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Developmental Language Impairment: Evidence from Greek and its Implications for Morphological Representation

by

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

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October, 1996

Abstract

Developmental Language Impairment: Evidence from Greek and its Implications for Morphological Representation

Developmental Language Impairment (DLI) is a language disorder characterized by difficulties in both language production and comprehension most readily observable on the morphological level. Previous research suggests that DLI subjects are atypical regarding word decomposition and word formation.

Given these observations, two questions arise: What is the extent of DLI insensitivity to word-internal structure and to morpheme features? and Is this insensitivity equally evident in inflectional, derivational and compounding processes? Three experiments address these questions: plural formation, nominal compounding and diminutive formation and comprehension.

These word formation processes are very productive Greek and are observed from (2;0) onwards in non-impaired children cross-linguistically. Nominal roots (bound) are mapped to other bound morphemes: inflectional affixes for plural formation, derivational affixes and inflectional affixes for diminutive formation, and lexical morphemes and inflectional affixes for compound formation.

In this thesis, the performance of Greek DLI subjects was compared to that of non-impaired controls using elicited production and comprehension tasks that probed real and novel word formation. Results show that DLI children are not sensitive to morphological features and have difficulty knowing where root boundaries are. Given the atypical performance of DLI children, the initial hypothesis on the building of an atypical competence appears to be supported.

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Résumé

Trouble développemental du langage: Données en provenance du grec et leur signification pour la représentation morphologique

Les enfants atteints de troubles développementaux du langage (dysphasie génétique) ont des problèmes importants en morphologie qui sont évidents dans la production et la compréhension du langage. Des données précédentes suggèrent que ces enfants sont différents par rapport à leur compétence à construire et à décomposer les mots.

L'objet de cette étude est d'explorer le degré auquel ces enfants sont insensibles à la structure interne et aux caractéristiques morphologiques des mots, et de trouver si cette insensibilité est évidente au même degré dans les opérations d'inflection, de dérivation, et de composition des mots. Trois expériences sont consacrées à l'étude de ces questions: la formation des pluriels, la dérivation nominale, et la formation et compréhension des diminutifs.

Ces processus de construction de mots sont très productifs en grec et se développent très tôt (de 2;0) chez l'enfant non-dysphasique de langues diverses. Les racines grecques sont obligées de se réaliser avec des morphèmes inflectionnels dans la formation du pluriel, avec des morphèmes dérivatifs et inflectionnels dans la formation du diminutif, et avec d'autres racines et morphèmes inflectionnels dans la formation des mots composés.

Dans cette thèse, on compare la performance des enfants hellénophones qui souffrent de ce trouble linguistique avec celui d' enfants témoins. On utilise des tâches de production de langage et des tâches de compréhension qui contiennent des mots réels et des logatomes. Les données ont montré que les enfants grecs dysphasiques ne sont pas sensibles aux caractéristiques de structure morphologique des mots et ont des difficultés à savoir où se trouvent les frontières des racines. Ces données sont compatibles avec l'hypothèse selon laquelle la dysphasie génétique affecte le développement de la compétence linguistique.

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ΖΗΤΗΤΑΙ ΙΘΑΚΗ

Ήδη τόσα μίλια ταξίδι
Τόσους σοφούς, τόσα λιμάνια
συνάντησες, απέλαυσες·
απέκτησες πραμάτια ακριβή.
Μα πού πας τέλος πάντων;
Δεν έχεις Ιθάκη να σε περιμένει
Σε τρώει η αγωνία, μαραζώνεις
σαν το σκέφτεσαι – μια στις τόσες.
Σε πονά που δεν έχεις Πηνελόπη,
μήτε Τηλέμαχο, μήτε Ευρίκλεια πια,
ούτε καν γέρο σκύλο.
Ήδη τόσα μίλια ταξίδι.
Θυμάσε γιατί σάλπαρες; 20–04–92

Καλά που σ'αρέσει η εξερεύνηση.
Σε ωθεί η δίψα για τη γνώση.
Αυτή θα αρκέσει ως Ιθάκη για τώρα. 27–08–96

Honkadori

Acknowledgements

This work could not have been done without the help, guidance, support and love I have been fortunate to have received from so many sources. I thank all my surrogate parents and school family for their encouragement and patience with me as I learnt to learn and to grow. The Linguistics Department of McGill has seen me through some of the most important transitions of my life as well as my academic development and I thank everyone for their infinite understanding.

I have benefited from the kindness of many fellow students, friends, and professors who listened to, read, commented, edited and proof-read different sections of this work through the course of its development. I thank especially Heather Goad, Suzy and Shinji Fukuda and Martine Kessler-Robb for their invaluable friendship, common sense, and moral support, Joelle Pelletier and Michel Denault for their wonderful dinners and initiation to locally brewed ale, Kamal Munir for his help with the emergency move, Nelson Phillips for his help with the photocopying and his Calvino short stories, Heather Goad, Catherine Rebellati and Phaedra Royle for their wug drawing skills, Nancy Kounadis for those long hours of putting stimuli together and for her help in setting up the data files, Carolina Iribarren for her Evaluation comments, and Michel Paradis for checking the French abstract.

Thank you to the Garfield Weston Pool at McGill where technical, formal and informal problems were solved during countless laps, to my housemates Margit and Andy for their support and sense of humour during the long hours of printing and the consequent fallout with the landlady, and special mention for Lindemans, Dhimou, Bach, Beethoven and Vivaldi for making this work happier. And thank you to Dr. Paris for his much-needed ulcer advice over the last three years.

A grateful thank you to Stelio Zyglidopoulos for his help in entering endless numbers and doing stats, for his help in translating, for his help with those grammaticality judgements at all odd hours, for his transcription checking, for listening to all my free-associating lectures on psychology at first and linguistics later, for his help driving around Athens and Thessaloniki to find subjects, for his computer during his absence, and most importantly, for convincing me to go back to school so many years ago.

Thank you to all the Greek colleagues who have generously mailed me their work and who have provided me with hard to find or unpublished research data as well as with insightful comments: Dimitra Kati for her constructive comments and for mailing me her (incredibly heavy) dissertation, Marie-Christine Loi for her Masters thesis; Voula Stavrakaki for her GIF91CAA case-study thesis and findings over that iced coffee in Platia Kolokotroni; and Vasilis Baslis and

Ursula Stephany for their work on Greek acquisition. My apologies to those whose help I have profited from but who I do not have space to acknowledge.

This work owes much to the astute and invaluable comments on content, style, and data analysis from Harald Clahsen and Heather Goad and to my unofficial advisor and mental lexicon mentor, Eva Kehayia, who spent precious time over the methodology and Greek morphology sections. Thank you also for the insightful comments from Brendan Gillon, Tanya Gallagher and Lise Menn who served on my defence committee. My official advisors, I could never thank adequately. Michel Paradis, my advisor early on, inspired me to study the biological aspects of language and gave me an appreciation not only for the value of language impaired populations, but also for the value of good critique and good research questions.

Glynne Piggott's enthusiasm for the beauty of morphology was infectious and I have greatly benefited from his broad theoretical knowledge, especially his perspective on the significance of DLI for morphological theory, and from his Okham's razor editing. His constructive comments, infinite patience, and calm wisdom are most appreciated.

Finally, Myrna Gopnik has been an inspiration for so much, I don't even know where to begin. A gifted artist, a culinary genius, a shoulder to cry on, and a scholar who supported me and trusted in me more than I did, she helped me achieve hard goals; it has been a great priviledge working with her and I treasure

my learning experiences with the Gendys project. I can only hope that some day I can myself be in a position to supervise students in the way these advisors have.

Subject background was made available and subject testing over the last three years was made possible with the invaluable help of language therapists in Greece, Marie-Annick Chrysomalli (the fresh juice and the walk through Plaka to reach her were unforgettable treats), Ludmilla Kirpotin, Maria Vlassopulos, Vanda Voutira, Irini Levandi, and Yorghos Kalomiris; the Doxiadi Foundation for Research for the Child where some of the testing took place, and, most importantly, the children and their families who voluntarily participated in providing the data.

Mea culpa for all the errors and oversights of this work. The shortcomings (especially the organizational ones) have been greatly mitigated due to the input of all the people mentioned above.

This work has been possible for me to do thanks to the generous financial support of a travel grant from the McGill Faculty of Graduate Studies and Research and a grant form the Social Sciences and Humanities Research Council of Canada (SSHRC #752-94-1775) to me, and the grants to Myrna Gopnik from SSHRC (#410-90-1744) and from the Medical Research Council of Canada - SSHRC joint Intercouncil grant (#SP-12754).

Some sections of this work have been published or presented elsewhere. The Greek DLI screening test results were first published in 1994 in the McGill Working Papers in Linguistics (vol. 10) and presented at the Psychiatric Hospital

for Children Daou Pendelis (Athens, Greece) during a workshop on acquired and developmental language impairment.

Different portions of the pluralization study were presented at the 1995 Canadian Linguistics Association Conference (held at Université du Québec à Montréal), at the First International Meeting of the Project on the Acquisition of Pre- and Proto-Morphology (Vienna, 1995), and at the 9th International Symposium of Theoretical and Applied Linguistics (Thessaloniki, Greece, 1995).

Portions of the compounding study have been presented at the 19th Boston University Conference of Language Development (1994) and the study was also the main focus of my comprehensive evaluation 'Morphemes bound: A clue to atypical representations' defended at the Linguistics Department of McGill University (1995) as part of the doctorate programme requirements.

This work is dedicated to my paternal grandmother for her indelible influence on who I am: she taught me to love learning and encouraged me to be curious, to question received truths, to keep an open mind and be fair, to love life and to persevere, to always see the best in people and to love them unconditionally; I know she would have tried to read it if she could read, even if it is in English.

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Preface

The study of Developmental Language Impairment has become increasingly important to linguistic theory in that it has direct implications for the language modularity hypothesis, morphological representation, language processing, and language acquisition. A number of theories concerning this language impairment have been proposed; some are linguistic in nature and some are non-linguistic.

It has been argued, for example, that Developmental Language Impairment may be attributed to a general cognitive impairment which affects language learning and language use as well as other cognitive skills (Johnston, 1991). This cognitive deficit view does not see DLI as an impairment which affects only skills subserved by a language faculty module and, therefore, does not attach any importance of DLI to linguistic theory.

Another set of non-linguistic explanations for DLI views DLI as a deficit affecting language processing or performance and perhaps consequently affecting language competence. Such theories see DLI as an impairment that does not directly compromise the potential of the language module but rather its means of either processing language output (Fletcher, 1990) or language input (Leonard et al., 1992; Tallal et al., 1980).

This thesis accepts the evidence that DLI is a linguistic impairment (Clahsen, 1989; van der Lely and Harris, 1990; Gopnik, 1990a; 1990b; 1992), namely one that specifically and directly affects language competence and not any

other peripheral competences or only linguistic performance. DLI, therefore, is seen as a natural experiment which provides the opportunity to examine deviant language competence and enrich our understanding of non-impaired language competence.

The focus of this thesis is on the morphological aspects of Developmental Language Impairment as it is evidenced in Greek. It is written from a linguistic perspective, and it focuses on the linguistic characteristics of the population in question and does not aim to either describe non-linguistic characteristics of DLI or to explain them. The scope of this work is to examine the morphological deficits of native Greek DLI subjects and to attempt to account for these subjects' performance within current DLI theory and linguistic theory.

The first chapter is an introduction to issues raised by Developmental Language Impairment (DLI) with regard to its definition and linguistic interest. It reviews and evaluates competing explanations proposed for DLI, both linguistic and non-linguistic approaches. Chapter 1 also introduces the theoretical framework and assumptions adopted in this thesis based on theories of lexical representation and theories of lexical processing.

Chapter 2 discusses how theoretical assumptions concerning non-impaired morphological representation in Greek and how cross-linguistic investigations of DLI can enrich our understanding of DLI.

Chapter 3 presents the methodology used in the experimental tasks: (a) subject recruitment (criteria for subject selection, description of subject pool, control groups), (b) test design (experimental paradigms, independent and dependent variables), (c) scoring (targetted vs. non-targetted responses, error analysis) and (d) the linguistic profile of the Greek DLI subjects.

Chapter 4 is a plural formation experiment which shows how the inflectional difficulties of Greek DLI subjects were consistent with previous cross-linguistic data and in what ways Greek DLI subjects' performance provides new information. The pluralization of novel words indicated that DLI subjects have difficulties with morphological features of gender and number.

Chapter 5 reviews a compound formation experiment that showed that DLI subjects have difficulties with bound morphemes other than suffixes, namely, bound roots. In constructing novel compounds, DLI subjects misjudge root boundaries which suggests that the word-internal structure of DLI morphological representations is impaired.

Chapter 6 presents a diminutive formation experiment that reinforces the findings of the pluralization and compounding experiments. In forming novel diminutives, DLI subjects have atypical performance with respect to both word root and suffix characteristics. There is evidence that derivational affixes are also impaired in their structural and feature representation. Chapters 5 and 6 were the

first experimental studies to investigate DLI performance on bound affixes other than inflectional suffixes.

The discussion of the experimental results and their significance for theories on the nature of DLI and theories of lexical representation and theories of word access and processing are presented in chapter 7. Questions for further research are discussed in chapter 7 as well. The appendices contain the stimuli used in the linguistic tasks discussed in the thesis.

Chapter 1

Developmental Language Impairment and Linguistic Theory

1.1 Developmental Language Impairment (DLI)

Developmental Language Impairment (DLI) is also referred to as Specific Language Impairment (see Bishop, 1992; Clahsen, 1992; Watkins and Rice, 1994 for recent literature reviews). The term Developmental Language Impairment (rather than Specific) will be preferred in this thesis in order to highlight the pervasive and non-acquired nature of this language disorder[1].

1.1.1 Defining the impairment

DLI is defined as a non-acquired language disorder characterized by language difficulties in the absence of factors such as mental retardation (performance IQ is within normal range), articulatory-motor impairment, hearing acuity impairment, frank

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[1] Other terms have also been used over the last two decades to describe this impairment (see also Bishop, 1987; Clahsen, 1989; Gopnik, 1994d; Leonard, 1982; 1989: Plante, 1995; Tallal, 1975; Tallal et al., 1989; Tallal and Piercy, 1973).

neurological disorders, or psychoemotional disorders (for criteria setting, see Zangwill, 1978; Bloom and Lahey, 1978; Clahsen, 1989; Tallal, 1991). These criteria are broad and consequently SLI or DLI individuals can be a heterogeneous group (Aram, Morris and Hall, 1993). If we consider linguistic characteristics that are typcial of DLI individuals, however, it is possible to identify a fairly homogeneous population (Adams and Bishop, 1990; Clahsen, 1989; Gopnik and Crago, 1991; van der Lely, 1992).

Linguistic characteristics of DLI

DLI is defined in negative terms by exclusionary criteria: it is a "default" disorder in that it cannot be accounted for by factors that may cause other language impairments. There are, however, certain robust linguistic characteristics reported in the literature that are typical of DLI language.

On the morphological level, for example, DLI subjects typically have difficulty with inflectional affixation. Grammatical number, for example, is not marked consistently in plural noun phrases in DLI language production although plural forms are used (e.g. 'The book' vs. '*Two book'). This is observed in both spontaneous speech (Gopnik, 1992b) as well as in elicited data (see Oetting, 1992; Goad and Rebellati, 1994; Gillon and Gopnik, 1994 for English DLI and Clahsen 1989; 1991 for German DLI).

Other inflectional difficulties observed in the DLI literature are problems with tense marking and comprehension (for English DLI, Gopnik, 1994d; and Ullman and Gopnik, 1994). Also problematic are case marking (Frome and Leonard, 1991) and comprehension

of passive voice constructions (e.g. van der Lely, 1992). Moreover, English DLI subjects have difficulties with the formation and judgement of adjectival comparatives (Dalalakis, 1994a).

In addition to inflectional difficulties, DLI subjects also are reported to have problems with derivational morphology (Gopnik and Crago, 1991). DLI subjects are impaired in other linguistic domains as well. Piggott and Kessler-Robb (1994), for example, report that DLI prosodic words are limited to a single foot, at least in production. In addition, DLI subjects have syntactic difficulties. Van der Lely and Stollwerck (ms.) report on DLI difficulties with syntactic government and binding principles as evidenced in DLI performance on assigning coreference to anaphors and pronouns involved in syntactic antecedence.Van der Lely and Harris (1990) also observe that the deficit extends to other modules of syntax such as Theta Theory. Finally, DLI subjects tend to have difficulty with closed class words, often omiting or using wrong forms for articles (Le Normand et al., 1993) and prepositions (Rice, 1994).

Psycholinguistic characteristics of DLI

In addition to being different with regard to their spontaneous and elicited linguistic behaviour in off-line or non-timed tasks, DLI subjects are also significantly different when participating in on-line or timed psycholinguistic experiments. Specifically, DLI subjects are different from controls with regard to their accuracy and reaction times. Such results are found when DLI subjects take part in lexical decision tasks where they must decide whether

a written stimulus presented on a computer screen is a real word or not. DLI subjects can correctly judge novel words as non-words but they tend to reject more quickly than controls those stimuli that contain both novel and real morphemes (Kehayia, 1994).

