.
    Η κοπέλα θα κόψει τα λουλούδια.

2. Ο κηπουρός φυτεύει τα λουλούδια.
    Ο κηπουρός φύτεψε τα λουλούδια.
    Ο κηπουρός θα φυτέψει τα λουλούδια.

3.   Ο άντρας βάφει το σπίτι.
    Ο άντρας έβαψε το σπίτι.
    Ο άντρας θα βάψει το σπίτι.

4. Η κοπέλα γράφει ένα γράμμα.
    Η κοπέλα έγραψε ένα γράμμα.
    Η κοπέλα θα γράψει ένα γράμμα.

5. Η γυναίκα ανοίγει ένα κουτί.
    Η γυναίκα άνοιξε ένα κουτί.
    Η γυναίκα θα ανοίξει ένα κουτί.

6. Ο αθλητής τρέχει.
    Ο αθλητής έτρεξε.
    Ο αθλητής θα τρέξει.

7. Ο άντρας μετρά τα λεφτά.
    Ο άντρας μέτρησε τα λεφτά.
    Ο άντρας θα μετρήσει τα λεφτά.

8. Η γυναίκα πουλά τα μήλα.
    Η γυναίκα πούλησε τα μήλα.
    Η γυναίκα θα πουλήσει τα μήλα.

9. Ο αθλητής πηδά.
    Ο αθλητής πήδηξε.
    Ο αθλητής θα πηδήξει.

10. Η γάτα κυνηγά τα ποντίκια.
    Η γάτα κυνήγησε τα ποντίκια.
    Η γάτα θα κυνηγήσει τα ποντίκια.

11. Η μητέρα κρεμά τα ρούχα.
    Η μητέρα κρέμασε τα ρούχα.
    Η μητέρα θα κρεμάσει τα ρούχα.

12. Το παιδί πετά τα χαρτιά.
    Το παιδί πέταξε τα χαρτιά.
    Το παιδί θα πετάξει τα χαρτιά.

13. Το παιδί τρώει το γλυκό.
    Το παιδί έφαγε το γλυκό.
    Το παιδί θα φάει το γλυκό.

14. Το παιδί πίνει το γάλα.
    Το παιδί ήπιε το γάλα.
    Το παιδί θα πιει το γάλα.

15. Η κοπέλα ανεβαίνει τις σκάλες.
    Η κοπέλα ανέβηκε τις σκάλες.
    Η κοπέλα θα ανεβεί τις σκάλες.

16. Η κοπέλα κατεβαίνει τις σκάλες.
    Η κοπέλα κατέβηκε τις σκάλες.
    Η κοπέλα θα κατεβεί τις σκάλες.

17. Το τρένο φεύγει.
    Το τρένο έφυγε.
    Το τρένο θα φύγει.

18. Ο κύριος έρχεται.
    Ο κύριος ήρθε.
    Ο κύριος θα έρθει.

19. Το αεροπλάνο προσγειώνεται.
    Το αεροπλάνο προσγειώθηκε.
    Το αεροπλάνο θα προσγειωθεί.

20. Το παιδί ντύνεται.
    Το παιδί ντύθηκε.
    Το παιδί θα ντυθεί.

21. Η κοπέλα χτενίζεται.
    Η κοπέλα χτενίστηκε.
    Η κοπέλα θα χτενιστεί.

22. Το παιδί παίρνει ένα βιβλίο.
    Το παιδί πήρε ένα βιβλίο.
    Το παιδί θα πάρει ένα βιβλίο.

23. Το κορίτσι σκουπίζεται.
    Το κορίτσι σκουπίστηκε.
    Το κορίτσι θα σκουπιστεί.

24. Ο μαθητής μπαίνει στην τάξη.
    Ο μαθητής μπήκε στην τάξη.
    Ο μαθητής θα μπει στην τάξη.

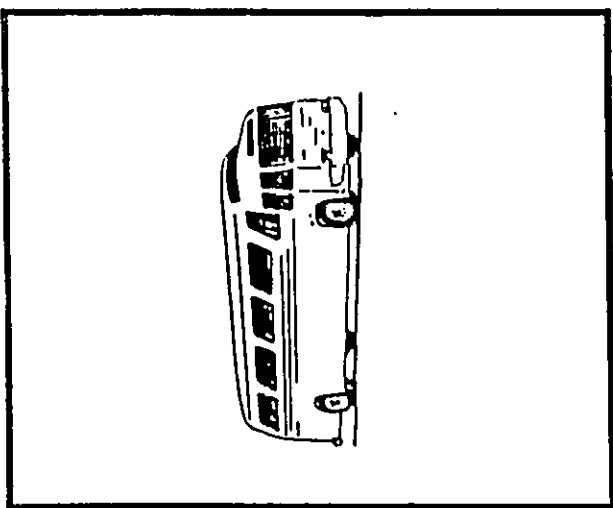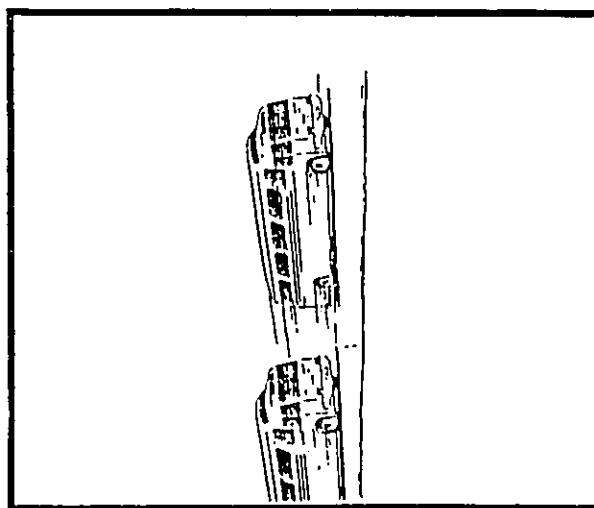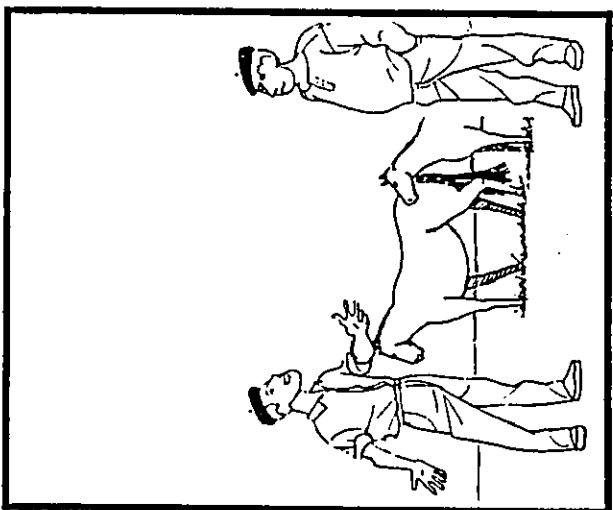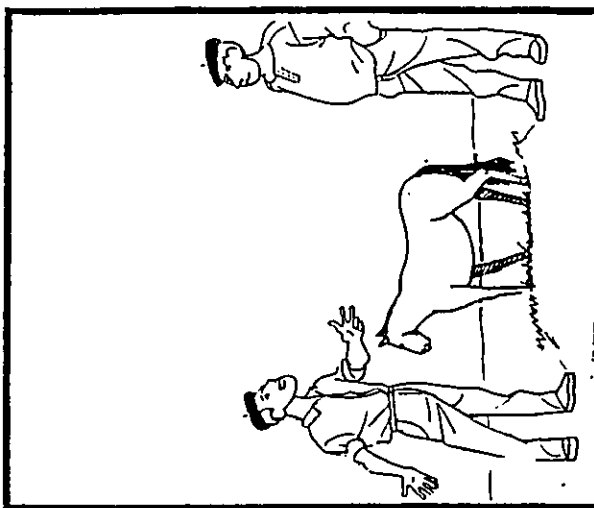Appendix V: Pictures testing the comprehension of nominal inflections
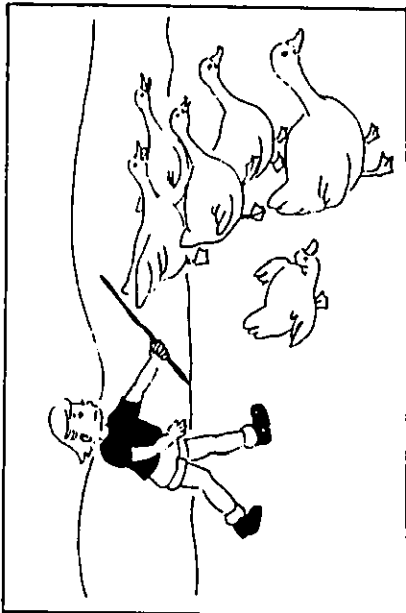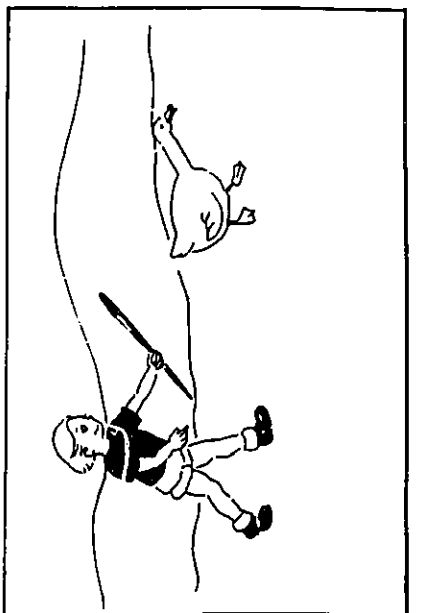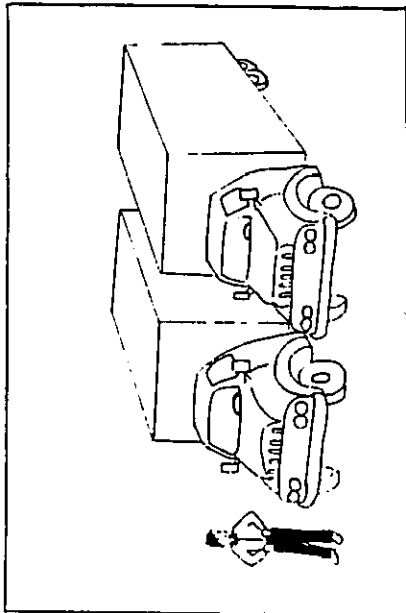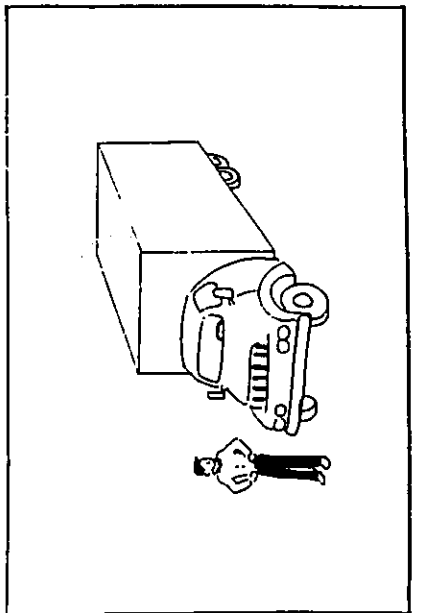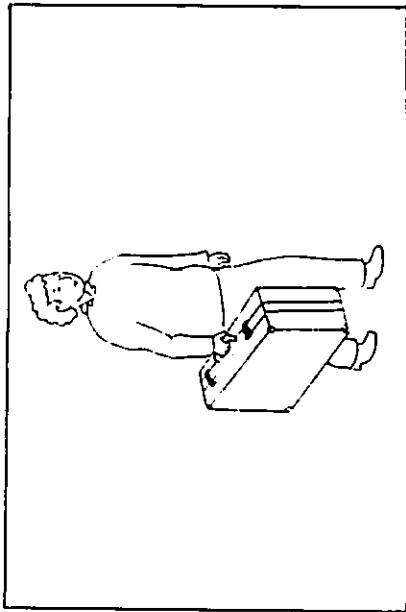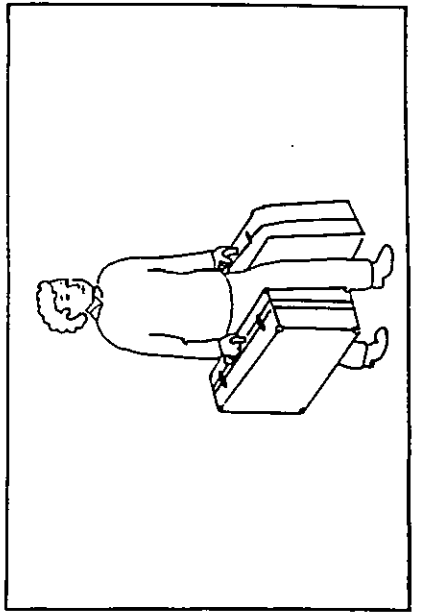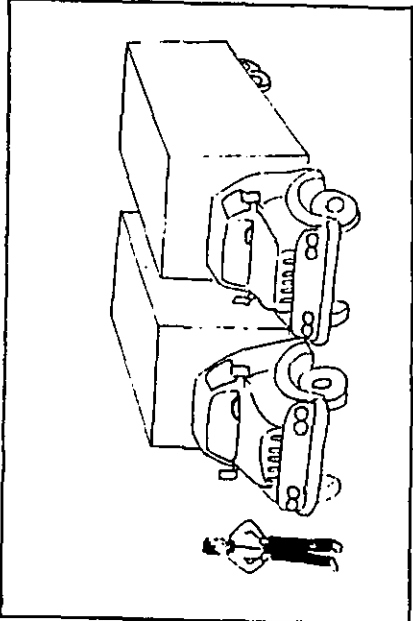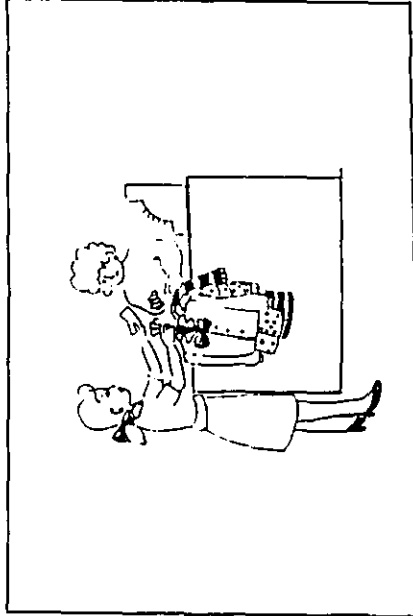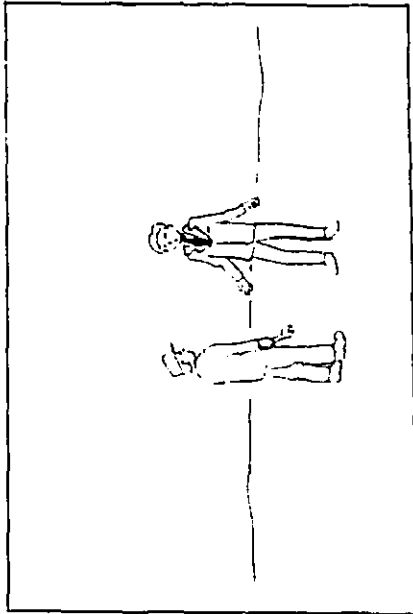