Not only, therefore, do DLI individuals have difficulties inflecting grammatically in off-line contexts, it also appears that, unlike controls, DLI subjects are not sensitive to the presence of real inflectional affixes when these appear with novel roots (Kehayia, forthcoming) in on-line tasks. In particular, whereas the presence of the real affix seems to slow down stimulus rejection for controls, English and French DLI subjects do not react differently to simple novel words compared to novel words inflected with real affixes. For DLI subjects, non-inflected forms such as *zash* and inflected ones such as *zashed* do not contrast in terms of reaction time. Both French and English DLI subjects rejected simple novel words (e.g. zash) and inflected novel words (e.g. zashed) as non-words with the same speed and accuracy. Average reaction time for simple novel words for English DLI subjects was 825 milliseconds and for French DLI subjects 790 milliseconds (compared to 700 ms. for controls). Average reaction time for inflected novel words for English subjects was 810 milliseconds and for French DLI subjects 795 milliseconds (compared to 750 ms. for controls). Non-impaired controls, in contrast to DLI subjects, take significantly longer to reject inflected novel verbs than non-inflected ones with the presence of the real affix slowing word rejection down. The status of inflectional affixes, therefore, for DLI subjects seems to be different compared to controls.

This contrasts even with the performance of other language impaired subjects. For example, the presence of the real affix *-ed* with a novel root slows lexical decision down for subjects with acquired language impairment such as Broca's aphasics[2].

Another psycholinguistic characteristic of DLI subjects is that on off-line inflectional tasks, DLI subjects tend to do better on regular items of high-frequency whereas item frequency is not a factor in whether controls do well on regular inflection. Ullman and Gopnik (1994) report that in marking for past tense, controls show frequency effects only for irregularly inflected verbs whereas DLI subjects' performance for both regular and irregular past tense verb forms is affected by frequency .

We now review the main theories for DLI advanced to account for the deficit.

1.1.2 Theories and explanations for DLI

The main theories that have been proposed for explaining DLI fall into four main frameworks with each type having alternative models within it. Three of these four main frameworks will be termed 'non-linguistic' in that they see DLI as a disorder not affecting one's language learning competence per se but rather as an impairment of either general or specific processing capacities.

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[2] Broca's aphasics may have slower reaction times than non-impaired controls for online lexical decision tasks, but Broca's aphasics' reaction patterns and error patterns show that real bound affixes are recognized as such; this is in spite of the fact that Broca's aphasics may have impaired inflectional skills in spontaneous or elicited production often omitting or substituting affixes (depending on the structure of the language used); cf. Kehayia (forthcoming).

Among the non-linguistic hypotheses, DLI has been considered a deficit primarily affecting input processing at the auditory-perceptual level (e.g. Leonard et al. 1992, or Tallal et al. 1980). DLI has also been considered as an output processing problem due to higher level articulatory motor difficulties peripheral to the language module (e.g. Fletcher, 1990). Thirdly, it has been argued that DLI is one problem among several cognitive processing deficits (e.g. Johnston, 1991).

The fourth type of explanatory framework we will term 'linguistic' in that the models within it (not always but often complementary) all assume that DLI is primarily due to some impairment basic to the language learning module (e.g. Clahsen, 1989; van der Lely and Harris, 1990; van der Lely, 1992; Gopnik and Crago, 1991; Gopnik, 1992; Rice, 1994).

There is also a model that represents the 'null hypothesis' in comparison to the other views (Ingram, 1972; 1976; cf. Curtiss et al., 1992). This alternative model assumes that the language module and the processing capacities that subserve it are all un-affected and considers DLI a problem of language delay. In other words, the status of the language learning mechanism is intact but there is a delayed onset of some language acquisition mechanisms or an impaired rate of development. This general delay hypothesis predicts that DLI individuals' performance is simply analogous to that of children at a younger stage and that, other than that, there are no qualitative differences between the language of DLI children and younger controls.

As in most fields of research, over time, proponents of each view have modified their models to incorporate new findings so the above typology is most useful for illustrative purposes. We will briefly discuss the main differences and predictions of each of the non-linguistic and linguistic frameworks and focus on those that see DLI as a 'deviant' linguistic competence rather than a 'delayed' one. For a more detailed review of the literature on theories of DLI, the reader is referred to Johnston (1988), Clahsen (1989), Bishop (1992) and Gopnik (1992).

1.1.2.1 Non-linguistic approaches

The language delay hypothesis (e.g. Ingram, 1976) assumes that the potential of the language learning module itself will eventually be realized. Given that DLI is a persistent language impairment and that it continues well into adulthood without totally receding at some point (e.g. Matthews, 1994) , it may be more appropriate to see DLI, within the scope of this hypothesis, as an arrest at a certain early language acquisition stage rather than as a temporary delay.

The hypothesis that DLI is a language output processing problem also assumes that the underlying linguistic competence of the language-impaired subjects is intact but that processes which are used in converting this intact linguistic competence into an utterance are impaired (Fletcher 1990). The observations upon which this type of articulatory processing deficit are built are that DLI subjects seem to simplify articulation, their speech problems may occur with varying degree of severity, associated motor skills may be

affected hinting at dyspraxia, and that DLI subjects do not necessarily do badly on perception tasks (linguistic and non-linguistic).

This evidence is, to a large extent incomplete, however, and the articulatory deficit hypothesis cannot account for nor predict several phenomena. For example, DLI subjects have morphological problems cross-modally (in both written and oral expression or comprehension). It is difficult to appeal to an articulatory deficit hypothesis to account for DLI errors in linguistic tasks that do not require speech production but rather grammatical judgements, lexical decisions, sentence comprehension or pointing.

Moreover, limited capacity to produce utterances does not necessarily result in developing impaired receptive language skills in the congenitally mute or deaf (Petitto, in press) whereas it does in DLI subjects. Even if DLI subjects did have an articulatory or motor processing deficit, it would not necessarily be sufficient reason why they would have impaired morphological comprehension [3].

In addition, there are double dissociations between having articulatory difficulties and having DLI. Specifically, one may have articulatory problems and not be impaired in tasks testing linguistic competence in comprehension, and one may be a DLI subject

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[3] DLI subjects also have difficulties comprehending passive cleft sentences such as 'It was John that Mary kissed.' In such sentences, the Patient is topicalized and it cannot be argued that it is not perceptually salient. Nevertheless, DLI subjects tend to interpret such sentences in a strict SVO order. This has been observed for both English and French subjects tested by the Genetic Language Impairment Project at McGill University.

without significant articulatory difficulties. It is therefore unlikely that articulatory difficulties concurrent with DLI are causally related.

Finally, DLI subjects may produce articulatorily difficult or marked utterances such as contiguous voiced - unvoiced phonemes within consonant clusters, or extra phonemes in novel word formation, which strongly suggests that they are capable of articulating marked sequences[4]. Some phonologically marked utterances of DLI subjects even violate linguistic constraints such as the universal constraint that requires voice agreement within tautosyllabic obstruent clusters (Greenberg, 1978) as reported by Goad and Rebellati (1994).

Theories that propose that DLI is due to an auditory perception/processing deficit (e.g. Leonard et al., 1992; Tallal et al., 1980) assume that auditory perception or processing is impaired at some level of analysis and that this deficit consequently affects the course of language acquisition. In this view, the linguistic capacity per se is unaffected and remains potentially accessible. Over time, however, even if the original processing deficit eventually recedes, language use remains affected.

According to Tallal et al. (1996), language perception and, consequently production, may be improved by providing the young DLI individual with digitally slowed down auditory stimuli, so that they may learn to process the adjusted input similar to the way in which impaired sight may be corrected using prescription glasses (Tallal, 1996). The

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[4] DLI voluntary production of phonologically marked sequences also argues against dyspraxia (Geschwind, 1967; Walsh, 1978).

findings supporting this vew are controversial and their interpretation have been criticized on methodological grounds (Mody, Studdart-Kennedy and Brady, in press).

The observations upon which Tallal's (1996 and earlier) perceptual deficit hypothesis is based are that DLI children may have problems discriminating non-verbal auditory stimuli (non-linguistic sounds or nonsense syllables) if these stimuli are brief and rapid. It does not follow, however, that such auditory discrimination difficulties presented by non-linguistic stimuli can be causally correlated with difficulties in processing linguistic stimuli. Independent research (see further Walsh 1978; Caplan, 1987) has shown that linguistic auditory information is processed independently of non-linguistic auditory information.

The auditory deficit hypothesis proposed by Leonard et al. (1988) and Leonard (1989) argue that DLI individuals have a deficit in the way they process linguistic input such that 'non-salient' phonemes are difficult to perceive and morphological paradigms difficult to learn. Saliency itself is not a well-defined criterion in this theory but, assuming that non-saliency means phonemes of morphemes in non-stressed syllables, there are several other concerns with this proposal. Such an account is language-specific in that inflectional endings in English may be "non-salient" and therefore difficult to perceive but not in other languages where DLI is observed. Affixes marking inflection or derivation in other languages may contain stressed vowels (Greek, French) or they may be longer than one syllable (Japanese) so saliency arguments are not satisfactory. Morphemes marking

tense make different perceptual demands across languages yet we see similar morphological difficulties cross-linguistically in DLI populations.

In particular, the future tense marker in English is a free word (will), in Japanese it is a two syllable morpheme (deshoo), the French future affix occurs in a stressed word-final syllable (given that the stress assignment in French is word-final), and the future particle in Greek is also a free word (tha). We cannot, therefore, appeal to phonetic saliency to explain for DLI difficulties with the future tense. Even if we could, we would still need to account for other tense marking problems that DLI subjects have.

Irregularly inflected verbs or verbs which undergo total suppletion with tense change are also problematic for DLI subjects. For example, English DLI subjects have difficulties producing the appropriate past tense forms regardless of whether these forms are regular or irregular (Ullman and Gopnik, 1994). Regular past tense in English may require the "non-salient" affix -ed but irregular verbs have "salient" suppletive forms (e.g. go - went). Arguments, therefore, based on perceptual saliency (Leonard et al., 1992) of morphemes cannot account for the range of morphological problems observed in the DLI population.

Moreover, even in English, "non-salient" phonemes are perceived by DLI subjects when such phonemes appear in non-morphological contexts. Gopnik (1994c) reports that DLI subjects can distinguish between forms such as *bus* and *bust* or *car* and *card.* Yet these DLI subjects fail to morphologically distinguish between forms such as *bus* and *bussed* or *scar* and *scarred.*

Not only can DLI subjects hear the "non-salient" phonemes that are associated with inflectional morphemes, but they also produce inflected forms at times. Inflected words produced by DLI subjects, however, are not always used grammatically or consistently. Nevertheless, even inconsistent use of inflected forms indicates that individual phonemes which typically represent affixes are perceivable at least sometimes.

The third non-linguistic explanation for DLI considers the syndrome to be either a consequence of a general cognitive impairment (Johnston, 1991) or to result in conceptual deficits beyond linguistic competence (Johnston, 1994). Let us consider the first hypothesis. Whereas non-impaired children's development has been argued to follow a set of universal milestones (Piaget, 1954; see also Siegler, 1986), DLI children have been considered (Johnston, 1991) to have a deficit in their cognitive development so that this general conceptual impairment or deficit spills over to language learning and language use. There are several shortcomings with this theory. First, cognitive skills and linguistic skills are doubly dissociated. Individuals with Down syndrome or Williams syndrome have low performance IQ levels but are not characterized by the type of linguistic difficulties that DLI subjects are (Bellugi et al., 1992; Cromer, 1991). Conversely, DLI subjects are selected in most studies (Tallal and Stark, 1981; Tallal et al., 1991) to have performance IQ skills within the non-impaired range. In several studies (e.g. Bishop et al., 1994) DLI subjects have an even higher-than-average performance IQ level.

DLI subjects do use their unaffected cognitive skills to build compensatory strategies. Some impaired subjects, for example, learn prescriptive rules and do try to

consciously apply them as a compensatory strategy (Paradis and Gopnik, 1994). Yet when DLI subjects consciously apply such metalinguistic rules, they may produce phonologically marked forms (e.g. [wʌgs] for [wʌgz]; Goad and Rebellati, 1994) or morphologically ungrammatical forms (e.g. swammed for swam)[5].

Bishop (1992) cites several studies in which DLI subjects do well on non-linguistic conceptual tasks such as mental rotation of objects, or concrete operations that require the abstraction and use of implicit non-linguistic rules. Despite non-affected performance IQ levels, however, DLI subjects remain unable to abstract linguistic implicit rules that non-impaired individuals acquire and use automatically and unconsciously as part of their linguistic competence.

Although there may be interactions between the development of cognitive and linguistic skills (Karmiloff-Smith, 1978; Siegler, 1986; Johnston, 1994), linguistic impairments are not a necessary consequence of cognitive impairments. The skills that are not impaired in DLI subjects suggest that not all implicit or procedural rule-learning capacity is equally affected and that the only significant deficit in the DLI population is specific to language. A general cognitive deficit, therefore, cannot account for DLI linguistic difficulties.

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[5] Gopnik (1994b) reports that when debriefing a 17-year old English DLI subject after a past tense production task which contained novel forms, he described his strategy as one where he followed what he had been taught in school during language therapy: "In the past tense you put E D on it; if it's today, add I N G. So 'Today I went swimming. Yesterday I swammed' (emphasis is the subject's)".

1.1.2.2 Linguistic approaches

A basic assumption in this thesis is that DLI is an impairment affecting linguistic competence (for a review of alternative theoretical explanations of DLI see Bishop, 1992; Gopnik, 1994b; 1994c; 1995). This, in turn, assumes that linguistic competence can be specifically impaired as a module (Fodor, 1983; Pinker and Bloom, 1990). As to the epidemiological profile of DLI, converging evidence indicates that a significant predictor of DLI occurence is inheritance[6].

Within the linguistic deficit framework, researchers have focused on different aspects of DLI language difficulties. A common element to many of the analyses to be summarized below is that DLI subjects have difficulty with morphological features. Some analyses have interpreted this as a problem of feature representation (e.g. Gopnik, 1990a; 1990b) and others as a problem of feature agreement (e.g. Clahsen, 1989; Rice, 1994).

Clahsen (1989; 1991;1992), for example, has argued that DLI does not affect a broad range of morphological operations but rather the specific competence for person agreement between subject and verb. Clahsen has noted that German DLI subjects have difficulties with verbal inflection, and in particular subject - verb agreement, but do not

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[6] See Ingram 1959, Arnold 1961, Borges-Osorio and Salzano 1985, Samples and Lane 1985, Neils and Aram 1986, Robinson 1987, Tomblin 1990, Gopnik and Crago 1991, Tomblin, 1994. For most of DLI cases, a large proportion of the epidemiological variance is accounted for by genetic factors: concordance of monozygotic twins ranges from 80% (Tomblin, 1990) to 89% (Bishop, North and Donlan, 1994), compared to only 50% to 60% concordance between dizygotic twins and other first degree family relatives of DLI children.

seem to be significantly impaired with regard to feature agreement requirements within noun phrases.

In testing the ability of German DLI children to form plurals and compounds, Clahsen and Rothweiler (1992) have argued that noun phrase agreement in German DLI subjects is not significantly impaired. Cross-linguistic DLI difficulties with noun phrases, however, appear to vary in degree across languages.

If Clahsen's proposal on the specific subject-verb agreement deficit were to be expanded into a general missing agreement hypothesis, it would be too powerful in that it would predict German and English DLI problems that are not attested (such as determiner - noun agreement errors). The notion of impaired feature agreement on a more general morphological level, however, cannot be rejected until we consider DLI evidence from languages with richer inflectional morphologies. A broader morphological agreement deficit may account for other DLI inflectional errors in verb phrases (such as tense, number, voice, aspect) and noun phrases or adjective phrases (such as case, class, comparison) across different languages.

Rice (1994) has advanced the argument that DLI difficulties with verb and noun phrases can be captured by a posited deficit in head-specifier agreement. It has been argued (e.g. Chomsky, 1992; Wexler, 1992) that, within phrases, heads of maximal projections have to be checked for morphosyntactic feature agreement with elements in their respective specifier position. According to this position, DLI errors in case assignment, subject-verb agreement for person, and quantifier-noun agreement for number can all be due to an

impaired or non-developed competence which normally checks whether there is feature agreement between heads and specifiers.

Rice (1994) also proposes that the ability to check for head-head agreement is not significantly affected in DLI subjects. This head-head agreement is posited to be unaffected in order to account for the better performance of DLI subjects in marking number when noun phrases have determiners rather than quantifiers (e.g. 'The dogs' vs. 'Two dogs'). Moreover, Rice assumes that lexical heads are not affected, in comparison to functional category heads. This is in accord with the findings that lexical features do not appear to be affected in DLI. The specifier-head agreement deficit hypothesis is, therefore, a very specific version of the agreement deficit hypothesis.