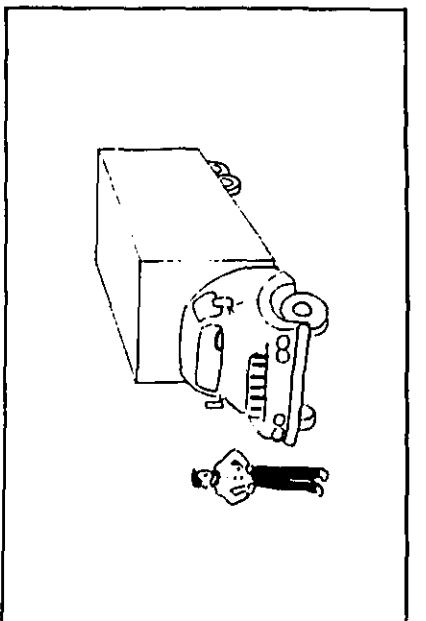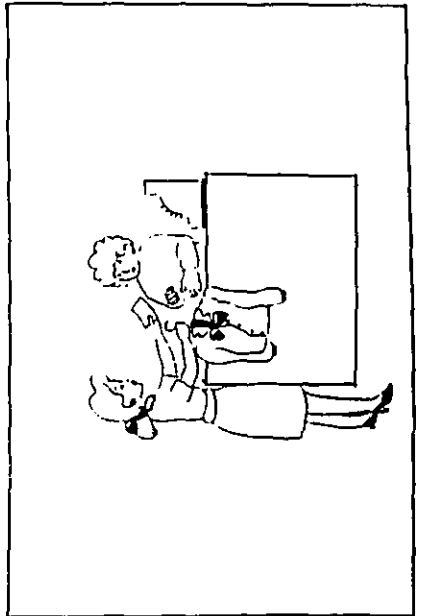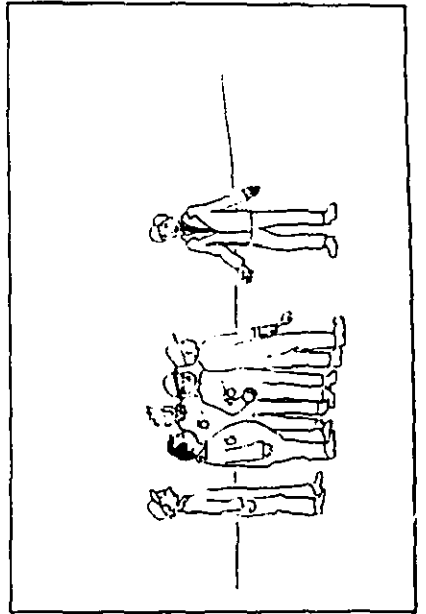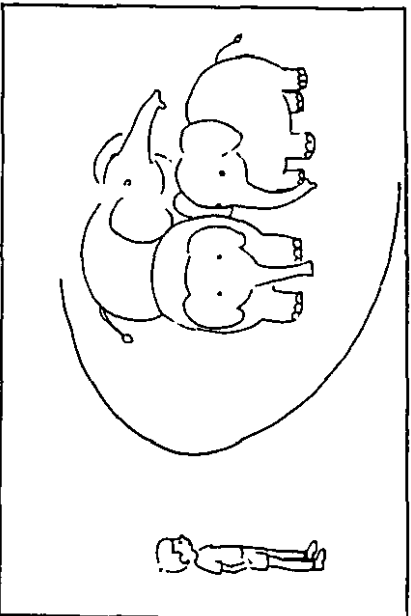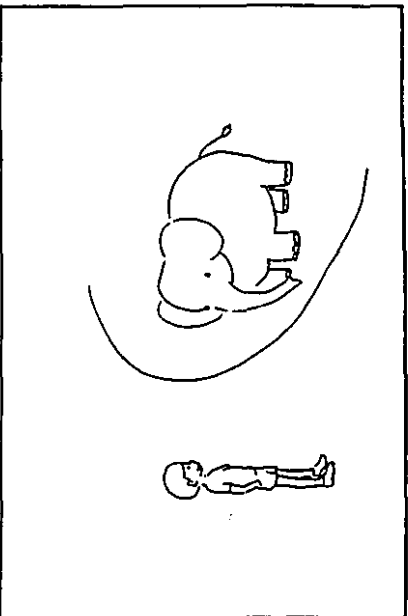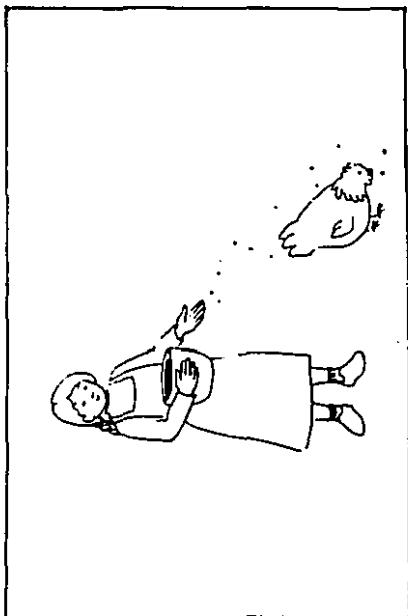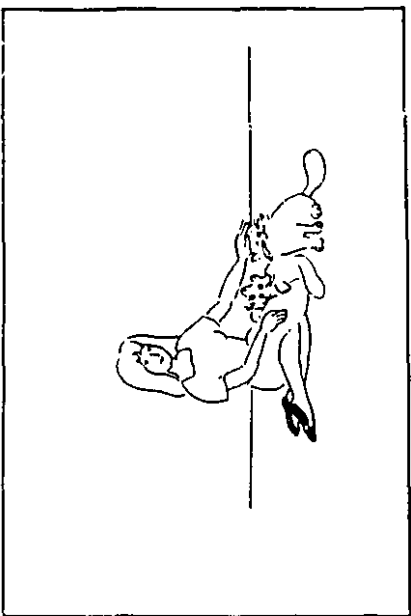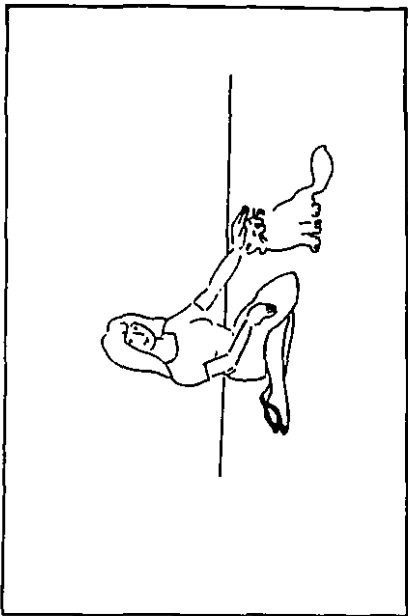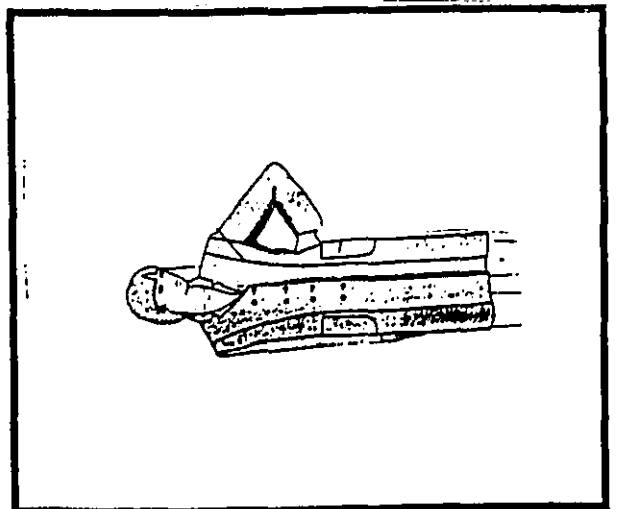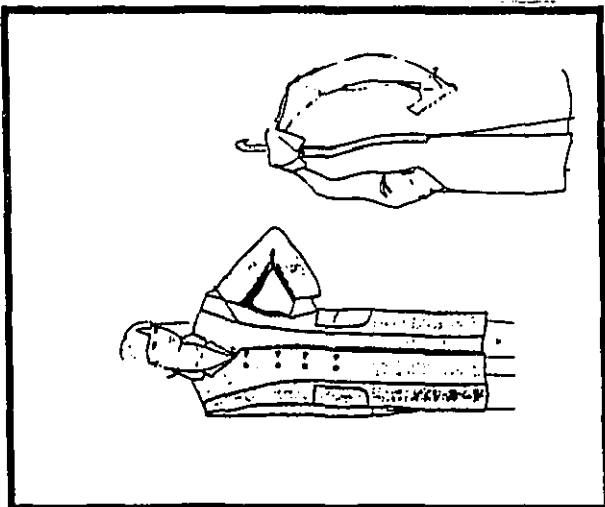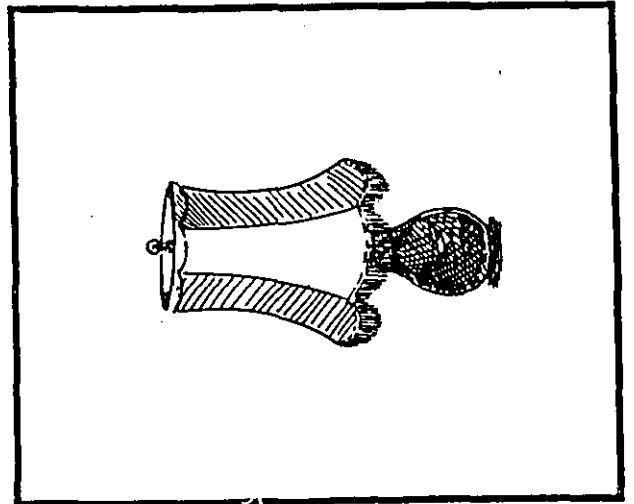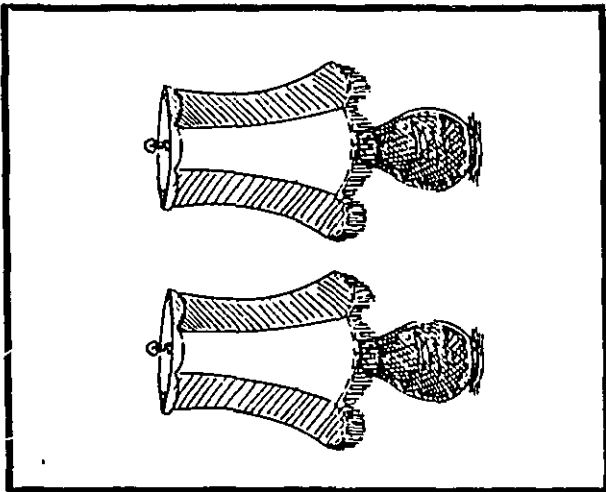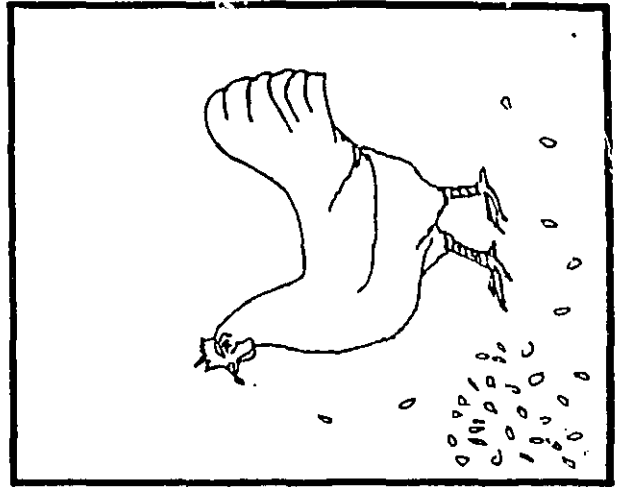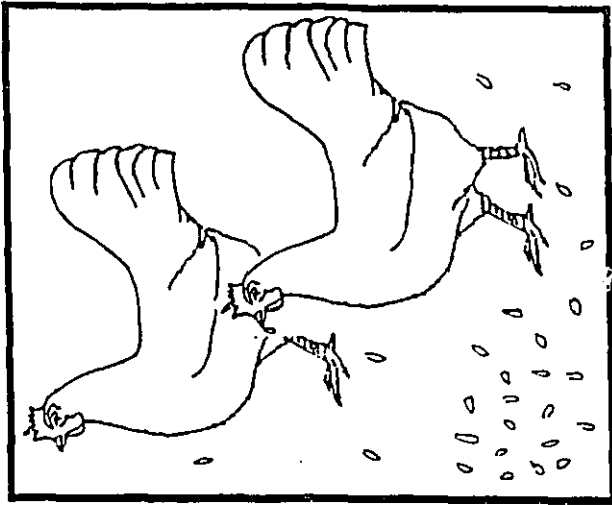