In addition to the specifier-head agreement deficit, Rice (1994) also proposes an explanation for DLI verb phrase problems. In this second proposal, DLI subject-verb agreement errors can be accounted for by the hypothesis that DLI individuals have remained at an early stage of syntactic competence where non-inflected default verb forms are used for third-person present tense (for example, '*he go' instead of the correct 'he goes'). This stage, where forms are used without inflection for person, has been termed as the Optional Infinitive stage (Wexler, 1992). During this period, it is argued that non-impaired youngsters do not have a notion of tense and, therefore, do not mark verbs for finite tense. Bare verb stems (licit in English) are thus used instead of the inflected forms. Rice (1994) argues that DLI individuals do not mark tense in obligatory contexts due to their not moving beyond this Optional Infinitive stage. This second hypothesis of Rice is a

specific version of the hypothesis that DLI is due to a delayed onset of language acquisition mechanisms. Rice does not favour either proposal (head-specifier agreement deficit or extended optional infinitive stage) more than the other but rather leaves them both open to empirical investigation.

Van der Lely (1992) , van der Lely and Harris (1990), van der Lely (1992) and van der Lely and Dewart (1986) have argued that DLI is a deficit that affects syntactic competence. They identify difficulties at the level of Theta Theory, binding Principles, and passive voice constructions. For example, DLI subjects have problems with reversible passive sentences such as 'John was pushed by Harry.' where either noun referent has the pragmatic potential to be the Agent or Theme. The syntactic competence required to parse the syntactic structure without help from pragmatic clues is impaired in DLI subjects. In such sentences where either noun referent can be the Agent pragmatically, DLI subjects are biased to interpret reversible passives in an 'active voice manner' which is an SVO order misinterpreting the Patient as Agent. In the above example, 'John' would be most likely interpreted as the person doing the pushing since it is the first noun in the sentence and precedes the verb. DLI impairments at the level of the syntax such as those identified by van der Lely and her colleagues support the hypothesis that DLI is a linguistic competence deficit. This syntactic account, however, is more an analysis of a particular set of DLI difficulties and does not necessarily aim to be a theory explaining all linguistic characteristics of DLI.

Of the above linguistic proposals, no one alone can cover the entire range of DLI difficulties across languages or across different linguistic domains. For example, Clahsen's account focuses on morpho-syntactic aspects of the impairment and would need to be expanded in order to account for some of the phonological agreement difficulties (Fukuda and Fukuda, 1994b) or prosodic limitations (Piggott and Kessler-Robb, 1994) that DLI subjects manifest.

The postulation of morphological agreement deficits (Clahsen, 1992; Rice,1994) can account for certain DLI errors observed on the level of morphological inflection, but do not extend to DLI limitations with morphophonological structure or with syntactic structures across phrases. Specifically, hypotheses of DLI as a morphological agreement deficit cannot accout for findings that DLI subjects have difficulties when forming compounds in Japanese. In native compounds, obstruents in the second member of the compound must be voiced (so that *ori* + ***kami*** = *origami,* for example) but Japanese DLI subjects have difficulty applying this morpho-phonological rule of rendaku (Fukuda and Fukuda, 1990b). In addition when forming regular plurals in English, there is phonological voice assimilation between the word-final phoneme of the stem and the plural allomorph (so that [dot] becomes [dots] and [dog] becomes [dogz], for example) but DLI subjects have difficulty producing plural forms with correctly voiced plural allomorphs (Goad and Rebellati, 1994).

One linguistic deficit hypothesis that aims to explain DLI difficulties across linguistic domains (morphophonology and morphosyntax) has been advanced by Gopnik

(Gopnik, 1992a; contributions to Matthews, 1994; Gopnik, 1995). This linguistic deficit hypothesis postulates that DLI is an impairment of a subsystem responsible for generating any linguistic rules that are typically procedural, implicit and automatic and which are part of one's linguistic competence (Paradis and Gopnik, 1994).

This linguistic rule deficit hypothesis is supported by converging evidence from different linguistic domains (e.g., prosody (Piggott and Kessler Robb, 1994), morphology (e.g., Ullman and Gopnik, 1994, Goad and Rebellati, 1994; Dalalakis, 1994a)). As a linguistic deficit hypothesis, it addresses the level of linguistic processing. It is preceded by another linguistic deficit hypothesis proposed by Gopnik which addresses the level of representation (Gopnik, 1990a; 1990b). Gopnik (1990a) argues that DLI subjects may be impaired in noticing morphological features. Such morphological features are necessary in triggering morphological operations. If DLI individuals are 'blind' to morphological features, linguistic operations that involve such features would be impaired as well. Gopnik's two hypotheses will be considered here as complementary.

Gopnik's linguistic rule deficit hypothesis for DLI builds on earlier work by Pinker and his colleagues. Pinker's (1991) model for non-impaired language processing posits two complementary subsystems for building and processing lexical representations. First, he proposes a subsystem which handles regular morphology (e.g. *smile - smiled; table - tables*) which uses abstract linguistic, symbolic rules for computing inflectional forms from base forms. This rule-based subsystem is insensitive to the relative frequency of words. Morphologically regular items, whether frequent or not, are treated in the same categorical

manner. For example, the plural form of a low-frequency item such as *gnat* is formed as easily and quickly as that of a high-frequency item such as *cat*. In Gopnik's view (1994d; 1995), this rule-based subsystem is impaired in DLI individuals.

A second subsystem, functioning in parallel and complementary to the first, handles irregular or subregular morphology (e.g. *go - went; child - children; foot - feet*). This lexical subsystem proposed by Pinker is similar to associative network models proposed by connectionist frameworks (e.g. Bybee and Slobin, 1982; Rumelhart and McClelland, 1986) in which forms are related according to factors such as frequency and phonetic similarity on a continuum of varying productivity rather than according to discrete rule-governed linguistic characteristics.

Pinker argues that the two main subsystems are to a large extent independent and therefore, either one may be selectively impaired independently of the other. Evidence for their independence comes from normal language acquisition and use (including tasks on the inflection of novel verbs for past tense), and from doubly dissociated language impairments[7]. In the subsystem which is responsible for unpredictable or irregular morphology, storage and access of non-predictable forms are sensitive to relative frequency so that high-frequency items compete more successfully during access than do low-frequency items. For example, being irregular, *bring* may become *brang* in analogy to a phonetically similar irregular, *ring - rang,* but it will resist becoming *bringed* since

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[6] Acquired impairments, developmental impairments (including DLI; Pinker, 1991), and impairments associated with ageing (Alzheimer's, Parkinson's, Huntington's; see Ullman et al., 1994).

regular morphology is subserved by a separate, rule based subsystem. In Gopnik's view (1994d; 1995), the lexical sub-system is not significantly impaired in DLI individuals and it is used to compensate to some extent for the impaired rule-based subsystem.

Pinker (1991) and his colleagues (Marcus et al., 1992) have argued that the lexical subsystem, which is responsible for totally irregular (suppletive) morphology, also subserves subregular morphological classes (common irregular clusters). Such subregular clusters are stored in the lexical subsystem in associative networks defined as "families" of phonetically related forms (*sing - sang, ring - rang, sting - stang)*. These paradigm families compete when new base forms (roots) are acquired and need to be inflected. Irregular forms to be computed (inflected) show sensitivity to frequent types or families (*ring* becomes *rang* by analogy to *sing - sang)*. This contrasts with regular roots which are subserved by the rule-based subsystem because, with regular roots, grammatical rules apply categorically to automatically compute forms regardless of root frequency.

When infrequent irregulars (such as *oxen*) do not have a strong memory trace for lexical retrieval, they are regularized (*oxes* for *oxen*); that is, the two subsystems may complement each other. Highly frequent irregulars, or subregulars, on the other hand, can block the application of a regular rule (*feet* overrides the construction of *foots*).

There is evidence from elicited inflection formation tasks that conceptual features associated with verb forms (such as non-grammatical past) are spared in DLI representations but that morphological features which mark grammatical past tense are not significant in choosing verb forms in a past tense context. Ullman and Gopnik (1994)

compare DLI performance on past tense formation of real and novel verbs that are regular, irregular or subregular. They report that DLI subjects are inconsistent when marking tense morphologically on verbs of all types and fail to over-regularize real irregulars (dig - digged) or regularize novel verbs (crive - crived) like controls do. DLI subjects do select verb forms to be conceptually appropriate rather than morphologically appropriate.

To summarize, Pinker's (1991) model is adopted by Gopnik (1992; 1994d) as a basis for a linguistic explanation of familial or developmental language impairment (FLI or DLI)[8]. Gopnik (1994d; 1995) extends this hypothesis beyond the morphological level and argues that some fundamental aspect of the language acquisition device, namely operations which take advantage of our implicit, procedural language learning mechanism (Paradis and Gopnik, 1994) may be selectively impaired. According to this view, DLI does not appear to affect the complementary explicit, declarative, language learning subsystem, which would actually be responsible for the storage of morphemes or freely-occuring words themselves[9]. In effect, lexical acquisition of forms is assumed to be unaffected for DLI subjects. DLI is proposed to affect all linguistic rule building or abstraction, however, impairing implicit language rules at the morpho-phonological, morpho-syntactic as well as semantic level.

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[8] DLI, as a type of Specific Language Impairment (SLI), highlights its perseverence through an individual's linguistic development well into adulthood (Tallal et al., 1989; Aram, Morris and Hall, 1993). When DLI is present in familial aggregations, it is referred to as Familial Language Impairment.

[9] Of all linguistic level problems observed, DLI subjects are most significantly impaired in (and most tested at) morphology (e.g., Clahsen, 1989; 1991; Crago and Gopnik, 1991; Khan and James, 1983; Leonard et al., 1988; 1992), especially in tasks requiring inflectional operations.

If only linguistic rules are impaired and input to such rules is not affected, however, we should not observe problems for words that lack internal structure (such as pronouns) or are formed in the lexical subsystem proposed by Pinker (1991) (such as subregular past tense forms). Gopnik's (1994d) rule-deficit hypothesis does not predict this problem (see also Lois, 1995 for a review of the current theories for DLI and their predictions).

DLI subjects, when tested across different linguistic tasks, tend to resort to a set of compensatory strategies when required to form new words. For example, when DLI subjects are required to inflect novel nouns or verbs, they tend to rely on conceptually appropriate and phonetically similar existing forms, especially high-fequency ones (Ullman and Gopnik, 1994; Fukuda and Fukuda, 1994b). Thus, it is argued, DLI subjects learn regular forms such as *walk - walked* in the same manner that they do irregular ones such as *go - went* conceptually marking both regular and irregular past forms as past without differentiating them as morphologically simple (walk- go - went) or complex (walked).

DLI subjects also attempt to use explicitly learned metalinguistic rules of thumb - but their utterances or responses are not always grammatical. Gopnik (1994b) reports an English DLI subject who explains his strategies on word formation in a post-task debriefing session as having been learned at school or in language therapy.

Some word formation skills are evident in DLI performance; for example, DLI subjects can and do combine elements but do not produce typical compounds. For example, morphologically motivated voice agreement across compound elements in Japanese is problematic for DLI subjects who cannot distinguish between those compounds which

require obligatory voice agreement across the elements being compounded and those compounds where there need not be voice agreement (Fukuda and Fukuda, 1994b). The process of voicing in some compounds, known as rendaku, is observed when a word-initial voiceless obstruent becomes voiced when it is the second member of a compound (e.g. ori + kami = origami). This process is impaired in Japanese DLI subjects who do not seem to know when the rendaku rule applies. The impairment is evidenced in the production of novel compounds where Fukuda and Fukuda observe that DLI subjects do not voice obstruent-initial elements (e.g. producing forms such as orikami instead of origami).

German DLI subjects are also observed to be able to form compounds. Clahsen et al. (1992) argue that DLI children can differentiate between regular and irregular nouns and respect the restriction of compounding that allows as first elements only forms not regularly inflected. In Clahsen's compounding study, controls and DLI subjects both tend to avoid regular inflection within compounds. Both DLI and controls, thus, are in accord with the predictions of Kiparsky's (1982) model of Lexical Phonology and level ordering. Kiparsky's proposal argues that only lexically stored forms such as singulars and irregular plurals can be used as first elements in compounding. It is possible, however, that DLI subjects and controls avoid inflected forms as first elements of compounds for different underlying reasons. DLI subjects, for example, tend not to mark plural more often than controls even when not compounding.

Respect for level ordering is also observed in the performance of English non-impaired youngsters (Gordon, 1985). English youngsters therefore may produce forms such

as *mouse-eater*, *rat-eater* or *mice-eater* but avoid producing forms such as **rats-eater*. In an elicited compound formation task based on Gordon's (1985) study, Oetting (1992) found that English DLI children were able to form compounds as an operation. Although in Oetting's (1992) study DLI subjects produced compounds where the first element was not regularly inflected, they were also more likely than controls to produce compounds where the first element was a regularly inflected form.

1.1.3 Questions to be addresed in this thesis.

A question to address in this thesis is whether DLI subjects are impaired at the morphological level of representation or at the level of morphological processing (or both). What morphological features are present in DLI representations? If the representation of certain features is impaired[10], there are a number of possible consequences. A feature representation deficit would affect abstracting, storing, and using underlying representations of bound morphemes. Intact morphological representations are the input (and as such are a prerequisite) for non-impaired word formation operations. In addition, intact morphological representations are required for a number of syntactic operations that involve morphosyntactic agreement (e.g. specifier-head agreement, antecedent agreement).

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[10] Cross-linguistically, DLI subjects respect lexical category features which are universal although they have difficulty with non-universal morphological features such as number, case, and gender.

An impairement at the level of morphological representation also has implications for the type of units to be found in the mental lexicon of DLI subjects. The types of representations that DLI subjects can build in their mental lexicon may be limited in structural complexity or feature specification. Much of the focus in the DLI literature has been on affixation difficulties which have been interpreted to be either impaired linguistic representations (Gopnik, 1990a; 1990b; Goad and Rebellati, 1994) or impaired linguistic operations (Clahsen, 1989; Gopnik, 1992a; Rice, 1994; van der Lely, 1992). This thesis investigates the status of bound lexical morphemes both in terms of structural representation and in terms of feature representation.

On the level of the mental lexicon, impaired representations of features and structure would also have consequences for word decomposition on on-line tasks since word internal structure would be different for DLI subjects.

Although DLI may have consequences for a number of linguistic domains (phonology, morphology, syntax), we will focus here on the difficulties of DLI subjects with morphological competence which are more widely noted in the literature.

Given the findings in earlier work that show DLI subjects have difficulties with word formation (Matthews, 1994) and word decomposition (Kehayia, 1994), the following questions arise: (a) What is the extent of DLI insensitivity to word-internal structure and to morpheme features? and (b) Is this insensitivity equally evident in all complex word formation, namely inflectional, derivational and compounding processes? Following on previous research, these questions are to be addressed in this thesis in three sets of main

experiments: plural formation, nominal compounding, and diminutive formation and comprehension.

These word formation operations are observed early in non-impaired children's development cross-linguistically (from (2;0) onwards) in Greek (Stephany, 1995) and other languages (Clark, 1993).

Specifically, in Greek plural formation, the bound root is obligatorily inflected (e.g *alogh-o* 'horse' becomes *alogh-a* 'horses'). The root's subcategorization frame specifies what inflectional affix is acceptable in terms of class and gender features. In compound formation, the two roots being compounded result in a stem that must be obligatorily inflected (e.g. *lik-* 'wolf' and *anthrop-* 'man' become *lik-anthrop-os* 'werewolf'). In diminutive formation, the nominal root is mapped to a derivational suffix to form a derived stem (e.g. *alogh-o* becomes *alogh-ak-*) which must then be inflected (e.g. *alogh-ak-* becomes *alogh-ak-i*).

The contribution of this work to refining our understanding of DLI is to determine whether DLI subjects are able to abstract and use features and structure of bound roots and affixes in word formation tasks or whether their morphological difficulties are limited to affixes only. Evidence of difficulties with both types of bound morphemes (i.e., affixes and roots), would support the linguistic deficit hypothesis over the view that DLI is a peripheral language processing impairment affecting only word ends. Such evidence would also inform us of the extent to which representation of morphological features and word-internal structure is impaired in DLI.

1.2 Assumptions on the morphological representation of features and structure

Theories of lexical representation make a number of assumptions as to what information is represented in the lexicon and what the minimal unit of morphological representation may be. Lexical representations are generally assumed to have a set of different linguistic features. Specifically, lexical representations are assumed to have features relating to (a) the surface form of the represented item (e.g., phonological), (b) the lexical or syntactic features of the item which project their properties to the phrase that the word belongs to (e.g. Noun, Verb)[11], (c) the sublexical or subcategory features of the item which are lower than the lexical features on the word structure tree and important for the syntax of the word (e.g. inflectional class, gender, count noun/ mass noun), (d) the meaning associated with the representation, and (e) any idiosyncratic characteristics of the item. An example is illustrated in (1) for the English word 'mouse':

(1) lexical entry: MOUSE

(a) phonological information:	[maus]
(b) lexical /syntactic information:	noun
(c) sublexical information:	singular, count
(d) denotative meaning:	primary: small rodent, grey-brown; 2ndary: computer auxiliary, white
(e) idiosyncratic information:	primary meaning has irregular plural form MICE

[11] Chomsky (1965) distinguishes between major lexical categories such as Noun, Verb, and Adjective.