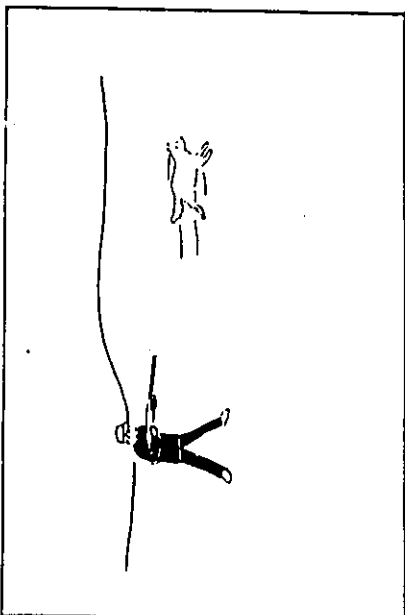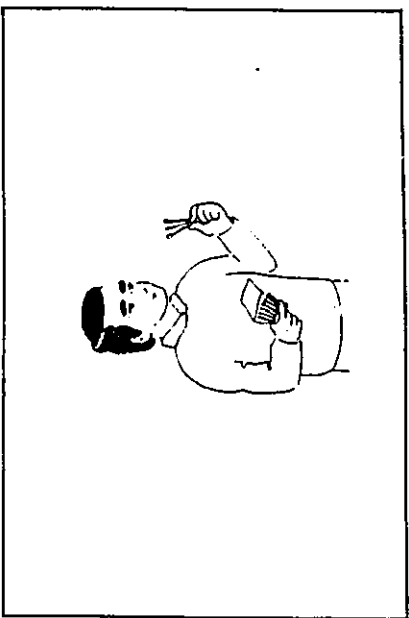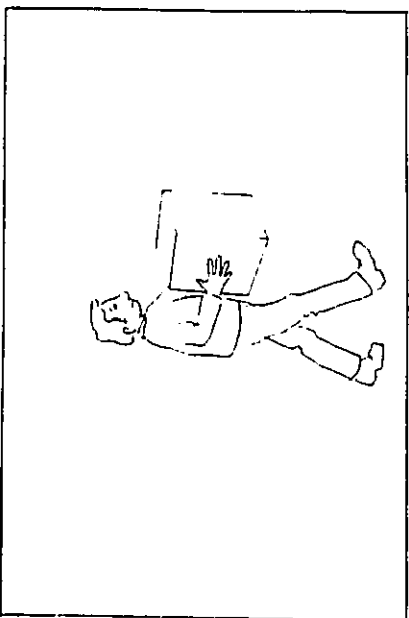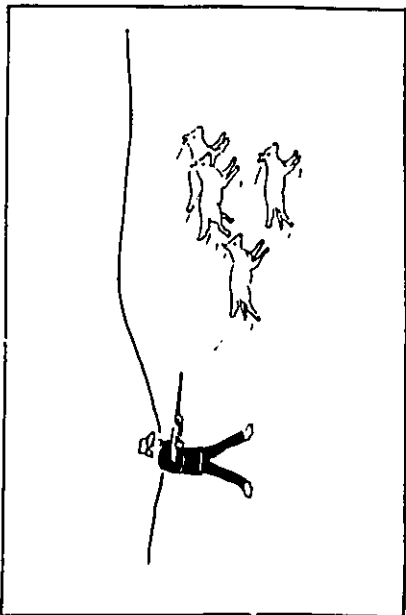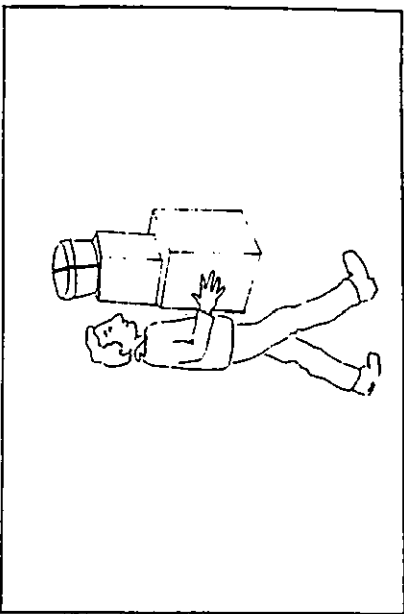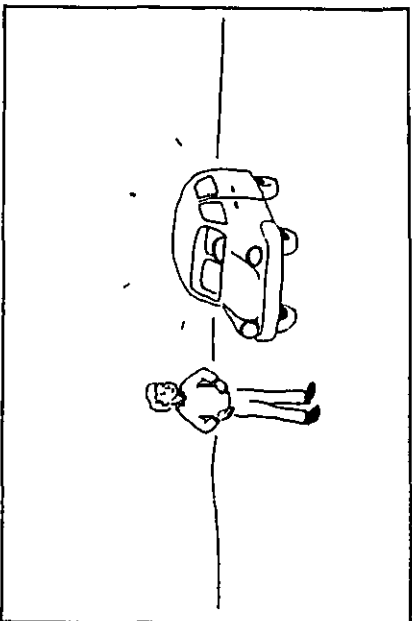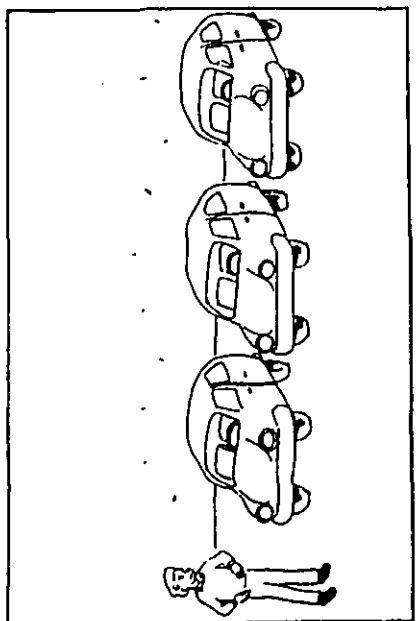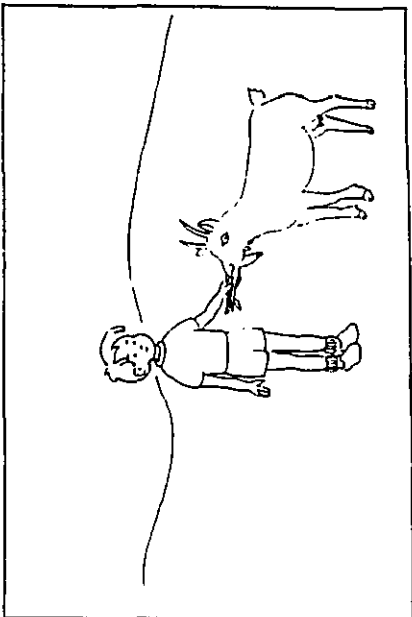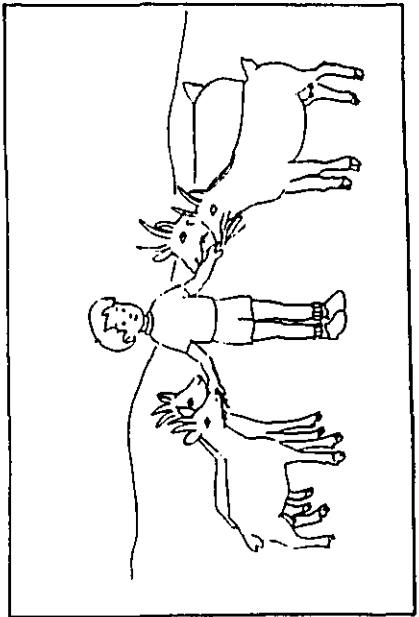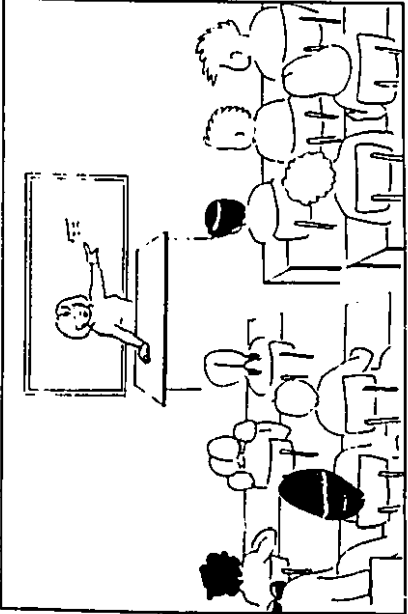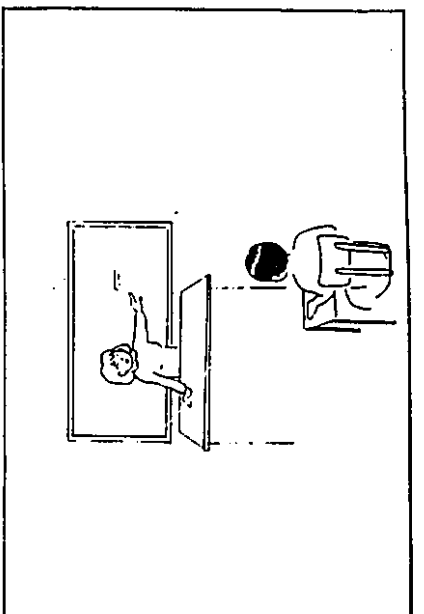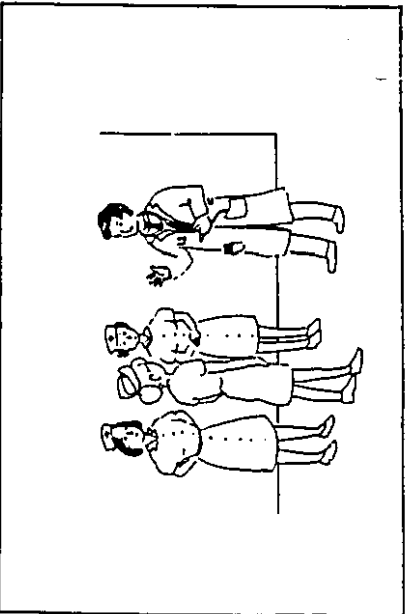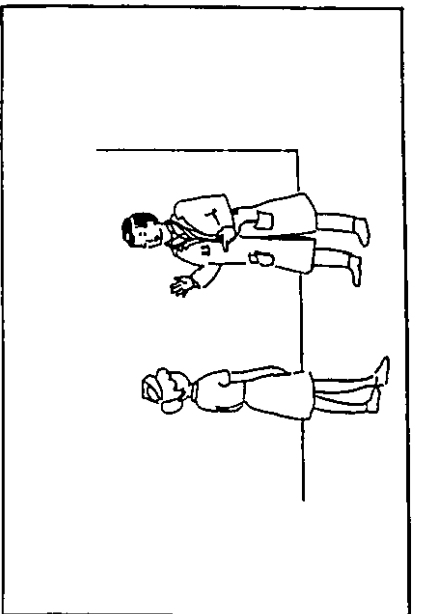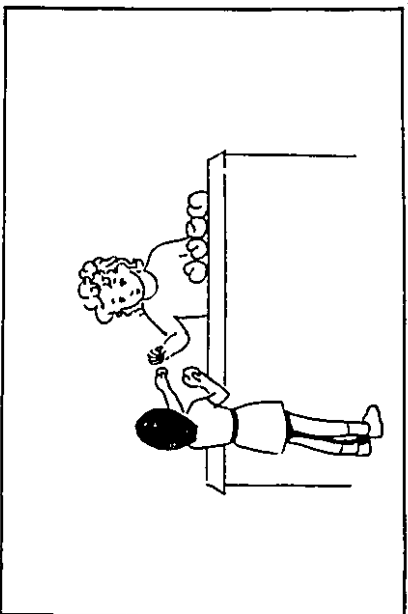