Although the nature of representations in theories of the lexicon is a controversial issue, there is general agreement that morphological competence includes a set of representational units and a system of well-formedness principles about how units combine with each other. It has been proposed that subcategory frames of lexical representations are associated with selection restrictions that allow rules of word formation and well formedness to concatenate elements which agree with regard to what items they may attach to and what syntactic outputs they will result in (cf. Spenser, 1991). There is controversy with regard to the types of units that are represented in the lexicon. Although most lexicon theories accept roots as represented units, affixes are considered to be morphemes or primitive units in some theories (e.g. Lieber, 1992) and rules in others (e.g. Halle, 1973).

Proposals for affix representation also distinguish whether affixes are inflectional or derivational Aronoff (1976; 1994). Inflectional affixes, especially those participating in productive inflectional paradigms, for example, are represented by word formation rules rather than in the lexicon. In contrast, derivational affixes are argued to be listed in the lexicon, perhaps because they are associated with a denotative meaning just as lexical roots are. For Lieber (1992) both inflectional and derivational affixes are argued to be part of the set of primitives listed in the lexicon.

A strong lexicalist view would argue that simple and complex words as well as bound morphemes (inflectional and derivational) may all be represented in the lexicon. A weak lexicalist view, in contrast, would 'split' morphology and argue that much of word

formation is subserved by syntax and therefore only primitives such as roots and derivational affixes (non-predictable information) or idiosyncratic elements (complex or simple) would be represented in the lexicon. Aronoff (1994) proposes that morphology and syntax may be independently involved in inflectional word formation in that inflectional paradigms may be considered as part of morphology even though they may also be governed by syntax. In either case, non-impaired native speakers are assumed to have knowledge of both morphological features and morphological structure.

It is assumed in this dissertation that the lexicon contains entries for (a) free forms (irregular or idiosyncratic words, closed class words, and roots that are licit words); (b) bound forms (roots, idiosyncratic or morphologically opaque stems, derivational affixes, and predictable inflectional affixes); and (c) a set of rules for evaluating well-formedness.

Bound morphemes are assumed to be abstracted from attested words that form productive morphological paradigms in the language (Williams, 1994). Free and bound morphemes may serve as input for Word Formation Rules (Halle, 1973; Aronoff, 1976; Pinker, 1991) provided they meet selection restrictions (Chomsky, 1965) and subcategorization restrictions (Lieber, 1992).

Word formation rules (including productive inflectional paradigms) and their products (complex words that are inflected, derived or compound forms) respect well-formedness requirements. Word-internal structure of words is therefore reflected in the way the primitives are used by word-formation rules.

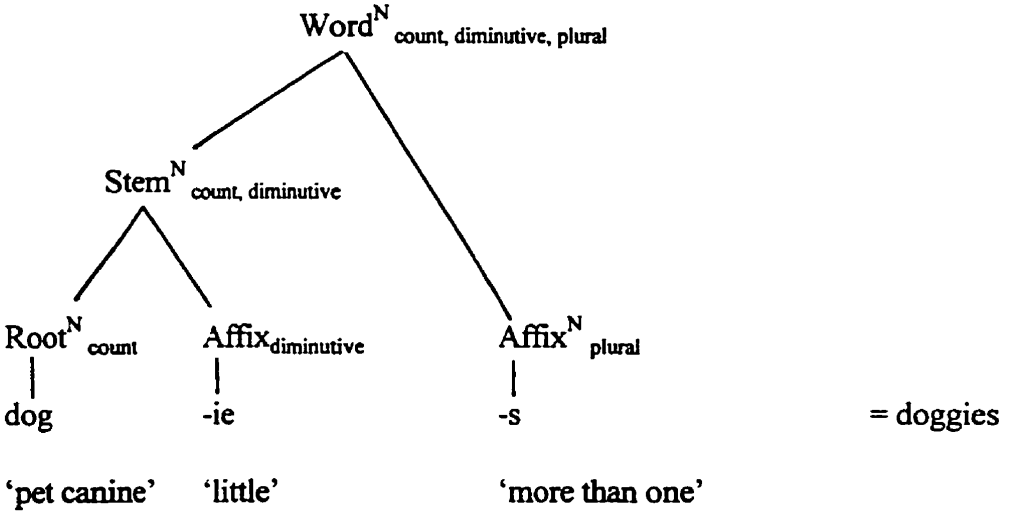
If complex words or phrases have idiosyncratic meanings (e.g. sister-in-law), they may be represented redundantly in the lexicon (as in Halle's (1973) concept of dictionary) even though their constituents are also assumed to be represented.

Regular morphology and irregular morphology are assumed to be represented and computed in parallel subsystems (as proposed by Pinker, 1991) and access of existing irregular forms may block the computation of regular ones.

Also adopted are the notion of relativized heads (Williams, 1981) and the notion of feature percolation conventions (Lieber, 1992). Percolated morphological and syntactic features are 'visible' to the syntax for the purposes of feature checking for head to head agreement or specifier head agreement (Lieber, 1992; Hale and Keyser, 1993; Keyser and Roeper, 1992; Pesetsky, 1994; Fabb, 1988).

A representation of a complex noun form, for example, would be fully specified for its morphological features and structure as illustrated in (2) for the English word 'doggies':

(2)



To summarize, the assumption in this thesis is that the lexicon contains fully specified representations of both simple and complex forms. Any redundancies (where complex forms are represented as well as their constituents) are part of the strength and flexibility of the lexicon rather than a metatheoretical weakness due to lack of parsimony.

1.3 Assumptions on morphological processing

For linguists, the questions about the nature of lexical structure are often based on patterns of word formation. In contrast, for theories about the mental lexicon, most assumptions are based on experiments that rely on word recognition and word decomposition. In psycholinguistic theory, therefore, the mental lexicon is not necessarily the same as the lexicon in linguistic theory. Nevertheless, psycholinguists assume that morphological processing, word access and word recognition all depend on some of the same factors of organization posited by linguists for the organization of the lexicon. For example, access of lexical representations may be sensitive to phonetic, morphological or semantic similarity, as well as to relative frequency (cf., Marslen-Wilson et al., 1994). Most findings on the mental lexicon and its organization come from timed experiments of subjects' reactions to visually presented word stimuli. For example, in the lexical decision experimental paradigm typically used in psycholinguistic experiments probing

morphological representations, subjects are asked to decide whether a stimulus is a real word or not either without the target having been primed (simple lexical decision task) or with the target having been primed by another word. Response patterns are examined for accuracy and speed and are interpreted as clues on how the lexicon is organized in the mind.

Taft and Forster (1975; 1976) have argued that in word recognition there is a process of word decomposition by which complex forms are analyzed into their constituents (concatenated roots and affixes). Each morpheme can then be matched to a stored form. Polymorphemic forms which are derived by combining roots and affixes need not also be represented themselves if their constituents already are. In contrast to Taft and Forster, Butterworth (1983) argues for a 'full-listing hypothesis' according to which the lexicon contains representations of both simple and complex forms (cf. Stemberger and MacWhinney, 1988). In such a lexicon, there are free morphemes and free complex words but each stored item is specified for its morphological features and structure. Marlsen-Wilson et al. (1994) argue that the morpheme is the basic unit in terms of which the lexicon is organized. They qualify this morpheme as 'cognitive' in that morphemes are whatever units lack structural transparency (using the term 'morpheme' thus to include morphologically opaque linguistic stems).

In this thesis, a hybrid model for the mental lexicon is assumed. Both whole words and morphemes are available or accessible. Bound morphemes, regardless of whether they are lexical (roots) or functional (affixes) are also available. Idiosyncratic words being processed may be accessed as whole forms regardless of whether they are simple or

complex. Lexical representations may be accessed using two parallel competing strategies: as whole words or decomposed into units depending on the idiosyncrasy and frequency of the word (Caramazza et al., 1988).

1.4 Research tools

In this thesis, off-line production and comprehension were used to test the morphological competence of DLI subjects. Greek DLI subjects and controls were tested on a set of production tasks using real and novel words: (a) plural formation which examined the subjects' ability to match roots and inflectional affixes for morphological features of class and gender while inflecting for number; (b) diminutive formation which examined the subjects' ability to match roots with derivational affixes and then match the resulting stems with inflectional affixes; and (c) compound formation which examined the subjects' ability to compound bound roots and then inflect the resulting stems. These production tasks aimed to test the representational status of roots and affixes in terms of structure and feature specification.The reason why Greek DLI subjects were studied are presented in chapter 2 and the general methodology of the experimental tasks is presented in chapter 3.

Chapter 2

DLI and Greek Morphology

2.1 Cross-linguistic evidence

DLI is attested in various languages[12] suggesting that it may affect basic language skills not specific to any one language. DLI is a deficit that limits or impairs linguistic competence at the level of word formation (Gopnik, 1994d) and morpheme representation (Goad and Rebellati, 1994). DLI subjects across languages have similar difficulties with inflection (Gopnik et al, 1996) and resort to similar compensatory strategies (linguistic as well as non-linguistic strategies; Paradis and Gopnik, 1994). If linguistic competence[13] is

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[12] French: Gopnik (1990b); LeNormand et al. (1993); Royle (1996); Inuktitut: Crago and Allen (1994); Italian: Leonard et al. (1988); Hebrew: Rom and Leonard (1990); Japanese: Fukuda and Fukuda (1994a); Greek: Dalalakis (1994b); Stavrakakis (1996).

[13] DLI is not modality- or channel-specific (i.e., to the extent tested, it affects all manner of expression and comprehension: oral and written expression, aural comprehension and reading ability) nor is it restricted to one lexical category as is often the case in aphasic patients (cf. Caplan, 1987; i.e., DLI affects noun, verb, adjective phrases).

affected due to a malfunction in the ability to build and use implicit linguistic rules, we would expect to find DLI type language difficulties in a comparable manner, cross-linguistically. These expectations are substantiated (see also Gopnik et al., 1996).

Cross-linguistic evidence is valuable in understanding DLI for a number of reasons. First, cross-linguistic evidence may help support one explanation over another with regard to what is impaired. Explanations for DLI have to be able to make predictions that are empirically testable in different languages. For example, articulatory or temporal processing explanations cannot easily account for inflectional difficulties across languages which make different articulatory or auditory processing demands for marking the same grammatical feature. Specifically, when tense is marked by free morphemes (as the future tense in English *will* or Greek *tha*) or by two-syllable morphemes (as in the probable future in Japanese *deshoo*), it is realized with morphemes that vary for phonological salience. Yet it is equally problematic in all three languages.

Secondly, where languages differ in structure, they can provide different clues to the linguistic limitations of DLI individuals. English allows lexical roots to surface as real words and so to investigate the knowledge of bound morphemes we must consider affixes. English does allow us to see that affixes are problematic for DLI subjects, but we cannot examine the status of bound roots in English as easily. Therefore, in order to study the kind of representations that DLI individuals build for bound roots, we need to examine DLI performance in a language that has bound roots.

It is for this reason, that Greek DLI was investigated in this thesis; Greek morphology, as will be described below, provides the conditions for investigating bound roots. In addition, Greek roots subcategorize for a number of features that must be fully specified in their representation in the lexicon in order for inflection to be grammatical. Greek DLI subjects, therefore, would inform DLI theory about both word structure limitations and morphological feature limitations.

2.2 Morphology in Greek

Greek lexical roots are bound, which means that, just like English affixes, they cannot surface as free forms. Lexical roots in Greek require affixes that denote Number, Gender, and Case for nominals, and Number, Person, Tense, Aspect, Voice, and Mood for verbs. In Greek compounding, bound roots may combine with other bound roots and then undergo inflection. In this context, the first root can surface licitly without inflection when followed by another root or stem.

For example, the root *lik-* (wolf) may not surface without inflection. Such a root may surface as a noun, with a number of different noun inflections (1). A root may also surface with derivational affixation followed by inflectional affixation (2) and it may also appear as part of a compound (3). What is in common to all the realizations of the root is that the root is never realized in isolation. The occurrence of a root under these three conditions is taken as evidence that the root has independent status.

(1) The root LIK- 'wolf' with its inflection marking gender (masc.), number and case:

	Singular	Plural
Nominative	LIK- os	LIK- i
Genitive	LIK- u	LIK- on
Accusative	LIK- o	LIK- us
Vocative	LIK- e	LIK- i

(2) The root LIK - 'wolf' is used to derive the stem *lík-en-* which is then obligatorily inflected for gender (fem.), number, and case as *líken-a* 'she-wolf':

[[[LIK-] -en]$_{\text{female}}$ - a]$_{\text{feminine, singular, nominative}}$ = líkena 'she-wolf'

(3) The root LIK- 'wolf' in the compound *likánthropos* (wolf-man) 'werewolf' inflected for gender (masc.), number, and case:

[[LIK -] [ANTHROP -] -os]$_{\text{masculine, singular, nominative}}$ = likánthropos 'werewolf'

In this thesis, three different morphological operations are considered: inflection, derivation and compounding. The remainder of this chapter provides some theoretical background on Greek (a) plural inflection, (b) diminutive derivation, and (c) nominal compounding.

2.2.1 Nouns

Greek noun inflection is realized with a number of different endings. Each ending expresses a set of morphological features, namely number, class, gender and case. The root subcategorizes for what gender and class features the inflectional affix must have. In table 2.1 there is a summary of the various options for plural formation in Greek for masculine nouns; in table 2.2 a summary for feminine nouns and in table 2.3 one for neuter nouns.

The nominative form of masculine nouns have two possible plural affixes: *-es* or - *i*. The majority of feminine nouns have *-es* as a plural affix in the nominative case with only a few taking - *i* . Neuter nouns have two main affixes in the nominative plural: most neuter plurals end in *-a* and some in *-i* .

Table 2.1 Plural allomorphs for masculine nouns (from Triandafilidhis, 1992)

Type	Affix		Example	
	Singular	Plural	Singular	Plural
Regular				
Stress on ultimate syllable	-os	-i	uranós 'sky'	uraní 'skies'
	-is	-es	nikitís 'winner'	nikités 'winners'
Stress on penultimate syllable	-is	-es	náftis 'sailor'	náftes 'sailors'
	-as	-es	aghónas 'race'	aghónes 'races'
	-os	-i	dhrómos 'street'	dhrómi 'streets'
Stress on antipenultimate syllable	-as	-es	fílakas 'guard'	fílakes 'guards'
	-os	-i	ángelos 'angel'	ángeli 'angels'
Irregular I				
Stress on ultimate syllable	-as	-adhes	papás 'priest'	papádhes 'priests'
	-es	-edhes	kafés 'coffee'	kafédhes 'coffees'
	-us	-udhes	papús 'grandfather'	papúdhes 'grandfathers'
Stress on penultimate syllable	-is	-idhes	nikokíris 'landlord'	nikokíridhes 'landlords'
Stress on antipenultimate syllable	-is	-idhes	fúrnaris 'baker'	furnáridhes 'bakers'
Irregular II				
Stress on ultimate syllable	-is	-es \ -adhes	afendis 'lord'	afendes 'lords' afendádhes 'lords'

Table 2.2 Plural allomorphs for feminine nouns (from Triandafilidhis, 1992).

Type	Affix		Example	
	Singular	Plural	Singular	Plural
Regular				
Stress on ultimate syllable	-a	-es	kardhiá 'heart'	kardhiés 'hearts'
	-i	-es	psykhí 'soul'	psykhés 'souls'
Stress on penultimate syllable	-a	-es	óra 'hour'	óres 'hours'
	-i	-es	níki 'victory'	níkes 'victories'
Stress on antipenultimate syllable	-a	-es	thálasa 'sea'	thálases 'seas'
	-i	-es	zákhari 'sugar'	zákhares 'sugars'
Ancient Greek inflection	- i	-is	sképsi 'thought'	sképsis 'thoughts'
	-os	-i	dhiámetros 'diameter'	dhiámetri 'diameters'
Irregular I				
Stress on ultimate syllable	-a	-adhes	yayá 'grandmother'	yayádhes 'grandmothers'
	-u	-udhes	alepú 'fox'	alepúdhes 'foxes'

Table 2.3 Plural allomorphs for neuter nouns (from Triandafilidhis, 1992)

Type	Affix		Example	
	Singular	Plural	Singular	Plural
Regular				
Stress on ultimate syllable	-o	-a	vunó 'mountain'	vuná 'mountains'
	- i	-ia	pedhí 'child'	pedhyá 'chilren'
Stress on penultimate syllable	-i	-ia	traghúdhi 'song'	traghúdhia 'songs'
	-o	-a	péfko 'pine'	péfka 'pines'
	-os	-i	méros 'place'	méri 'places'
Stress on antipenultimate syllable	-o	-a	sídhero 'iron'	sídhera 'irons'
	-os	-i	édhafos 'ground'	edháfi 'grounds'
Irregular				
Stress on ultimate syllable	-os	-ota	fos 'light'	fóta 'lights'
Stress on penultimate syllable	-as	-ata	kréas 'meat'	kréata 'meats'
	-a	-ata	kíma 'wave'	kímata 'waves'
Stress on antipenultimate syllable	-a	-ata	ónoma 'name'	onómata 'names'
	-o	-ata	fteksimo 'blame'	fleksímata 'blames'

There is no clear default pluralization rule. Nominal borrowings from other languages into Greek do not necessarily get adopted into the case and number system. Borrowings which are phonetically similar to native words, may eventually be fully adopted and given inflectional affixes. Whether a borrowed noun becomes fully assimilated into an inflectional paradigm may thus depend on whether there are native nouns that are phonetically similar. Borrowings with no phonetically similar native words may exist without overt marking for number or case in the language[14].