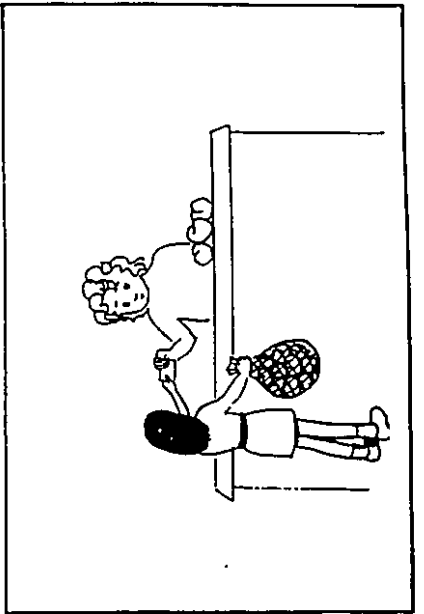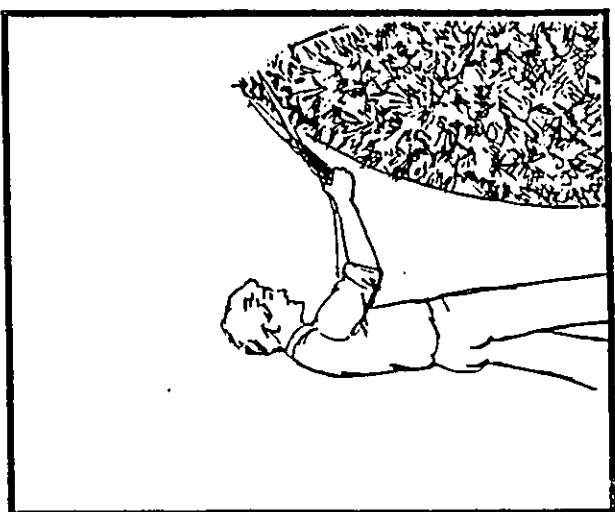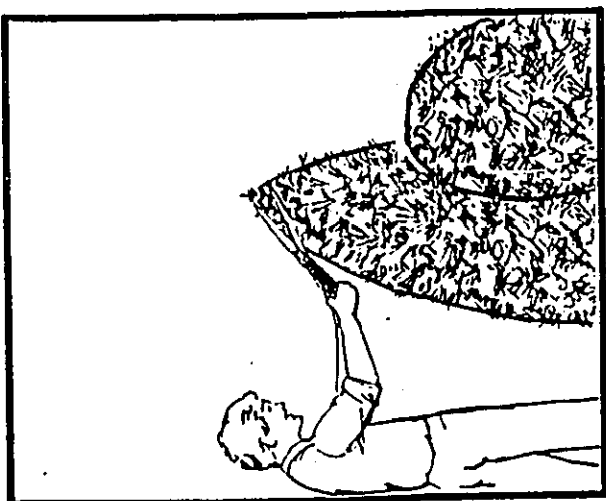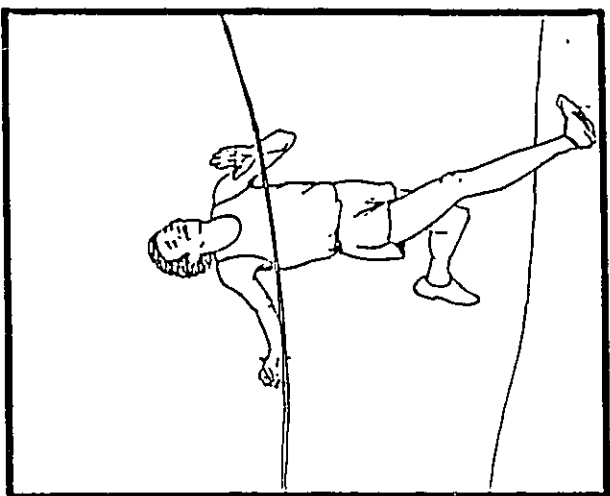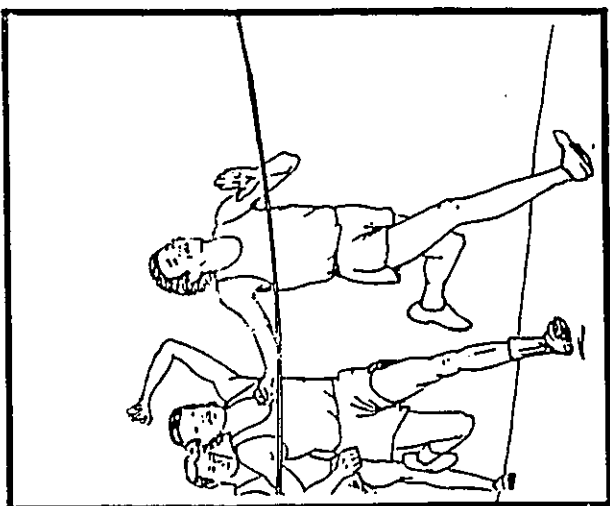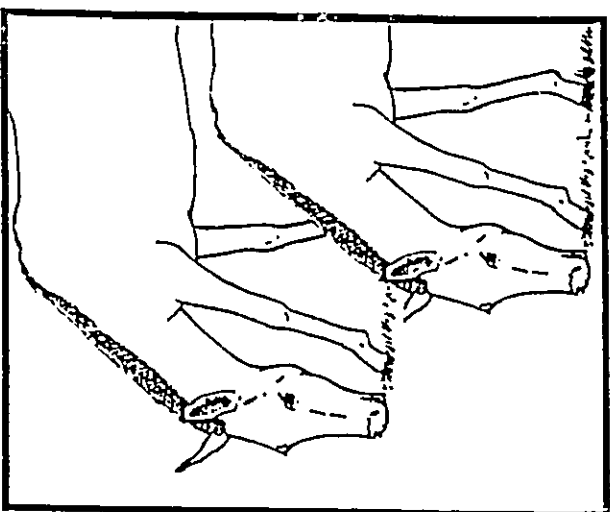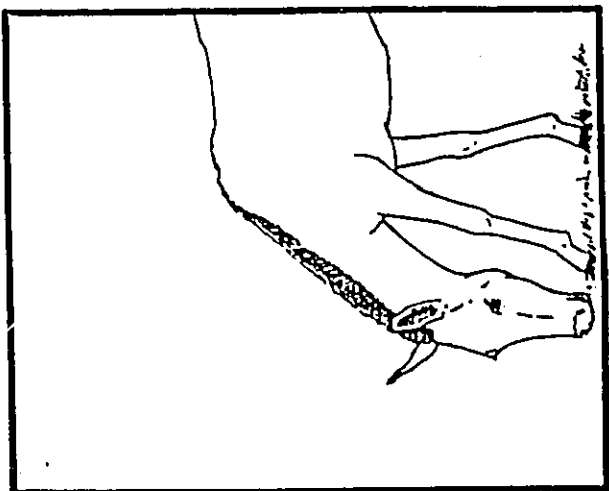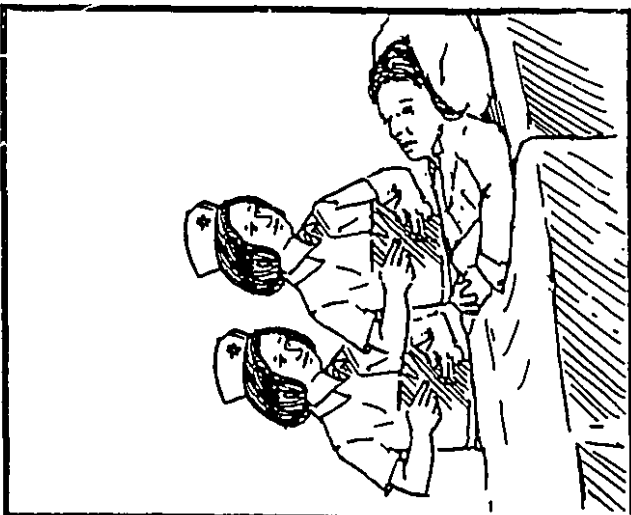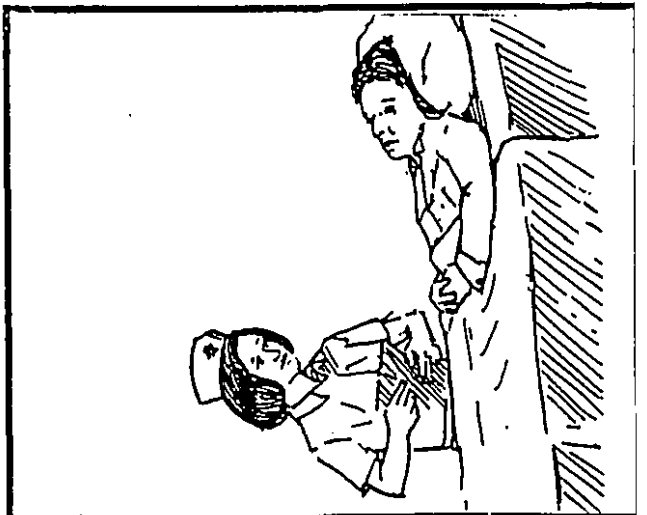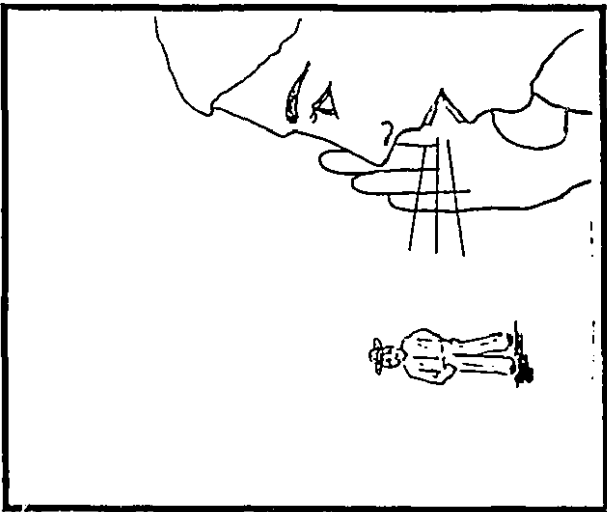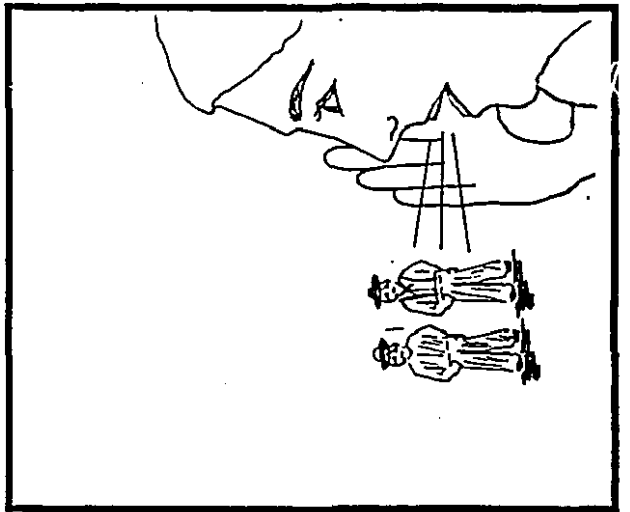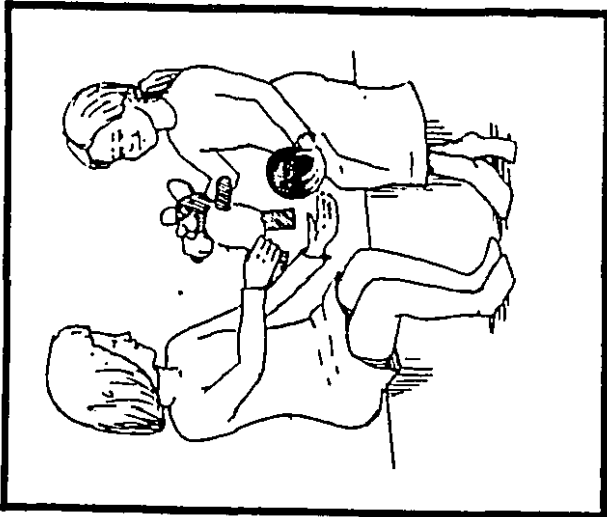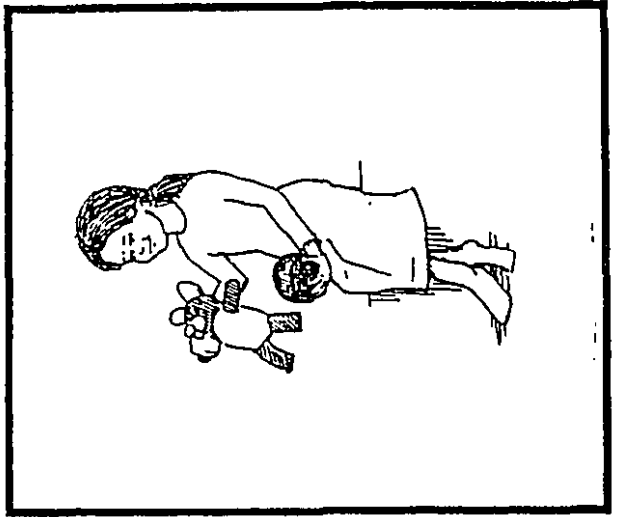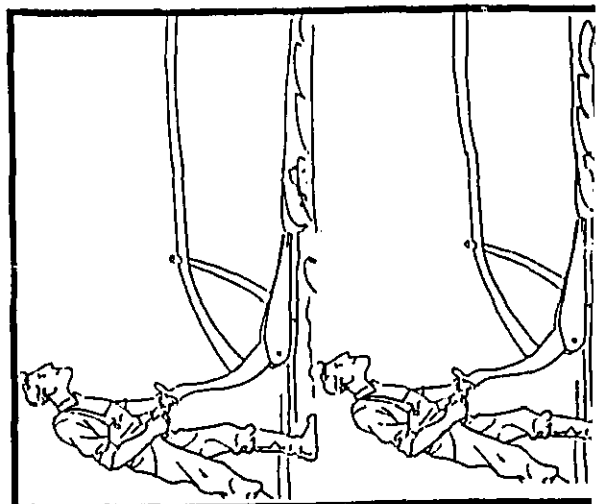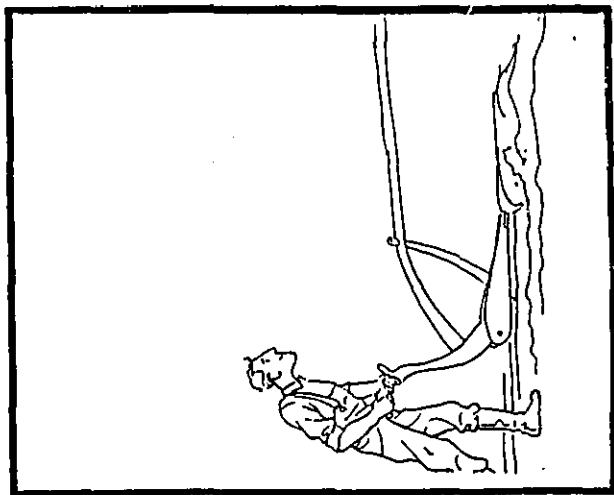