Examples of the former case would be the nouns *stilós* 'pen' (masc.), *taksí* 'taxi' (neuter), and *kórna* 'vehicle horn' (fem.). The noun *stilós* (borrowed from French *stylo* 'pen') existed for a while as *stiló* (neuter) without case or number but has since been adopted as *stilós* by many speakers on analogy with a large number of native masculine nouns and adjectives ending with *-ilos*. The noun *kórna* (borrowed from Italian *corna* 'car horn') was easily adopted as a feminine noun since a large number of native ones end in *-a*. The noun *taksí* (borrowed from French *taxi* 'taxi') was first used as a neuter noun without case or number, but has now come to be fully adopted into the case system as a neuter noun on analogy with many native neuter nouns ending in *-i*.

Examples of cases where borrowings do not acquire any native inflection are likely to be more recent borrowings, such as *body-building*, or *fax*, although there are also a

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[14] This interaction between phonetic shape and morphological operations is noted in other languages as well as discussed in Aronoff (1994).

number of older borrowings, as well, such as *kheruvím* 'cherub or cherubs', or *portatíf* 'table lamp'. Such borrowings are not phonetically similar to any native nouns due to coda restrictions (word-final codas of native words are either [n] or [s]). Consequently, phonetically marked borrowings are used without inflectional suffixes to denote case, gender or number, and these features are marked only on optional determiner or modifier elements of the noun phrase.

There is no perfect correlation between gender and the phonetic shape of the plural endings. For example, almost all feminine singular nouns take the same plural morpheme *-es* regardless of variation in their singular inflectional affix and stress assignment (e.g. *kharά - kharés* 'joy - joys'; *khóra - khóres* 'country - countries'; *fiyí - fiyés* 'fleeing - fleeings'; *zésti - zéstes* 'hot time - hot times').

However, *-es* may also appear with masculine plurals (*mathitís - mathités* 'student - students'; *alítis - alítes* 'tramp - tramps'). Similarly, masculine singular nouns (e.g. those ending in *-os*) may take *-i* as a plural morpheme (e.g. *yéros - yéri* 'old man - old men'), but *-i* may also appear with some feminine plurals (e.g. *éksodhos - eksódhi* 'exit - exits') or even singulars.

Even though roots may arbitrarily fall into inflectional paradigms, some generalizations do hold. For example, *-es* is never associated with neuter plurals; *-a* , as a plural marker, is associated only with neuter nouns. The assumption here is that the subcategorization frame of an inflectional morpheme must contain information as to what features it represents so that a noun root may appropriately select for these features.

Knowing the singular suffix of a noun does not necessarily help in determining what the plural one will be since the inflectional class that a noun belongs to may be lexically determined.

Representation of nouns

It is assumed that lexical roots are abstracted by speakers from a set of surface forms (as in (1)) in order to be used in productive inflectional, derivational and compounding operations. Most native roots are consonant-final and inflectional affixes are vowel-initial so that the final consonant of the root and the nucleus of the inflectional affix usually appear in the same syllable as illustrated in (4)[15].

Consider the following examples for the masculine noun 'dog' (4a), the neuter noun 'forest' (4b) and the feminine noun 'base' (4c). The nominative case of 'dog' is *ski.los* and we see here that the root (SKIL-) is distributed over two syllables. The same spread of the root over two different syllables is observed for almost all Greek nouns of all genders[16]:

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[15] This is significant in that it does not inhibit non-impaired children from abstracting the root whereas DLI individuals appear to judge root boundaries by syllabic criteria, favouring core syllable root boundaries rather than respecting consonant-final root boundaries. We return to this issue in the error analysis of the pluralization task in chapter 4.

[16] I would like to thank Heather Goad for bringing to my attention the fact that the right edge of Greek roots does not correspond to the right edge of a syllable. Hence, there is a mismatch between the edges of morphological and prosodic categories.

(4a)	SKIL- (dog)	(the)	*Singular*	(the)	*Plural*
	Nominative	o	SKIL os	i	SKIL i
	Genitive	tu	SKIL u	ton	SKIL on
	Accusative	to(n)	SKIL o	tus	SKIL us
	Vocative		SKIL e		SKIL I

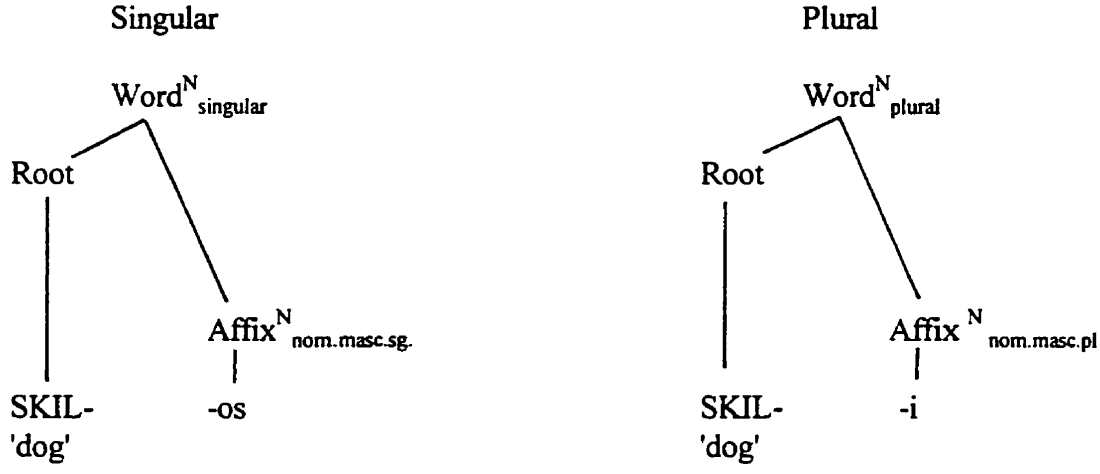
(4b)	DHAS- (forest)	(the)	*Singular*	(the)	*Plural*
	Nominative	to	DHAS os	ta	DHAS i
	Genitive	tu	DHAS us	ton	DHAS on
	Accusative	to	DHAS os	ta	DHAS i
	Vocative		DHAS os		DHAS i

(4c)	VAS- (base)	(the)	*Singular*	(the)	*Plural*
	Nominative	i	VAS i	i	VAS is
	Genitive	tis	VAS is	ton	VAS eon
	Accusative	ti(n)	VAS i	tis	VAS is
	Vocative		VAS i		VAS is

The theoretical assumptions for non-impaired morphological representations are that nouns have complex internal structure in that both the root and the inflectional affix are represented, each with its associated morphological features (as illustrated in (5)). Both singular and plural forms respect (a) morphological principles necessary to match features of affixes to those of roots, and (b) hierarchical morphological relationships among

morphemes found in a single word as constrained by feature percolation conventions (Lieber, 1992) and relativized head properties (Di Sciullo and Williams, 1987)[17].

(5)



It is assumed here that the root subcategorizes for an inflectional affix that is the relativized head of the word with regard to its syntactic category (in accordance with the Righthand Head Rule (Williams, 1981)). Without inflection, a native root or stem (which would both be lexemes according to Aronoff, 1994) cannot surface. The inflectional class that the root will be associated with is arbitrary but it is important that the root be associated with one. The inflected word can then inherit the features of the affix ([+N], gender, class) and morphosyntactic checking for case and number agreement is possible.

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[17] Morphological headedness in Greek is always on the right with inflectional morphemes carrying morphosyntactic features, and almost always on the right with regard to semantic features in compounds (this is further discussed in Chapter 5).

The assumptions regarding the representations of DLI individuals will be presented in the general research questions and hypotheses section at the end of this chapter, and specific hypotheses with regard to representations of nouns will be outlined in the chapter dealing with of each experiment.

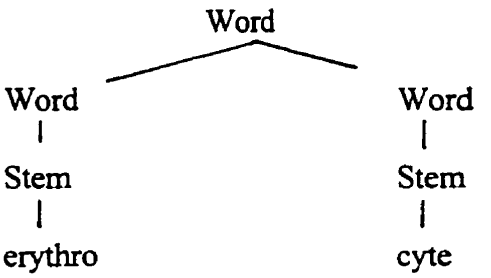
2.2.2 Compounds

We will consider only compounds in which one element functions as a head, namely endocentric compounds. The other element in endocentric compounds is a modifier which has the function of attrributing a property to the head, much like the function of an attributive adjective (Spencer, 1991). Another property of the endocentric compounds we will be considering, and the reason that makes them appropriate objects of study for this thesis to consider is that these are root compounds. In Greek, the first element may be a bound root or a stem and the second or right-most element, which is the semantic head, may be a root or a stem as well.

Finally, two types of endocentric compounds will be examined: (a) primary (root) compounds and (b) synthetic (verbal) compounds. "Primary compounds are simply concatenated [roots (as in the English *doghouse*) whereas] synthetic compounds are formed from deverbal heads and the non-head fulfils the function of the argument of the verb from which the head is derived [(such as the English] *truck driver* 'one who drives a truck')" (Spencer, 1991: 319).

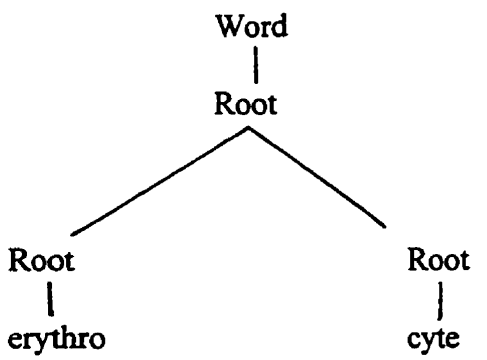
English has borrowed a number of Greek stems that appear in compound formation and these compounds are often called neo-classical or non-native compounds. In morphological theories such as those advanced by Selkirk (1981) and Williams (1981) bound stems that appear in neo-classical compounds such as *erythrocyte* 'red cell' are assigned to a level below that of the word as illustrated in (6); that level is the Stem level:

(6a)



Selkirk (1982) considers the level below the word to be the root level and, if necessary, there may be more than one root level so the Root is treated as a recursive category as illustrated in (6b):

(6b)



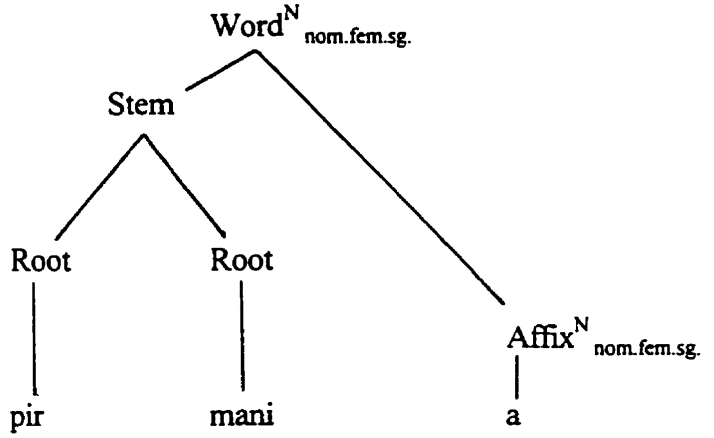
In this thesis, in examining Greek compounding, we will assume that each lexical element is a root rather than a stem; the term stem will be used when a root is followed by derivational affixes as in (7b).

Also assumed here is that the operation of compounding triggers the linking morpheme -o- to surface between the elements being compounded (Dalalakis, 1995). It is therefore a marker that differentiates compounding from other derivational word formation operations in that it signals that compounding of two major lexical category items has taken place.

Inflectional affixes do not occur within compound words. The first element of a compound must be uninflected, in accordance to universal compounding principles of level ordering, where regular inflectional affixes within one-word compounds are illicit (Kiparsky, 1985).The first compound element, therefore, is not followed by inflection and in this context we see a root or a stem. That first element of a compound in a modifier relationship with the head (the rightmost element) of the compound. Greek compound formation is a productive context where we can see roots at work .

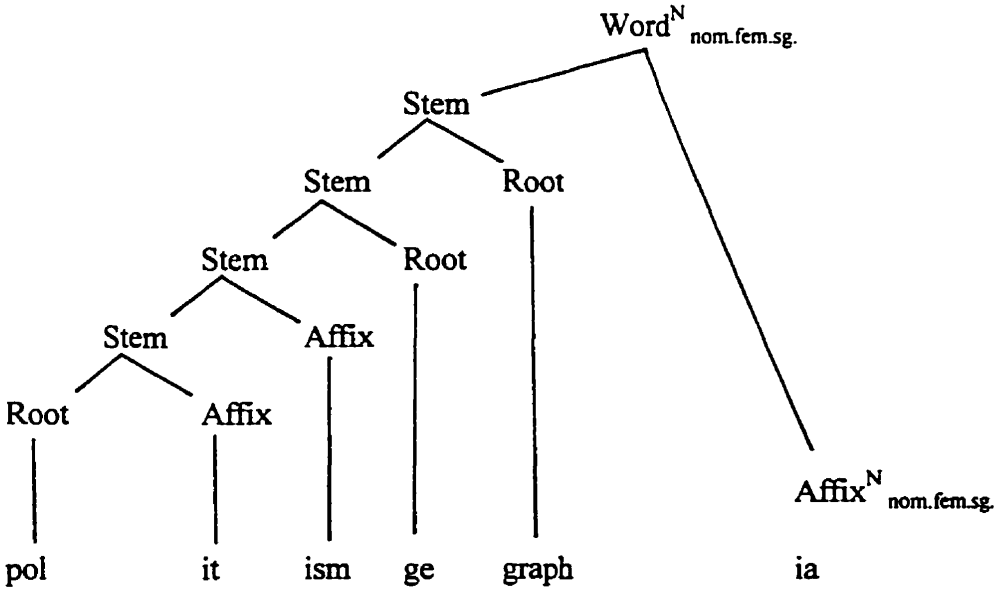
The first compound element may be either a root or a stem. In (7a) the first element of the compound is a root and in (7b) the first element is a stem. We also see in (7b) that -o- joins more than one stem and root in a single compound:

(7a)



= piromania

(7b)



= politismogeographia 'anthropological geography'

The realization of -o- is constrained by both phonology and morphology [18] as outlined below. Two conditions are necessary for -o- to surface and neither alone is sufficient:

The morphology of -o- : The appearance of -o- in compounds is positively correlated with both the compounded constituents being lexical categories. Bound morphemes such as prepositions, or particles, then, by this simple test, are not considered to be part of true compounding. Moreover, -o- does not surface between the compound stem and the inflectional affix it needs to receive. The only context in which -o- does not surface in compounding two lexical constituents, is when the second lexical element is vowel-initial.

The phonology of -o-. In addition to the morphological requirement that both constituents be lexical elements, there is also a phonological consideration. When the second element of a nominal compound begins with a consonant (8a), or glide (8b), then -o- invariably appears regardless of the shape of the first element. The first element of a compound is most often a consonant-final root. If it happens to be vowel-final, that vowel is followed by a /dh/ and then -o- as in (8c) and (8d):

---

[18] I consider -o- a linking morpheme instead of adopting earlier interpretations of -o- which, due to its lack of denotative meaning, do not consider it a morpheme but rather consider it a stem formative (Nida, 1949: 83), a derivative suffix (Nida, 1949: 98), a thematic vowel (Bloomfield, 1933: 229-231; Scalise, 1984: 74-76), or a linking vowel (Triandafillidhis, 1992 edition: 59; Ralli, 1992: 153-4). It should be noted that the works cited here never aimed to explain the role of -o- but rather mentioned it in the scope of work on other issues of compounding (because its presence cannot be ignored).

(8a)	akr- 'edge'	+	thalas a 'sea'	=	akrothalasyá 'seaside'
(8b)	akr- 'edge'	+	yal os 'shore'	=	akroyáli 'seashore'
(8c)	maimu 'monkey'	+	kamom a ta 'antics'	=	maimudhokamómata 'monkey antics'
(8d)	maimu 'monkey'	+	anthrop os 'person'	=	maimudhánthropos 'monkey-like man'

Whatever variability -o- shows when surfacing in compounds, it is restricted to the cases where the second constituent is vowel-initial. Consider (9a) and (9b). They are both formed with the same first element (*mavr-* 'black') and their second element is vowel-initial. However, (9a) has -o- between two lexical elements and (9b) does not:

(9a)	mavr- 'black'	+	aspr i 'white'	=	mavróaspri 'black and white'
(9b)	mavr- 'black'	+	aghor itis 'marketeer'	=	mavraghorítis 'black marketeer'

Compounds whose head is adjectival or verbal and so result in non-nominal compounds invariably take the compounding marker -o- between the two constituents. It is only noun compounds that exhibit the variability on -o- realization. In (10) we see that in noun compounds, the compounding morpheme -o- does not surface when the second element is vowel-initial:

	constituents					output (Noun)
(10) a.	metal-	-o-	+	orikh io	=	metalorikhío
	metal			mine		'iron-ore mine'
b.	lik-	-o-	+	anthrop os	=	likánthropos
	wolf			man		'werewolf'
c.	sikhn-	-o-	+	ur ia	=	sikhnuría
	frequent			urination		'condition of frequent need to urinate'
d.	fil-	-o-	+	ergh o	=	filerghos
	friend			work		'hard worker'
e.	pedh-	-o-	+	iatros	=	pedhiatros
	child			physician		pediatrician

Unlike all other cases of compounding, the presence of -o- in compounds (e.g., (10)) depends on the initial phoneme of the second constituent. We observe that -o- does not surface if the second constituent is vowel-initial and it does surface if the second

element is consonant-initial[19]. A discussion as to why -o- does not surface when the head is vowel initial is beyond the scope of this paper.