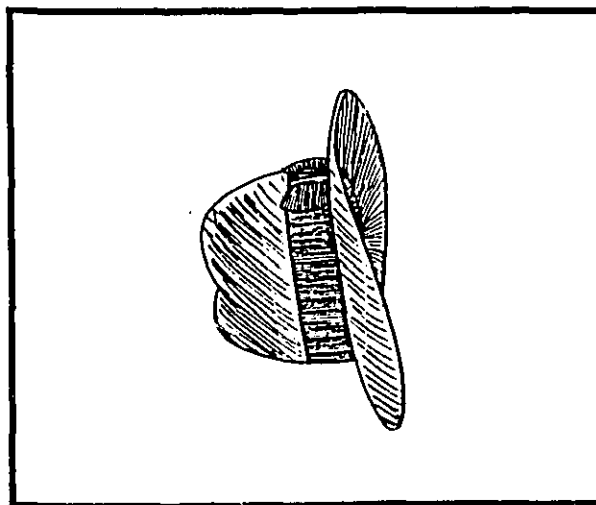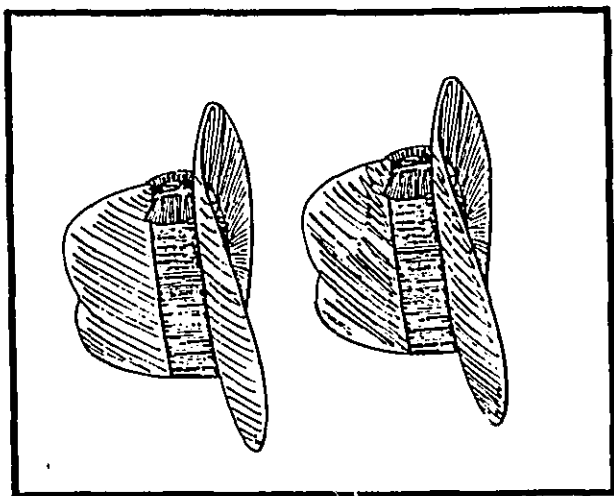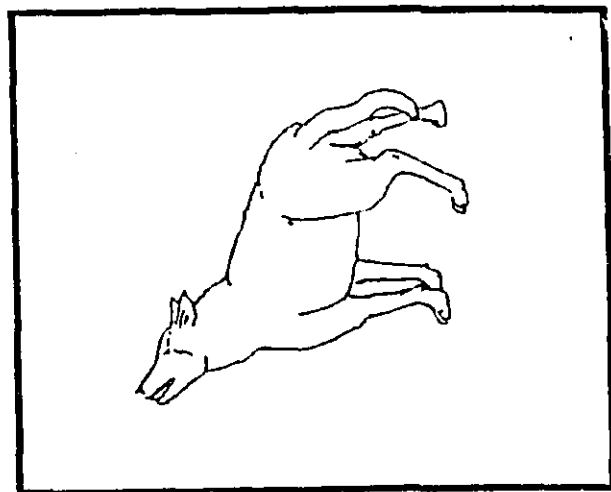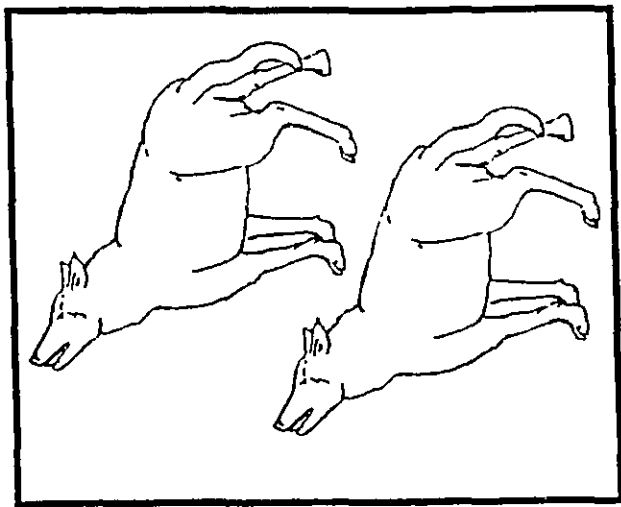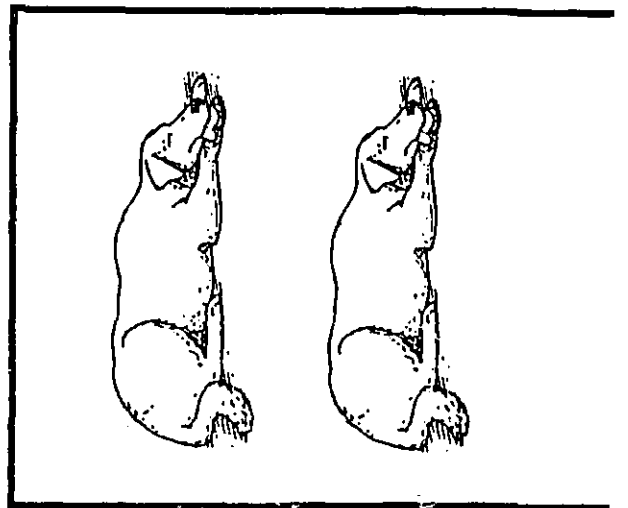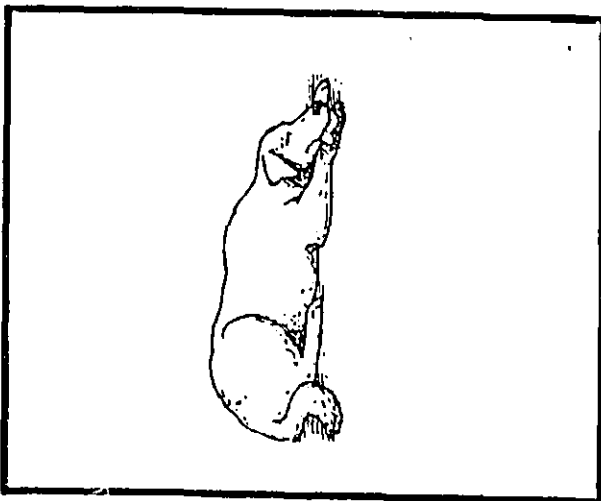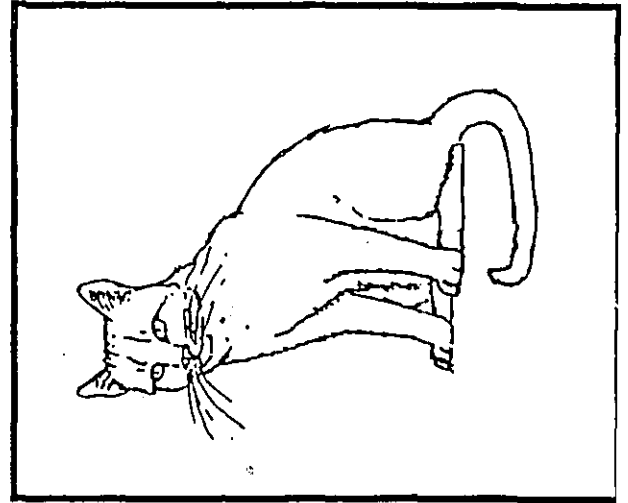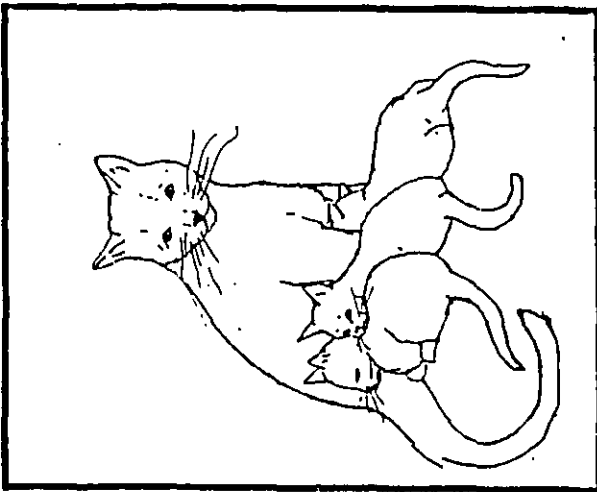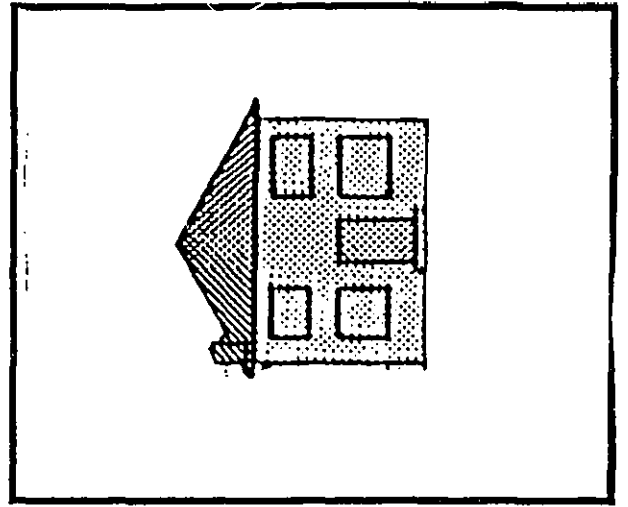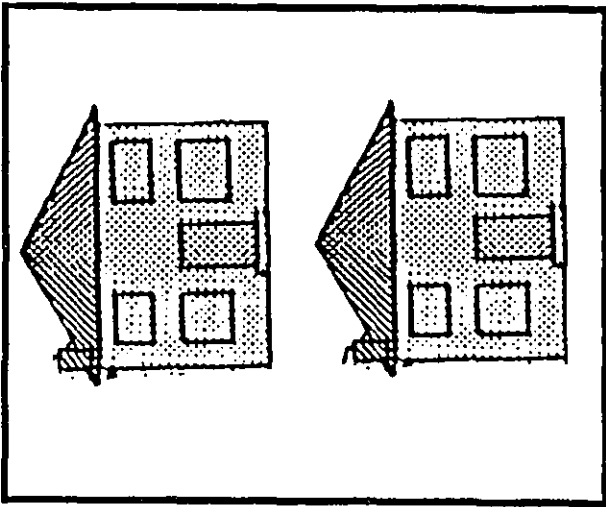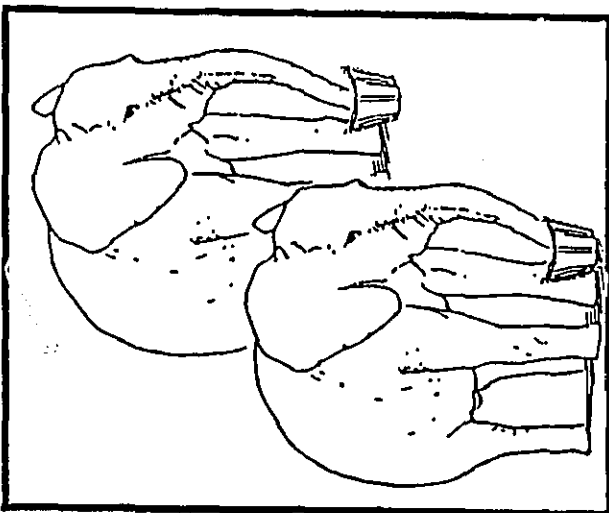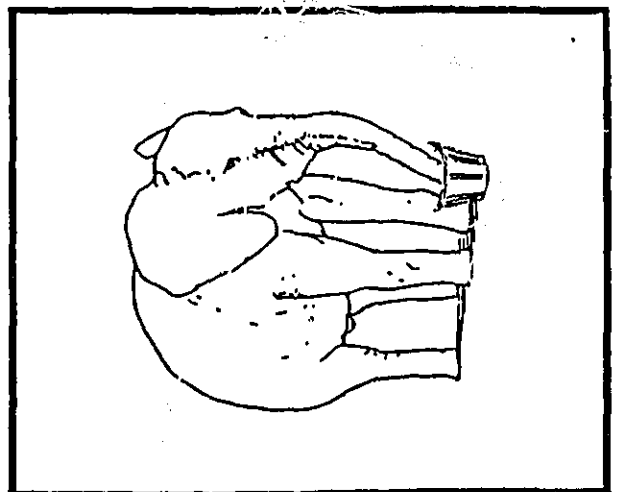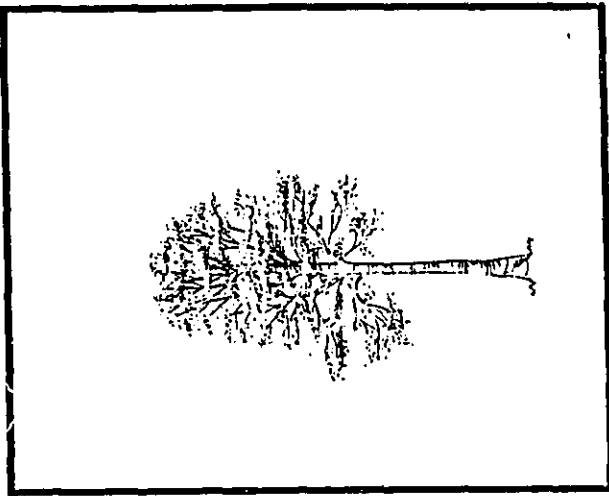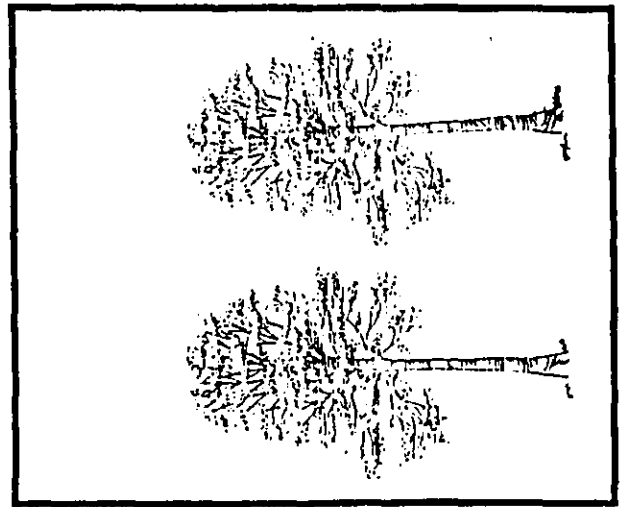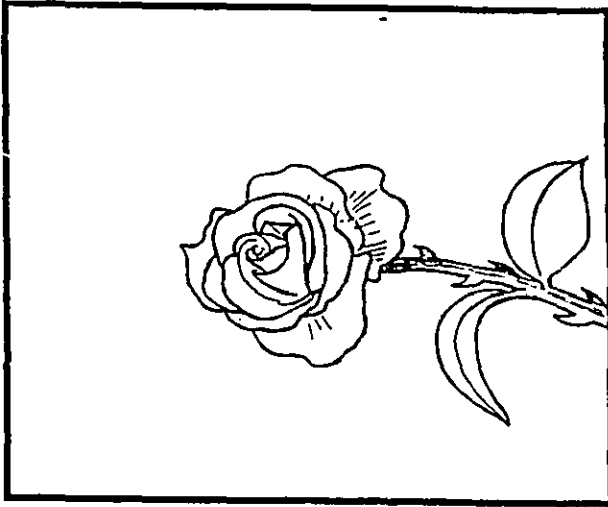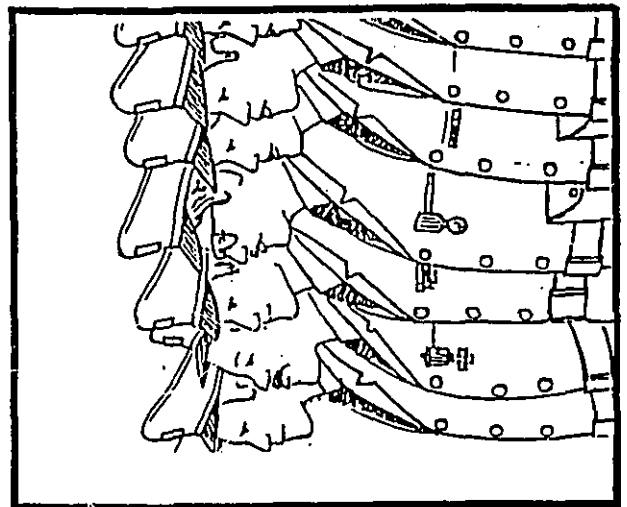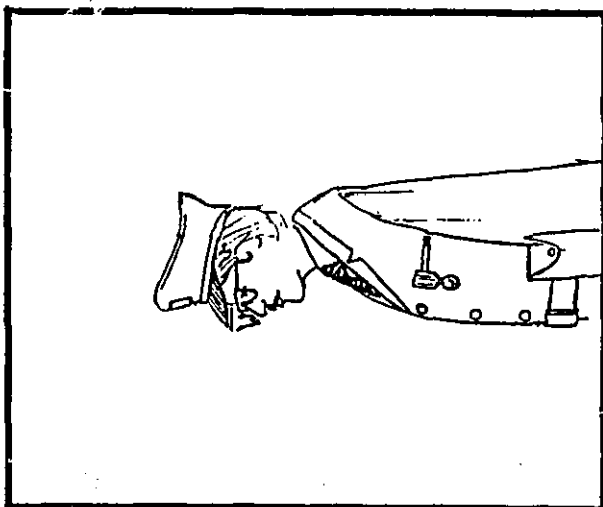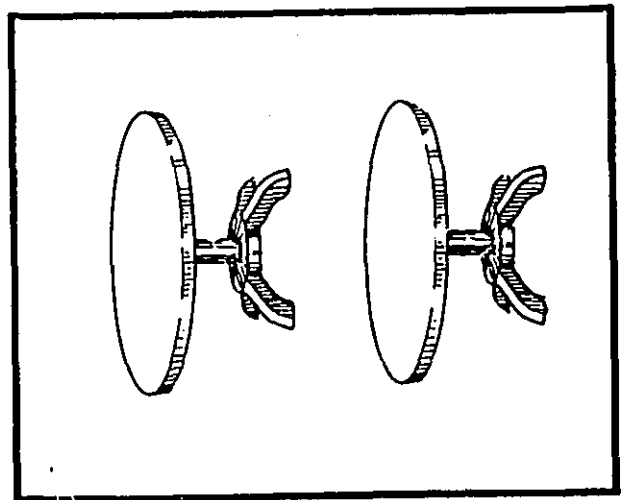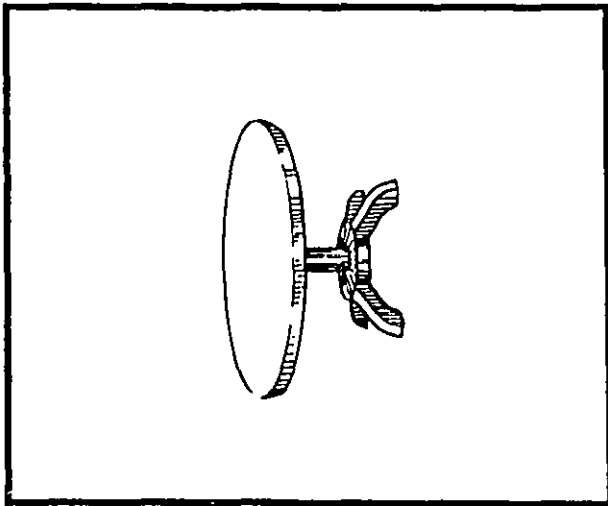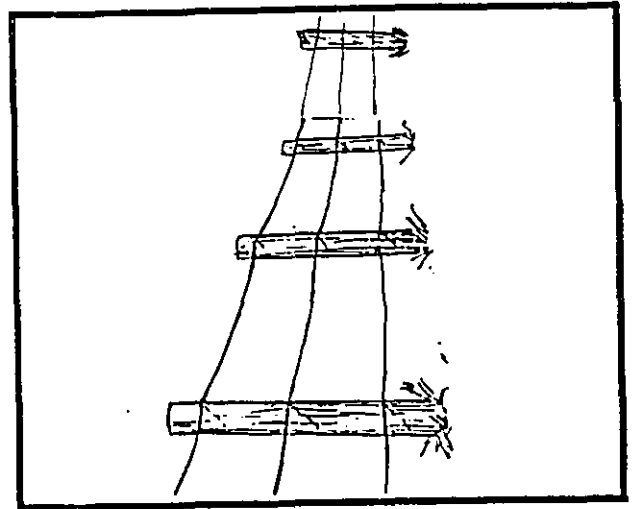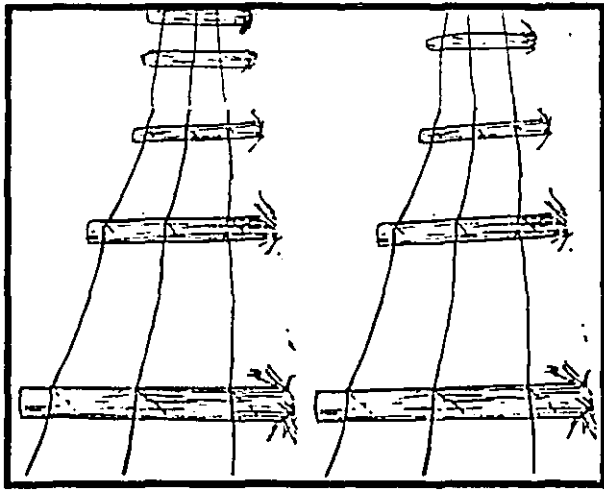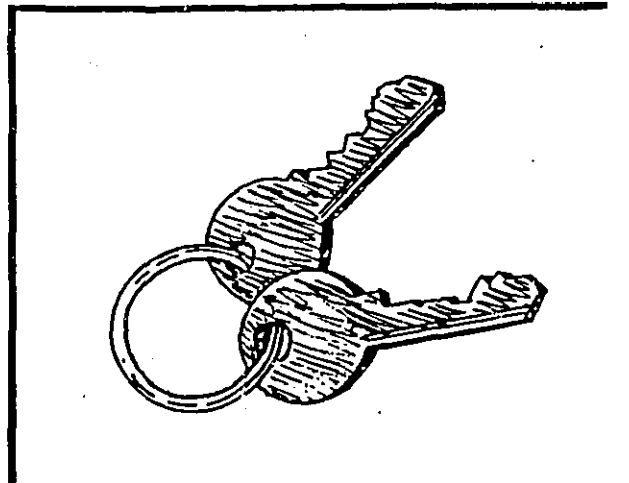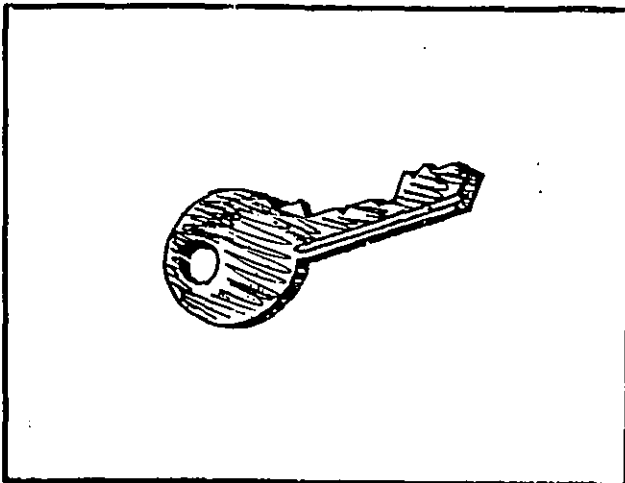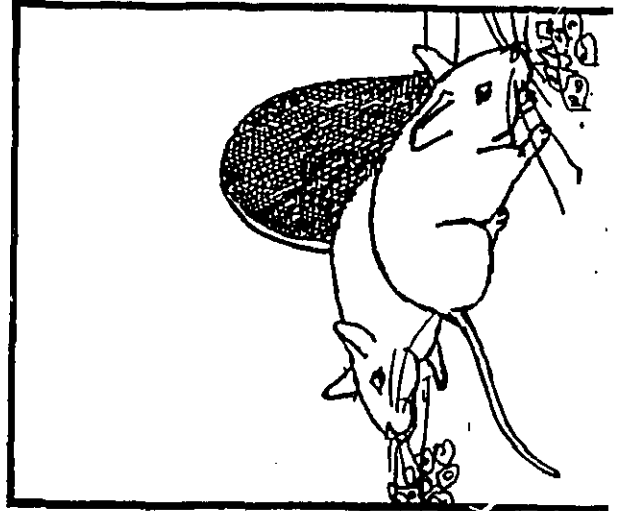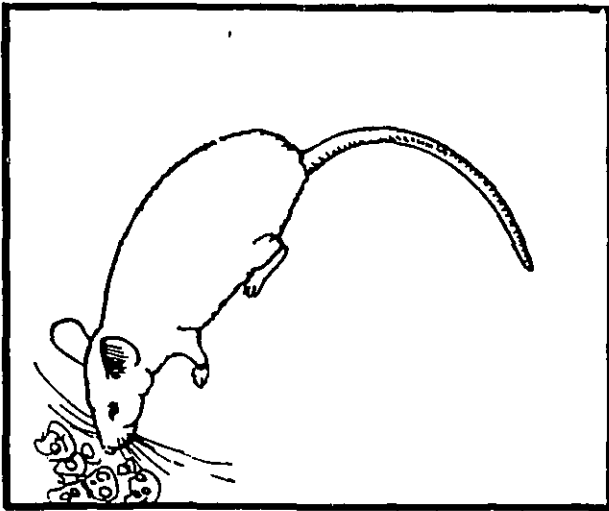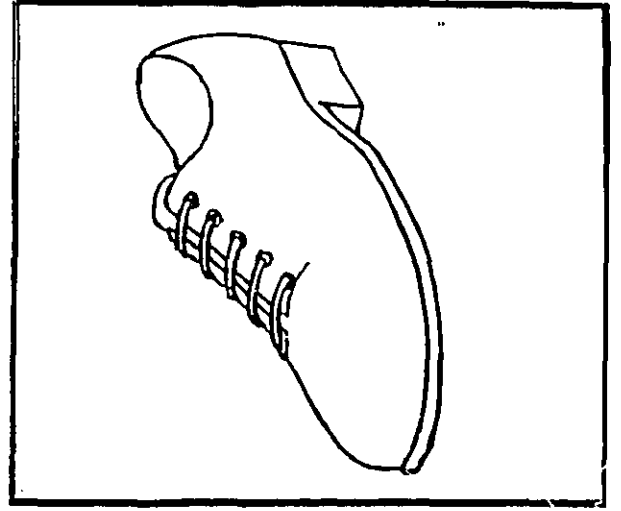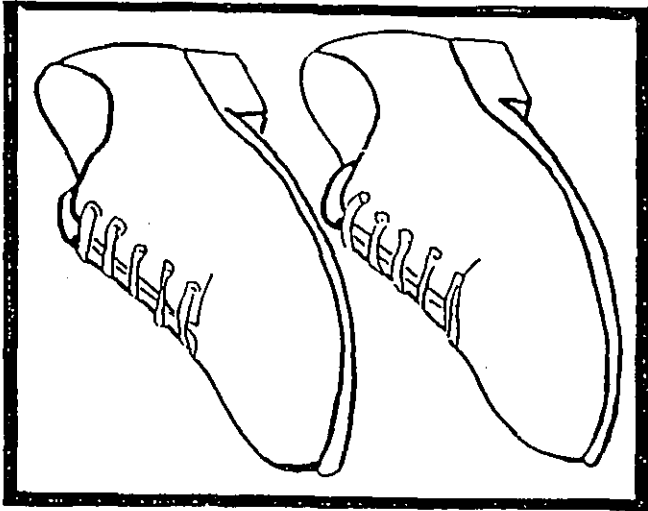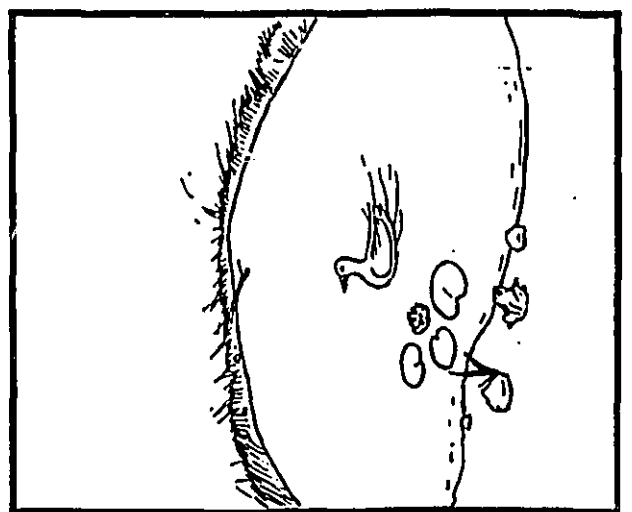