Representation of compounds

Two types of nominal compounds are considered in this study, each meant to provide different clues to root representation differences between non-impaired controls and DLI subjects: (a) primary compounds, namely nominal compounds that were composed of two noun roots (henceforth denoted by N+N) and (b) synthetic compounds, namely nominal compounds composed of a noun root and a deverbal nominal derived from a transitive verb root (henceforth denoted by N+DevN).

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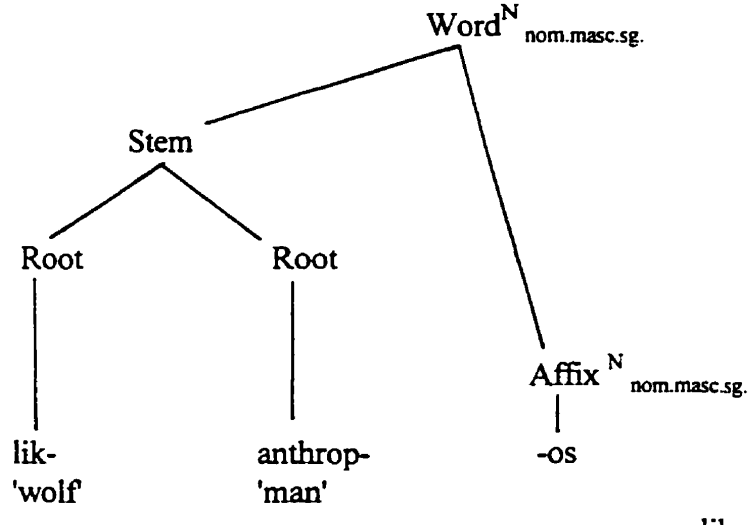
[19] We note that -o- is a constant characteristic of Greek compounding through the different stages of the language's history. Left-headed compounds were more productive in Ancient Greek (i) than they are in Modern Greek (ii) (many survive as fossils as in (i)) but regardless of headedness, -o- is realized between the two constituents, so long as the morphology and phonology allows it (i.e. the result is a noun compound and its second element is consonant-initial).

(i)	a.	hipp-	+	potam os	=	hippopótamos	
		'horse'		'river'		'hippopotamus'	"river horse"
	b.	mis-	+	yin i	=	misoyínis	
		'hate'		'woman'		'misogynist'	"hater of women"
	c.	fagh-	+	kitar o	=	faghokítaro	
		'eat'		'cell'		'phagocyte'	"cell eater"
(ii)	a.	khas-	+	mer a	=	khasomeris	
		'waste'		'day'		'time-waster'	
	b.	kleft	+	kot a	=	kleftokotas	"stealer of hens"
		'steal'		'hen'		'hen thief'	

It is assumed here that primary compounds of the N+N type is represented in the lexicon as in (11). We will outline the hypotheses for compound representation for the DLI population in chapter 5. For non-impaired individuals, a compound is assumed to be represented with the full complexity of its morphological structure and fully specified for its morphological features.

(11) Greek N+N compound

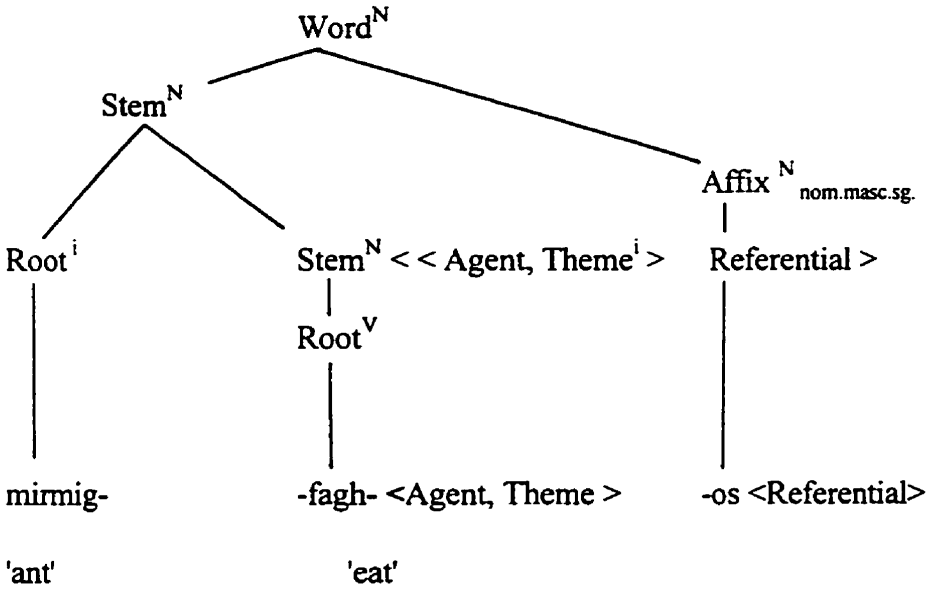


= likanthropos 'werewolf'

We now consider the representation of synthetic compounds which will be referred to as N+DevN . An example of a Greek synthetic compound is *mirmigofághos* 'ant eater' as illustrated in (12). I am assuming a representation of synthetic compounds based on that

advanced by DiSciullo and Williams (1987) with a composite theta grid for the deverbal nominal stem *-faghos*[20] :

(12) N+Deverbal Nominal: Nominal Root and Deverbal Nominal Stem



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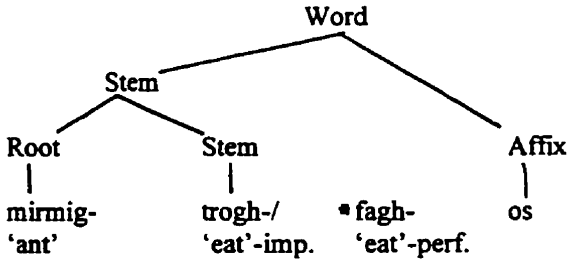
[20] Lieber's (1983) approach, which would argue for a representation such as that below, is not adopted here because the verb **mirmigotrógho* 'to ant eat' is not licit and we resort to bracketing paradoxes compounded by choice of perfective (fagh-) and imperfective (trogh-) roots in Greek.



We now present the theoretical background of diminutives in Greek. This derivational operation complements the inflectional and compounding operations examined in this thesis.

2.2.3 Diminutives

Greek diminutive formation is a very productive process where nominal roots (bound) are mapped to one (or two as in (14b)) diminutive suffixes to form a derived nominal which then needs to be obligatorily inflected. For example, the noun 'horse' *álogh-o* becomes 'little horse' *alogh-ák-i.* The stem *alogh́ak-* subcategorizes for the class and gender features of the inflectional affix that will be the relativized syntactic head of the derived word.

Diminutivization applies to nouns (as illustrated in (13)) and adjectives (as in (14)) most productively but it may also, even if rarely, apply to adverbs if these are derived from diminutivized stems (as in (15)). Examples of roots, non-diminutive base nouns and diminutive outputs are given in (13) to (15).

(13)	Root	Non-Diminutive Base Noun	Noun Diminutive
	khrist- 'annoint'	khrist ós 'Christ'-masc.nom.sg.	khrist úl is 'baby Christ'-masc.nom.sg.

(14)	Root	Non-Diminutive Base Adjective	Adjective Diminutive
(a)	mikr-' 'small	mikrós 'small'-masc.nom.sg.	mikrúlis 'small little'- masc.nom.sg.
(b)	mikr- 'small'		mikrútsikos 'smallish' -masc.nom.sg.

(15a)	Root	Diminutive Stem	Diminutive Adj.	Adverb Diminutive
	zest- 'warm'	zestutsik-	zestútsikos 'rather warm'	zestútsika 'warm cozy'

(15b)	Root	Diminutive Stem	Adverb Diminutive
	ligh- 'little'	lighulak-	lighuláci 'very little' (in quantity)

Derivational morphemes that mark diminutivization, as we see in Greek, are also attested in other languages such as Spanish (Jaeggli, 1980)[21]. The diminutive affix does not itself specify for syntactic category; the syntactic category head is the inflectional affix that is required for the stem to be realized as a word (DiSciullo and Williams, 1988). Perhaps the diminutive affix, like derivational prefixes, is not assigned to a lexical category. This is

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[21] In Spanish, for example, we also find nouns, adjectives and adverbs marked as diminutive by the allomorph *-ita* in the following examples:

(a)	poco - poquita (adj.)	'little'
(b)	chica - chiquita (n.)	'girl'
(c)	ahora - ahorita (adv.)	'now'

similar to Russian diminutives where the base determines agreement features required by the inflectional affix and the diminutive affix is irrelevant for the syntax.

As in Spanish, Greek diminutive affixes are transparent to the gender of the noun root they attach to. A Greek root selects for a diminutive affix and the resulting stem needs to select for an inflectional affix in order for the word to be licit.

As can be seen in (16), there are a number of diminutive allomorphs in Greek. The first sets, *-ak*[22]*-*, *-ul-* and *-its-*, are the most productive:

(16) Diminutive allomorphs by gender

	Masculine Base noun - Diminutive		*Feminine* Base noun - Diminutive		*Neuter* Base noun - Diminutive	
(a) -ak-						
	skílos	skilákos	mamá	mamáka	pedhí	pedháki
	'dog'	'doggie'	'mom'	'mommy'	'child'	'little child'
(b) -ul-						
	papús	papúlis	yayá	yayúla	sákos	sakúli
	'grandfather'	'grand-dad'	'grandmother'	'grandma'	'sac'	'little sac'
(c) -its-						
			míti -	mitítsa		
			'nose'	'little nose'		
(d) - udh[23]-						
					ángelos	angelúdhi
					'angel'	'little angel'

[22] *-ak-* is part of the set of *-Vk-* which includes the very infrequent *-ik-* and *-ek-* used in hypocoristics of some dialects.

[23] *-udh-* belongs to the set *-Vdh-* which includes {*-adh-*, *-idh-* *-udh-*} but *-udh-* is the most productive allomorph of the set.

(e) -isk-

lófos	lofískos
'hill'	'little hill'

As can be seen from the examples above, some of the allomorphs are productive with only one gender. Each gender, however, may be associated with a set of diminutive allomorphs[24]. Which diminutive affix is chosen for the root may be lexically determined. Some roots select only one particular diminutive affix while others may tolerate more than one diminutive affix as illustrated in (17) where the same root may surface with different diminutive affixes[25] .

(17a)	Masculine: Root	Noun Base		Diminutive	
	skil-	skílos$_{masc.}$ 'dog'		skilákos$_{masc.}$	'doggie'
			Or:	skiláki$_{neuter}$	
(17b)	Feminine: mit-	míti$_{fem.}$ 'nose'		mitúla$_{fem.}$	'little nose'
			Or:	mitáki$_{neut.}$	'little nose'
			Or:	mitítsa$_{fem.}$	'little nose'

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[24] As in Czech diminutivization, the Greek diminutive allomorphs *-ak-*, *-ik-* and *-ek-* are subject to palatilization so the velar becomes palatalized when followed by an inflectional affix that is front-vowel-initial (e.g. *-i, is, -es*).

[25] Roots may even take more than one at the same time, (in Czech diminutivization it may even be the very same affix: -ek -+ -ek- which becomes -eček-), so that the noun is doubly marked with more than one diminutive in the same word; in Greek, the compound affix need not be made up of the same diminutive repeated twice. When two different diminutives are both present, their order may be strictly ranked or not.

Diminutives modify the meaning of the root so that the product means 'smaller in size', but a diminutive may also denote a referent 'younger in age' or 'more familiar'. When animate masculine and feminine nouns are diminutivized, they often undergo gender shift and surface as neuter. Often they become synonyms to nouns used to denote young of particular animals as can be seen in (18).

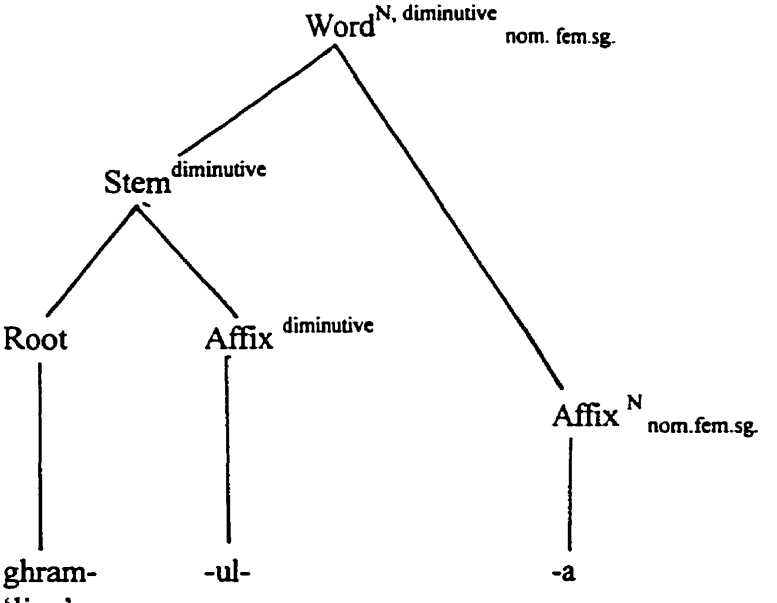
(18)	Noun	Diminutive form
(a)	skílos$_{\text{Masculine}}$ 'dog'	skiláki$_{\text{Neuter}}$ 'doggie/ puppy' Synonym to *kutávi* 'pup'
(b)	pápia$_{\text{Feminine}}$ 'duck'	papáki$_{\text{Neuter}}$ 'duckling'

Diminutive forms may also be used to refer to treasured personal possessions of children such as toys, clothing, furniture, or to refer to body parts, or family members. In such cases, the diminutive has a different gender from the base as in *karékla*$_{fem.}$ - *karekláki*$_{neut.}$ 'chair - chair-diminutive'. In this case, for example, *karekláki*$_{neut}$ has the connotative meaning of 'child's chair'. When the gender of the noun does not change, as in *karékla*$_{fem.}$ - *kareklítsa*$_{fem.}$ 'chair - chair-diminutive', the diminutive simply denotes 'small X' so that *kareklítsa*$_{fem}$, for example, means simply 'small chair in scale' (the kind one finds in a doll house, for instance).

Diminutive representation.

What all diminutive allomorphs have in common is that they all attach to bound roots. This is assumed to be reflected in the representation of diminutives. An example is provided in (19):

(19)



= gramula 'little line'

The derived diminutive *ghramúla* in (19) has percolated features from the affixes. The inflectional affix is the head of the diminutive with respect to lexical category; without it the stem cannot be realized as a word.

2.2.4 Acquisition of morphology in Greek

The following sections briefly outline some of the findings regarding the development of plural formation, compound formation and diminutive formation in non-impaired children. Non-impaired development of morphological competence will be the base against which the performance of DLI subjects will be compared. In chapter 7 we will evaluate in what ways DLI morphological competence differs from non-impaired morphological competence and what the linguistic implications are.

Acquisition of plural formation.

Children start to form plurals productively by the age of three, often over-generalizing irregular words (Marcus et al., 1992; Marcus et al., 1993). In Greek plural formation, a child is faced not only with 2 grammatical numbers (singular and plural), but also with 3 grammatical genders and 4 cases. In terms of frequency, neuter nouns are most frequent, followed by feminine nouns, and least frequent as a gender are masculine nouns.

Since there are different morphological classes (or subregular families) for each gender, coordinating number and gender agreement may vary. Stephany (1995) reports that plural formation is freely observed for more frequent classes as early as (1;9). She reports 97% accuracy for plural marking of children between the ages of (1;9) and (2;6).

Casemarking, especially for the non-frequent cases, starts to be established after the age

of (2;4) (Stephany,1995; Theophanopoulou-Kontou, 1973). The nominative singular for masculine nouns starts to be correctly marked as early as (1;10) but only for the higher-frequency classes. The nominative case for high-frequency nouns of all three genders is consistently marked by children from the age of (2;9) onward (Stephany, 1995).

Overgeneralization errors characteristically affect low-frequency classes which are given high-frequency affixes. In forming plurals, gender is respected. When gender errors occur, they tend to be toward neutralizing nouns. Gender neutralizations are correlated with (a) the relative high-frequency of neuter nouns compared to feminine ones or masculine ones and (b) the pronounced tendency in motherese to use neuter diminutives.

In sum, neuter plurals emerge the earliest followed by feminine ones and lastly, masculine plurals. Noun pluralization in normal language development of Greek children seems to rely to some extent on surface analogy with existing forms[26] but by the age of (2;6), plural formation respects basic agreement of morphological subcategorization frames of affixes and roots with regard to gender, number and case (Katis, 1984; Baslis, 1992; Stephany, 1995)[27]. When inflectional errors occur, they are overgeneralizations of class but gender is respected so that, for example, less frequent feminine plurals such as *-i* (*odhós - odhí* 'street - streets') are regularized toward *-es* (*odhí -odhés*).

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[26] As argued by the connectionist school of language acquisition development as exemplified by Rumelhart and McClleland (1986).

[27] In this sense, a feature-based lexicon is being organized, in accord with generative grammar frameworks (Pinker and Prince, 1992).

Acquisition of compounding

Cross-linguistic data on compound formation and comprehension shows that, as a word formation strategy for two- to three-year old speakers of Germanic languages. compounding (both root-root and synthetic compounding) is heavily favoured over derivation for noun formation. Clark (1993) reports that, for one English native speaker studied between the ages (1;6) and (1;11), all his innovative nominals were noun-noun compounds.

Compound comprehension and production is observed early in Greek children as well, since compounds in Greek are very productive and have a high degree of transparency. Comprehension, including an understanding of internal structure, is reported by Stephany (1992) for two children studied at (2;10). Both of these children produced the same phrasal compound with the two lexical elements as inflected words instead of producing the targetted exocentric compound that combined those two lexical elements in one word. The targetted exocentric compound *kokinoskufítsa* [red-toque-diminutive] 'Little Red Riding Hood' was produced as a phrasal *kókini skufítsa* [red [toque-diminutive]].

This error is interpreted by Stephany to be evidence that children analyze complex words such as compounds into their constituents[28]. Thomadaki (1986) reports that between

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[28] In spontaneous speech of non-impaired children, I have observed the formation of novel endocentric compounds by concatenating roots, using the linking morpheme -o- and inflecting the stem accurately as early as (3;0). By calling a cat *'liondarodhinósavro'* 'lion dinosaur' during a reading of a dinosaur book, I prompted the child I was with to produce (in protest) the compound *ghatodhinósavros* 'cat dinosaur'.

the ages of (6;4) and (6;11) her son expressed awareness of compound structure[29] and also produced novel compounds. The examples she provides show correct concatenation of roots, correct use of -o-[30] and correct inflection. Research with English-speaking children (Gordon, 1985) has also shown that three-year old youngsters respect level ordering in that they may produce compounds where the first element may be irregularly inflected (e.g., mice-eater) but will not produce compounds where the first element is regularly inflected (e.g. *rats-eater).

It has also been argued that children's ability to analyze compounds is facilitated by semantic transparency (Stephany, 1980; Clark, 1993). Semantic transparency is a factor in early acquisition for a number of different operations.

Acquisition of diminutive formation.

Diminutive affixes are likely to be used early and correctly also depending on whether they are relatively frequent and transparent. To produce diminutives freely in languages such as Greek, children must use bound roots, diminutive affixes and inflectional affixes. In spontaneous speech, children start to produce diminutives as early (2;0), as

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[29] He explained *ghrafomikhaní* (writemachine) 'type-writer' as *ghráfi ghrámata ke íne ke mikhaní* (writes letters and it's and machine) 'writes letters and is also a machine'; from Thomadaki (1986).

[30] Consider the novel words he formed: *pendavrómikos* (five times dirty) 'very dirty', a novel word formed through prefixation, and *theovrómikos* (god dirty) 'very dirty' which is a real compound; from Thomadaki (1986).

reported for both highly-inflected languages such as Russian, Serbo-Croatian and Czech (Gvozder, 1961; El'konin, 1973; Pacesova, 1976) and also for Greek (Stephany, 1995), and languages with simpler morphology systems such as English (Clark, 1993).

Productive diminutivization appears by the age of three or earlier in highly inflected languages[31], especially for familiar nouns. By the age of five, children have become proficient with both diminutive affixes and augmentative affixes to mark relative size, making overgeneralization errors related to root class[32], as seen in elicited production (Bogoyavlenskiy, 1973; Ushakova, 1970). This type of error is also reported for Hungarian (as cited in Clark, 1993) with root-suffix matching errors reported to occur as early as (1;11).

Since the factors influencing diminutivization development are transparency of meaning, transparency of morphological structure and productivity, we consider each for the different Greek diminutive allomorphs for these characteristics.

The meaning usually associated most productively with diminutives is (a) 'smaller than X'[33] as in (20a); (b) 'younger than X' as in (20b); and 'less than/ rather X' as in (20c) and (20d) respectively:

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[31] See also Katis (1984) for diminutive production examples in native Greek children's spontaneous speech between the ages of 2 to 3 years.

[32] Root class overgeneralization errors result when a more productive diminutive affix is selected for a root that subcategorizes for a lower-frequency diminutive affix.

[33] Whether these features are acquired first to denote absolute size that is not comparative to some base or reference noun only later to be associated with relative size (as is also the case with comparative adjective

(20)		Base form		Diminutive form	
(a)	Noun	trapézi	'table'	trapezáki	'small table'
(b)	Noun	pedhí	'child'	pedháki[34]	'young child'
(c)	Noun	zésti	'hot (weather)'	zestúla	'rather hot (weather)'
(d)	Adjective	psilós	'tall'	psilútsikos	'tallish '

Secondary or connotative semantic features associated with diminutive affixes are (a) 'more personal than (base noun)' as in (21a); (b) 'more familiar than (base noun)' as in (21b) where we see diminutives used as nicknames; or (c) 'more beloved than (base noun)' as in (21c):

(21)	Base Noun		Diminutive Noun
(a)	míti	'nose'	mitúla 'little nose (child's)'
(b)	Yánis	'John'	Yanákis[35] 'Johnny'

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features), is an issue beyond the scope of this work. Baslis (unpublished ms.) reports that Greek native children start to use adjectival comparatives at (1;11) in spontaneous speech but only at (2;11) do they start to use the adjectival comparative to contrast it with the base adjective.

[34] The meaning 'younger than (base)' seems more likely to be associated with the allomorph *-ak-* than other diminutive allomoprhs; in such cases where it is used to mean 'younger than', *-ak-* also may trigger gender neutralization, as we saw in the case of *ghata -ghataki* 'cat - kitten'.

Or: Yanúlis
Or: Yanákos

(c) papús 'grandfather' papulis 'granddad'

A child may not have the full range of semantic features of diminutive forms at first, but may acquire knowledge of the subtle connotations they are associated with over a period of years.

The morphological structure of diminutive forms may also be considered in terms of (a) transparency and (b) productivity. First, the inflection signals the grammatical gender of the diminutive form and the diminutive affix preceding the inflection appears to be transparent to the gender that the root subcategorizes for. Second, there is a frequency effect for some diminutive allomorphs in that they may appear with nouns of all three genders even though they are associated most strongly with only one or two. For example, *-ak-* may appear in diminutive nouns of all three genders: *skílos - skilákos* 'dog -little dog - masc.'; *mamá - mamáka* 'mom - mommy - fem.'; *neró - neráki* 'water - little water - neuter' and it is relatively frequent for all three genders, whereas the low-frequency diminutive affix *-udh-* may also appear with all three genders but is most strongly associated with neuter nouns.

In contrast, some diminutive affixes are associated only with one gender; *-isk-*, for example, appears with masculine nouns only as in *lófos - lofískos* 'hill - little hill' or as in

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[35] Different diminutives may be associated with the same name reflecting variation of different diminutive allomorph distribution over different areal dialects.

the more frequent *asteriskos* 'little star' which has now become semantically opaque to denote 'asterisk' rather than 'little star'[36].

The most productive diminutive allomorph in terms of type and token frequency as well as in terms of gender distribution[37] is *-ak-*. Two rather productive affixes are *-ul-* and *-its-*, and the least productive ones are those of the set *-Vdh-* which includes {*-adh-*, *-idh-*, *-udh-*} and *-isk-*. This informal ranking of productivity is helpful in predicting what direction regularizations are likely to favour.

Clark (1993) reports that in highly-inflected languages (such as the Slavic family), diminutivization skills develop earlier than compounding as a word formation strategy. Greek appears to be similar to the Slavic languages in that diminutive formation is used early. In addition, as in compounding, diminutivization requires the use of roots and affixes. For these reasons, investigating Greek diminutivization skills complements examining the plural formation and and compound formation. These three operations provide us with the context to study how non-impaired individuals abstract roots in forming complex structures and to what extent they are sensitive to the morphological features marked by inflectional affixes.

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[36] It is often the case, as with *asterískos*, that some diminutive affix has a low type frequency but a high token frequency in that words that it occurs in are of high frequency themselves even if there are not many of their kind.

[37] The diminutive affixes of the set *-Vk-* which includes {*-ak-*, *-ik-*, *-ek-*} may each take different inflectional affixes even within the same gender.

Lexicon acquisition

We now review some of the theoretical assumptions about the stages morphological representations go through during development and the adjustments they undergo as the lexicon expands and becomes more specified.

In the one-word stage, Greek children produce inflected forms with the nominative/ accusative endings (Baslis, 1992) but they cannot inflect productively. It is likely that at this stage, children have morphological representations which are 'chunks' or morphologically unanalyzed for structure and underspecified for features (see also Pinker and Prince, 1992). If so, their representations are simple (despite any appearance of inflection). Inflected words for Greek youngsters at this stage do not have internal structure. Representations between children at the one-word stage and adults differ in terms of morphological features associated even with simple structures (Anglin, 1993). For English toddlers, a singular noun or a plural noun may be morphologically specified as [N] and associated with a set of conceptual features but not have any complex structure as illustrated in (22).

(22) One-word stage representations in English

(a) $Word^{N}$
|
foot
'one foot'

(b) $Word^{N}$
|
feet
'more than one foot'

(c) Word^{N}

cat
'one cat'

(d) Word^{N}

cats
'more than one cat'

For Greek toddlers, a nominative form of a noun may also be morphologically specified only for [N] but not for case, or gender, or class, or number and lack internal word structure as illustrated in (23). The reason that the nominative form is used is that the root is not a licit word as it is in English. In the absence of productive case marking, we assume that for Greek toddlers the forms used are morphologically unanalyzed chunks.

(23) One-word stage representations in Greek

(a) Word^{N}

podhi
'one foot'

(b) Word^{N}

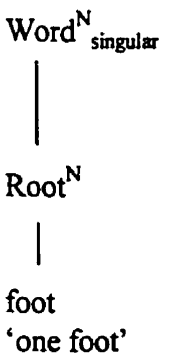
podhia
'more than one foot'

At the two-word stage, the mental lexicon representations of youngsters are assumed to have developed so that they are specified for more morphological features. Pinker and Prince (1991) argue that in the earliest stages of inflectional development, inflected forms may be stored in the lexicon as unanalyzed forms and that the lexicon normally develops into reorganized units that are abstracted from regular and therefore

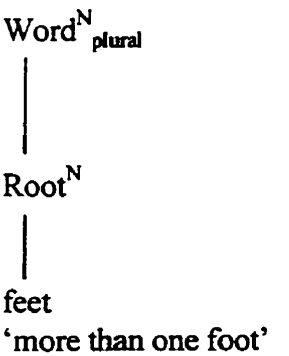
predictable paradigms. Beyond the one-word stage, therefore, nominals, for example, are expected to become specified for gender in languages that mark morphological gender. For an English youngster at this stage, there is sensitivity to features of number which will effectively be a tendency to notice patterns of features associated with inflected forms. Word endings are associated with morphological features. Between the ages of two to three, children start using word formation paradigms productively. Williams (1994) argues that children notice parallel correlations between word endings and their grammatical function and thus abstract bound morphemes which are then stored in the lexicon. By the age of four or five, the morphological representations of a noun are similar to those of an adult (24). Representations of irregularly inflected words reflect only morphological features (such as number) as in (24a), whereas representations of regularly inflected words reflect both morphological features and complex structure as in (24b):

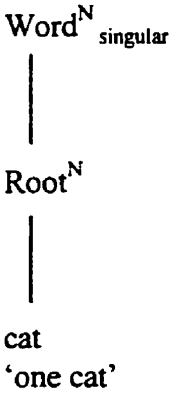
(24) Morphological representations beyond the three-word stage for English

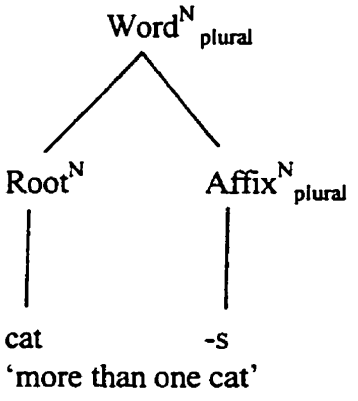
(a)



(b)



(c) 

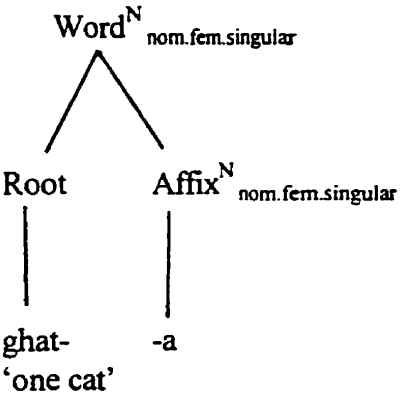
(d) 

It is assumed here that the children's noticing of feature patterns and the function of morphological markers will trigger the rule-based subsystem Pinker proposes. By the age of three, then, morphologically complex forms are being both decomposed and constructed according to morphological criteria. Lexical representations are no longer underspecified for morphological features such as number and gender. As we can see in over-regularization errors, this linguistic discovery is not yet constrained in three-year olds as it is in adults so that either singular forms may be used as input to the rule (resulting in forms such as *cats* but also **foots*) or irregular plural forms may be used as roots and be marked morphologically for plural as well (resulting in forms such as **feets*).

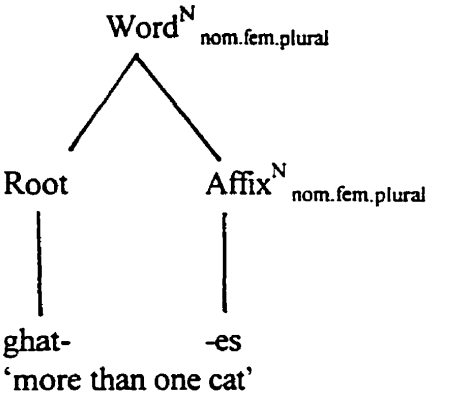
At the two-word stage, representations of Greek youngsters are becoming more specified regarding morphological features such as class, gender, number and also more structurally differentiated to include affixes as in (24).

(24) Morphological representations beyond the three-word stage for Greek

(a)



(b)



It is assumed here that, even if not all words are fully specified for both morphological features and word-internal structure at this stage, most are. Bound morphemes and the system of principles governing word formation are being abstracted so that roots and affixes are represented as such. There is cross-linguistic evidence for this in the early appearance of systematic, even if not totally accurate, use of inflectional affixes that mark gender, number and case and the appearance of agreement within noun phrases for such features.

The existence and development of a rule-based subsystem has consequences for mental representations of words. Even if there is a subset of items for which there is redundant representation in both simple and complex structure, at least, for non-impaired individuals, both the association- or lexically-based subsystem and the rule-based subsystems are working in parallel often complementing as well as perhaps competing with each other (Caramazza et al., 1988).

A mental lexicon with a wide set of representations (both complex and simple, both bound and free morphs) may have redundancies and not be theoretically parsimonious, but is more flexible and compatible with findings that support hybrid models with parallel subsystems (e.g. Pinker, 1991; Caramazza et al., 1988). The balance of how lexically-biased or rule-biased a lexicon is, may be a function of the specific language word structure. For example, the morphological demands of an agglutinating language may be more rule-based compared to those of an isolating language. Isolating languages may be more lexical based in this respect (see also Hankamer's (1989) argument for lexical representations which is based on the word structure of Turkish). Languages with more than one type of word-structure, such as English, may make use of both rule-based and lexical subsystems and so we observe these two subsystems working in a complementary (and at times competitive) way with each other (as argued, for example, by Pinker, 1991).

2.3 Research hypotheses

2.3.1 Morphological representations.

Given the persistent occurence of feature agreeement errors observed in both spontaneous speech and in elicited tasks, it is assumed that DLI subjects remain at the early stage of simple unanalyzed lexical representations and do not progress. The stage where

DLI subjects most likely begin to differ is when non-impaired children notice morphological paradigms and start to store bound morphemes.

DLI subjects may have an incomplete or impaired morphological pattern recognition subsystem so that morphological rules do not develop normally. Alternatively, DLI subjects may have impaired lexical representations that are missing either sublexical features (25) and are therefore similar to representations of non-impaired children at the one-word stage. A second possibility is that DLI subjects have lexical representations that are missing internal word-structure (26). Thirdly, it may be that DLI impairs both feature and structure representation (27).