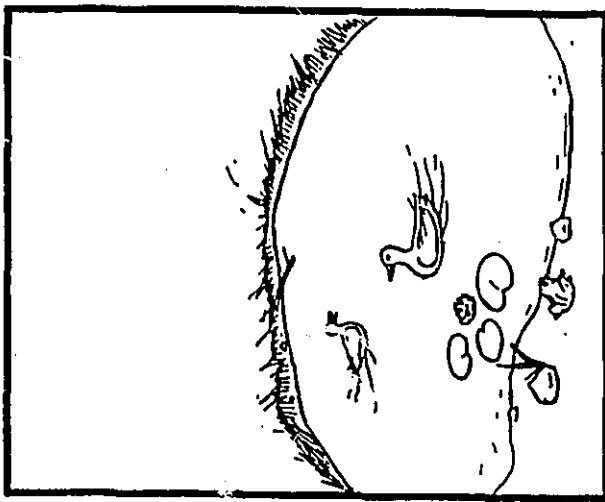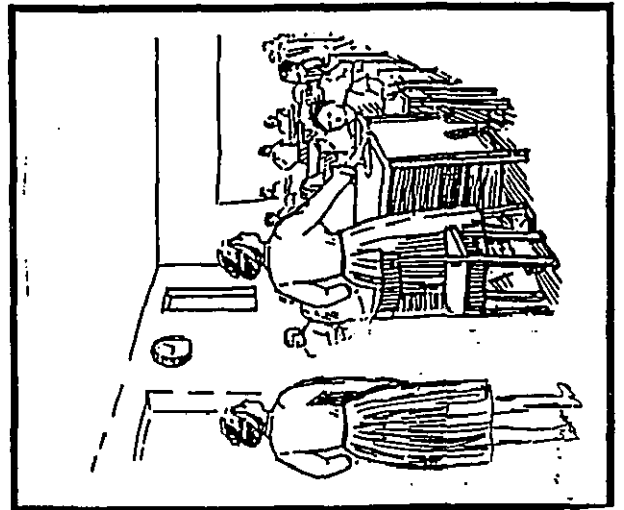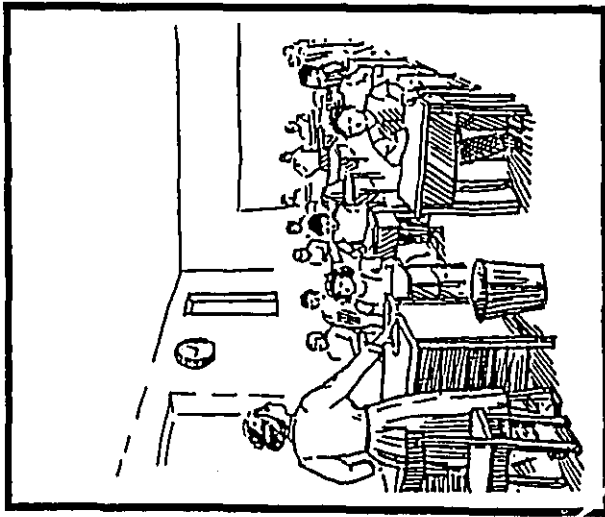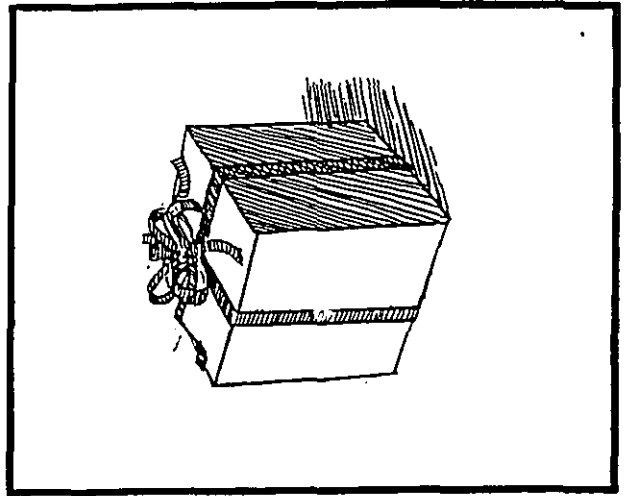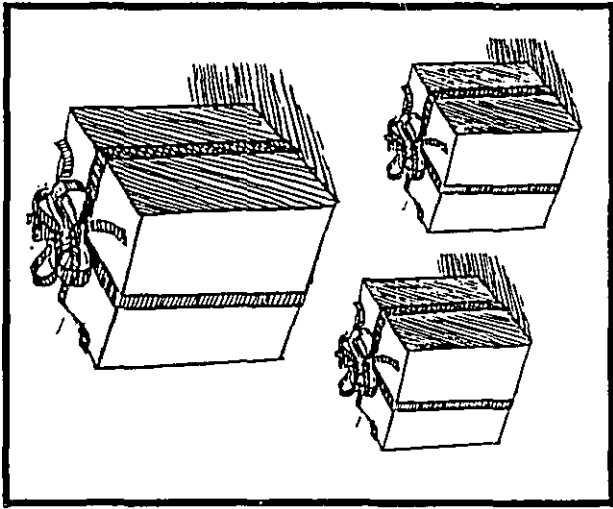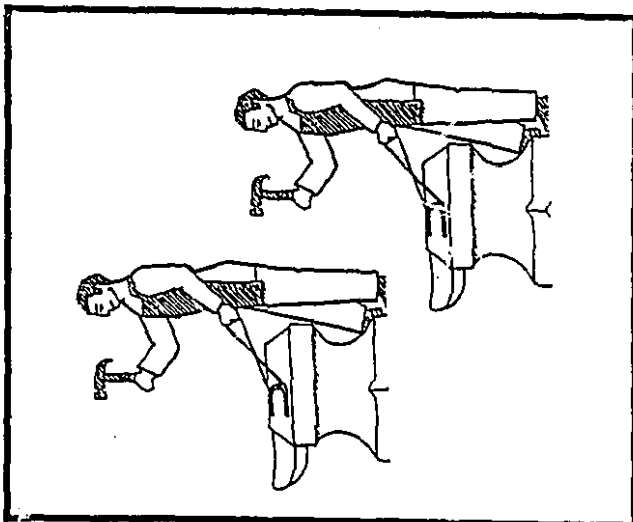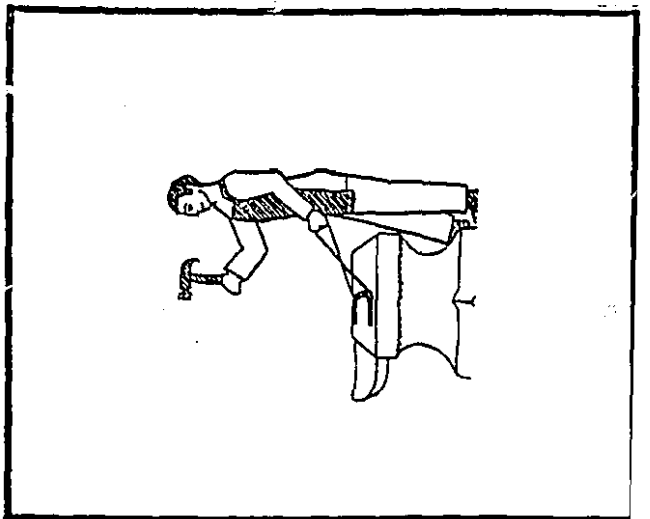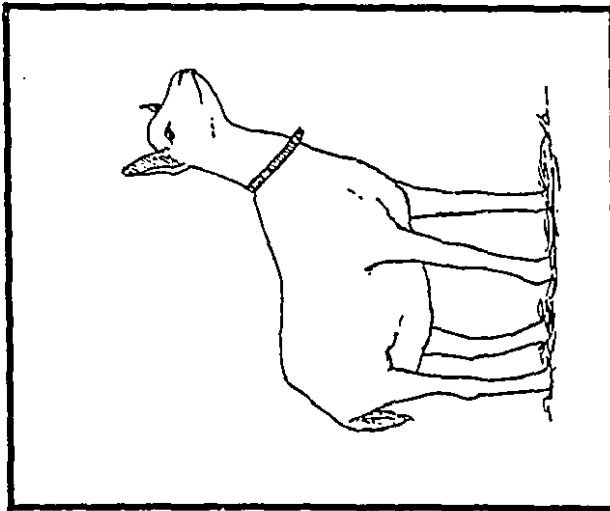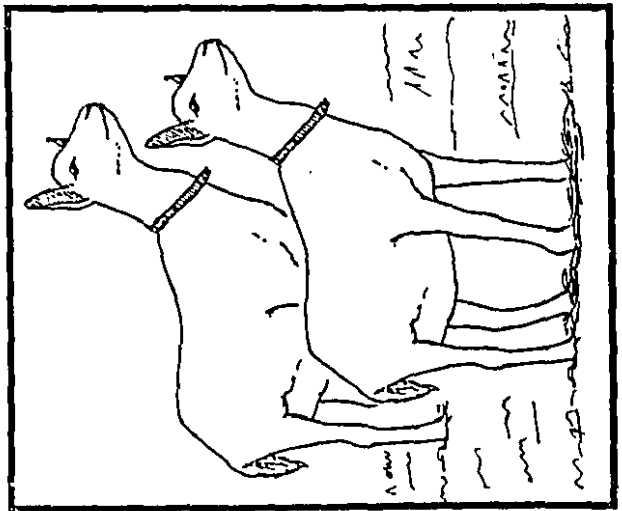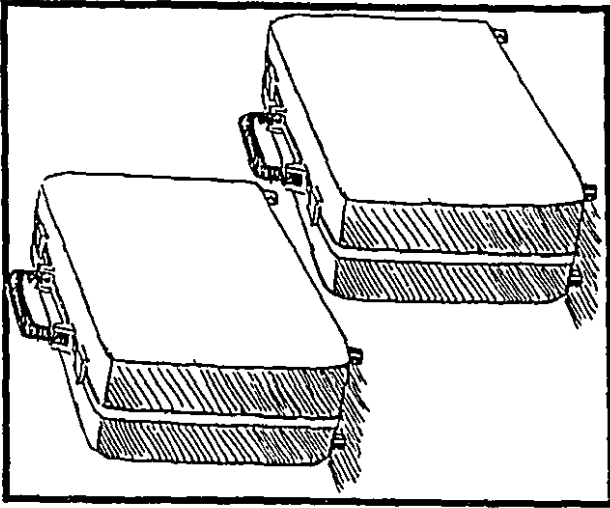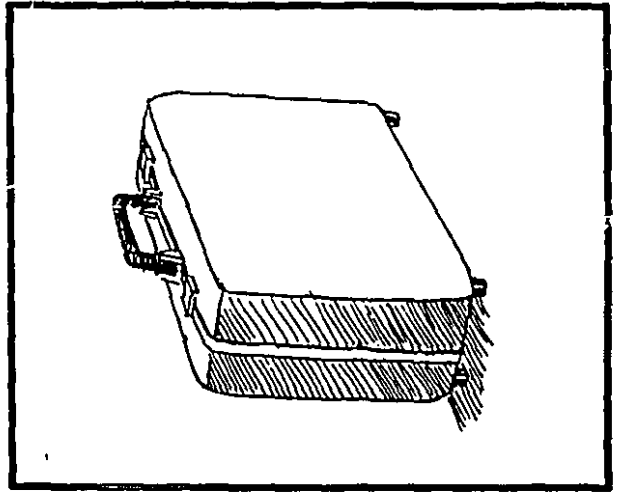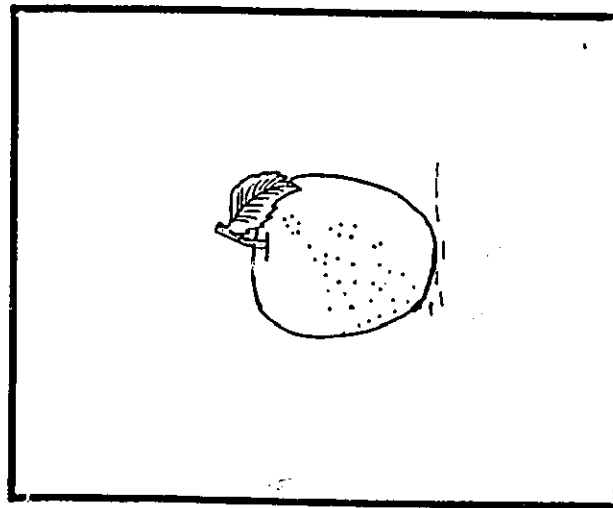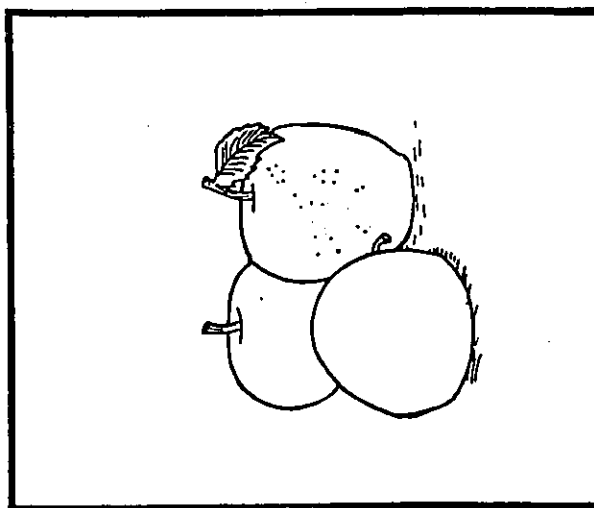
Appendix VI: Pictures testing the comprehension of verbal inflections