(25) Possible DLI lexical representation problems: absence of features

(a) $Word^N$

foot
'one foot'

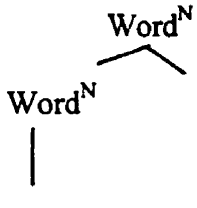
(b) $Word^N$

feet
'more than one foot'

(c) $Word^N$

cat
'one cat'

(d)



'more than one cat'[38]

[38] Such a compound structure in lieu of typical inflection is proposed by Goad and Rebellati (1994; 1995) based on their phonological analysis of DLI novel plural formation. It is not clear what the morphological status of /s/ may be but it may not be that of a typical bound morpheme.

(26) Possible DLI lexical representation problems: absence of structure

(a) $Word^{N}_{singular}$

|

cat
'one cat'

(b) $Word^{N}_{plural}$

|

cats
'more than one cat'

(27) Possible DLI lexical representation problems: absence of features and structure

(a) $Word^{N}$

|

cat
'one cat'

(b) $Word^{N}$

|

cats
'more than one cat'

By the three-word stage, it is assumed that the morphological representation difference between the non-impaired development and the DLI development is wider. Whereas the non-impaired youngsters' mental lexicon representations have long reached a threshold where the recognition of morphological features has triggered a rule-based subsystem to go into effect, the mental lexicon of the DLI subjects may still not have the necessary features to trigger the rule-based subsystem.

To summarize, the research hypotheses for the morphological representations of DLI subjects are that (a) representations are impoverished in terms of sublexical features for grammatical class, gender and number and (b) word internal structure is impaired for complex words. To test these hypotheses, tasks that require word formation and comprehension will be used to investigate whether DLI subjects are sensitive to such morphological features and whether they can use bound roots to form novel words.

2.3.2 Morphological processing.

Perhaps it is the case, for DLI subjects, that lexical representations are feature-impoverished so that sublexical features cannot get checked by the morphosyntax. Alternatively, DLI may affect the rule-based subsystem itself rather than the input it needs to develop (i.e. morphological features may be recognized but cannot be used to build morphological operation rules). A third hypothesis is that both features and the operations checking them are independently impaired.

The hypothesis posited here is that word decomposition is impaired for DLI subjects because word representations do not have typical sublexical features and do not have internal structure. As a result, bound morphemes do not get noticed or represented and therefore cannot be used as input for word formation. Even when given explicit training on the use of affixes (as reported for English DLI subjects in Gopnik, 1994), DLI subjects cannot use this knowledge to fully compensate for impaired word formation rules because

their linguistic competence does not include a morphological appreciation of what affixes represent.

Here it is proposed that not only will bound elements such as affixes be difficult to abstract, represent, and use for DLI subjects, but also bound elements such as roots and stems. Both of these difficulties, ability to abstract and use affixes as well as roots and stems, are predicted to result from impaired morphological representations. It is therefore important that the focus for understanding DLI not be just on word-final elements (phonemes, phoneme clusters, or affixes) under the assumption that these are perceptually or articulatorily difficult (Leonard et al., 1992 and Fletcher, 1990 respectively), but rather on all bound morphemes which cannot be learned explicitly on their own.

To summarize, DLI subjects are hypothesized to have impaired word decomposition and word formation rules due to their morphological representations being impaired for feature and structure representation. This will be tested in word-formation tasks that require abstraction of bound roots in order to form novel words.

The above issues will be revisited in chapter 7 after the experimental evidence on nominal tasks is presented. The following two chapters discuss how the Greek DLI subjects in the main experiments were identified and screened, and tested on pluralization, compounding and diminutivization.

Chapter 3

Experimental Methodology

3.1 Subject recruitment

3.1.1 Criteria for DLI subject selection

All potential Greek DLI subjects were selected according to criteria set in earlier work (Zangwill, 1978; Tallal and Stark, 1981; Tallal et al., 1991; Gopnik and Crago, 1991):

Subject Selection Criteria

(a) Performance IQ of 85 (one standard deviation below average) or better;
(b) Normal hearing acuity;
(c) No history of motor impairments;
(d) No history of autistic symptoms;
(e) No history of otitis media;
(f) No history of neurological impairment (peri- or post-natal);
(g) No history of psychoemotional disorders;
(h) Difficulty with language skills reported by parents and /or school
(i) Diagnosis of language impairment and history of language therapy.

All Greek DLI subjects were originally chosen by language therapists, who had treated them for language difficulties. DLI subjects had no reported impairments other than

their language difficulties to the extent that it was possible to verify from consulting their language therapy files, psychological profiles, and medical records. DLI subjects selected for the screening test were receiving or had received language therapy in the past.

DLI subjects had already been diagnosed as language impaired.Traditional intelligence test tools such as WISC-R and Griffiths showed normal performance IQ and poorer than average verbal IQ (at more than one standard deviation (i.e., fifteen points) below average).

3.1.2 Greek DLI subject pool

The Greek DLI subjects were identified in Greece with the help of Greek language therapists who were working with the subjects at that time or had worked with them in the past. The DLI subjects had all received language therapy focusing on the phonology, morphology, and syntax of their language. The therapists themselves assisted with and /or were present at testing; some sections of the tests were given at the subjects' homes.

Thirty-eight Greek DLI subjects in all participated in different experimental tasks reported in this thesis. Nineteen subjects took part in the DLI screening test but only eight of those completed all parts and their performance is reported in section 3.5. The other subjects had been already screened by the therapists on equivalent tasks that had probed for inflectional and derivational problems. Only two subjects were the same across all tasks, but

the same six subjects participated in the plural formation task and the compound formation task due to variable subject availability throughout the testing period[39]. Despite the fact that different DLI subjects participated in each task, we observe the same types of response and error patterns across tasks. It is considered a methodological advantage that the subjects participating in this study formed a homogeneous group in terms of their linguistic behaviour.

DLI subjects ranged in age between (5;8) and (17;7) and most were male. Appendix A has the DLI subjects by code, age on testing, family history for DLI and controls.

3.1.3 Control subjects

Controls were considered not to have any language difficulties, learning impairments, cognitive impairments, hearing problems, psychoemotional problems, or known neurophysiological or motor problems. Controls were also matched for sex, socio-economic status and geographic area (for dialect control). Three types of non-impaired control groups were used:

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[39] Subject availability factors were beyond the experimenter's control; language therapy is often discontinued by the child's parents after a year or two due to a combination of socioeconomic reasons and follow up of the child's language development is usually difficult even for language therapists. The testing of the different tasks reported in this thesis span over a period of three years.

(1) Age-matched controls: Age-matched control subjects were 6 months older or younger than their matched DLI subject.

(2) Younger controls: Younger controls were one to one and a half years younger than their matched DLI subject. Younger subjects were selected as a control group in order to determine whether DLI performance reflected temporarily delayed language development or whether it was significantly different in terms of response patterns and error patterns.

(3) Adult subjects: Adult subjects were used as an independent non-matched group in order to establish a reference baseline for some novel word formation and comprehension tasks which reflect the final state of the native competence.

3.2 Materials and test design

All experimental tasks conducted were off-line tests. Stimuli were presented both visually with drawings and aurally within carrier sentences. Production tasks required the subjects to produce single words to complete a sentence in the diminutive experiment. Comprehension was tested by requesting the participant to point to a picture that corresponded to an aurally presented sentence.

Some production tasks in the screening test required the production of phrases. Comprehension tasks in the screening test required the subjects to judge sentences for

grammaticality, or to point to a picture which corresponded to a sentence. The screening test is described by task in more detail in section 3.5.

The plural formation task, the compounding task and the diminutive tasks all used two types of stimuli: (a) real words and (b) novel words. Performance on real words was compared to that for novel words because novel word formation tests more convincingly one's competence on a given morphological operation since one cannot rely on knowledge of learned forms.

The novel word formation test design for the plural formation and diminutive formation tasks was based on Berko's (1958) wug test paradigm. Novel nouns were created by changing the first phoneme of existing native nouns which were consonant-initial. The resulting form was a non-attested but phonologically licit word in the language. For example, the novel feminine noun *roliá* was created from *foliá* 'nest' expecting to trigger the novel plural *roliés* on analogy to *foliés* 'nests' in the pluralization task; in the diminutive formation task, *foliá* was expected to trigger the novel diminutive *rolítsa* on analogy to *folítsa* 'little nest'. The novel nouns and corresponding drawings of novel items were drawn from the same pool for both the pluralization task and the diminutive tasks.[40]

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[40] The drawings used were from the same pool of drawing created for the extended wug test by Goad and Rebellati (1994) in their study of English plural formation.

Real word stimuli were familiar concrete nouns easy to represent in drawings or pictures; the visual stimuli accompanying each word for the three main experiments were independently checked for recognizability with a group of native Greek speakers.

Novel nouns were phonetically similar to native words. The novel stimuli were independently piloted among adult natives to ensure that they were phonetically acceptable words even if they did not correspond to any meaningful item.

To summarize, both production and comprehension tasks were given and both real and novel words were used (controlling for word frequency). Other independent variables controlled for across the plural formation and diminutive formation tasks were (a) morphological class (all main classes were represented, regular, irregular and subregular), (b) gender, and (c) number of syllables per word. Regular or subregular status was determined by which real nouns the novel ones were based on. Those novel nouns that were derived from real regular nouns were categorized as regular novels and those derived from subregular or irregular ones were categorized as subregular and irregular, respectively.

Relative frequency of real nouns used was established by an independently administered frequency rating scale completed by a different set of adult native controls. The novel nouns were of zero frequency because their roots were of zero frequency even if their inflectional affixes were real.

3.3 Testing procedure

Spontaneous speech was recorded for each subject prior to testing where subjects spoke about every day activities with their language therapist, and this helped establish for almost all subjects that they understood and used noun plurals. compounds and diminutive words in a non-test situation.

A pre-trial established understanding of each task to be given. The task itself was given if there were at least three attempts to give a response at the pre-trial. For example, three attempts to produce a diminutive using the same instructions and stimuli style as the test itself ensured task validity. All subjects understood the requirements of the task as confirmed by a pre-test trial.

Visual stimuli (pictures for real nouns, drawings for novels) were presented simultaneously with the aural stimuli which were embedded within a sentence. All participants were read the instructions, the examples and the stimuli, and were asked to respond orally; they were not required to either read or write anything themselves. In this manner, confounding possible reading and writing problems at the level of grammar was avoided. Moreover, the results could later be compared to children diagnosed as dyslexic

for a three-way comparison in order to show that dyslexic children's difficulties would be modality-specific, whereas DLI difficulties would be central and not specific to reading and writing.[41]

Participants' responses were not timed but were tape-recorded to be later transcribed and checked. Requests for repetitions of stimuli were noted, as were self-corrections. The test length was designed to be about half an hour to avoid subject fatigue, and the experimenter monitored subject attention. Moreover, subjects were told that they could request breaks, and test sections were structured so that natural breaks could be taken between sections without affecting performance.

A family history questionnaire was completed by the experimenter or therapist with the cooperation the child's parents or from information already recorded in the subject's file when available. This questionnaire inquired into the health history, the educational background and the language development of the individual being tested. A consent form was also signed by the participant's guardian or parent.

In the production tasks, subjects responded orally and their responses were manually noted and audio-recorded for later transcription and checking. The administration of the test

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[41] This three-way comparison was useful in the context of language impairment research in Greece, as more than one type of language impaired child population as well as children with learning difficulties due to various reading-writing impairments are often all classified as dyslexic. Such a preliminary comparison was presented by the author at a workshop on language impairment at the Daou Pendeli Psychiatric Hospital for Children in Athens (Dalalakis, 1994c).

and both the transcription and checking of the responses were carried out by native Greek speakers blind to the hypotheses being tested. There was no disagreement on the checking of the transcriptions. To ensure subjects were at ease, testing took place in a setting they were familiar with: either at home or at the place where their language therapy sessions usually took place. The subject's parent or language therapist was present or nearby.

3.4 Scoring criteria

Production task responses were coded by type as well as by accuracy. A response could fall into the following types: (a) attempt to form target (correct or incorrect for (i) gender, (ii) number, (iii) class), (b) substitution with another word (real, neologism), (c) no response, or (d) repeating the singular form. Responses could be incorrect due to more than one error. For example, if , for a novel noun, a real plural was given by the subject, the response was coded as pluralization attempt and a substitution.

A response was coded as correct only if it corresponded exactly to the targetted form. For real words, that is rather straightforward; a real plural form, for example, is attested in the language. For novel nouns, the forms targetted and considered correct were only those which corresponded to the form on which the noun was modelled. For example,

bírios targetted the plural form *bírii* by analogy with *kírios* - *kírii* 'gentleman - gentlemen' and no other pluralization attempt was accepted as correct.

Novel forms resulting in a non-targetted plural inflection, for example, were considered a regularization toward another morphological class. This allowed for an error analysis that could make claims about generalizing toward another class or regularizing in the case of irregular novels.

For some novel nouns, more than one form may have been acceptable under a less conservative scoring scheme but there are two reasons why a conservative scoring was chosen. First, the responses of the control groups, which were expected not to vary greatly, would serve as a baseline, and second, a lower acceptance level for plural attempts for both controls and DLI subjects will strengthen any claims made regarding significant group differences.

3.5 Greek DLI linguistic profile

Pilot research identified native Greek DLI subjects (Dalalakis, 1994b) and investigated in what ways they were similar to DLI subjects observed in other languages (see also Lois, 1996 for a review of Greek DLI findings compared to English and German DLI findings). In this thesis, the linguistic ability of the native Greek subjects who might be

DLI was assessed in one of two ways. First, by using a set of tests which were linguistically equivalent to those already used to test the English DLI subjects reported in Gopnik and Crago (1991)[42]. Second, when subjects had already been tested on equivalent Greek test batteries by their language therapists, scores significantly lower than performance of controls on word formation tasks were taken as an inclusionary criterion for participation in the word formation tasks reported here.

What follows in a summary of the main areas of linguistic difficulty with word formation as evidenced by data from spontaneous language expression and screening of Greek DLI subjects. Greek DLI subjects had difficulties analogous to those observed in DLI testing in other languages (Gopnik et al., 1996) thereby supporting the hypothesis that DLI is an impairment that affects linguistic competence across languages in similar ways to the extent that languages are comparable. Moreover, DLI is not restricted to a single word category (as may happen in anomias), or modality (as may happen in aphasias or dyslexias)[43].

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[42] The original English DLI screening test (Gopnik and Crago, 1991), was based on the Bilingual Aphasia Test (BAT) developed by Paradis (1987) and his colleagues as a battery of paired language tests to record the extent of acquired language deficit (aphasia) following cerebral insult. The Greek version of the DLI screening test was adapted from the Greek BAT version developed by Kehayia and Paradis.

[43] DLI symptoms should be explainable using the same linguistic theory regardless which specific language is considered and how structurally different specific languages may be among themselves. This goal of having cross-linguistic evidence support a theoretical framwork is also common to research that focuses on acquired language impairment (e.g. cross-linguistic aphasia studies).

Specifically, Greek DLI subjects have difficulties with inflectional morphology as they are reported to have in English (Matthews, 1994). Marking grammatical number and number agreement within noun phrases is affected, and there are also difficulties within verb phrases with regard to tense, person and aspect. There are problems with case assignment, subject-verb agreement, closed class words (prepositions, articles, pronouns) and with derivational morphology (see Dalalakis, 1994b; Lois, 1995; Stavrakakis, 1996). Such problems were apparent both in production tasks and comprehension tasks that tested grammaticality judgement (the ability to distinguish incorrect sentences and correct them).

Greek DLI performance is morphologically impaired both in oral and written spontaneous language production. Grammaticality judgement of sentences is impaired, especially judgement of ungrammatical sentences (see examples below) although pragmatically incorrect sentences are identified and corrected more accurately. When an incorrect sentence is judged as ungrammatical by a DLI subject, it is often corrected in such a way as to produce another incorrect sentence.

Greek DLI subjects also have difficulty in morphologically marking verbs for tense. Ungrammatical sentences were produced even when DLI subjects were provided with a set of lexical items to use in producing a sentence of their choice. In addition to inflectional errors, Greek DLI subjects also produce errors in production tasks on derivational morphology. Moreover, the patterns of errors as well as the patterns of responses were similar between Greek DLI subjects and English DLI subjects (Gopnik and Crago, 1991),

Japanese DLI subjects (Fukuda and Fukuda, 1994a) and French (Royle, 1996) who were tested on equivalent tasks.

Greek DLI subjects are also more likely than controls to have a positive family history for DLI. Given, the extent to which DLI (or SLI) tends to cluster in kindreds (Tomblin, 1991; 1992; 1993), such a finding is taken as support for the genetic basis of language development.

Greek DLI subjects' performance on spontaneous speech and writing (in terms of the types of errors made) is comparable to their performance on elicited tasks. DLI subjects' performance is significantly worse than that of controls.

The Greek language therapists working with DLI children note that Greek DLI children's language is affected at different levels. Phonemes may be acquired with delay or the order in which phonemes are acquired is not typical. The structuring of phonemes into syllables is also impaired and the most frequent errors are those of omission, simplification, metathesis, and substitution of phonemes and syllables.

Other observations by language therapists are that declension is impaired and there are errors of grammatical gender, number, case, article omission, and difficulties with tense, person, and voice in verb phrases. Syntactically, there are omissions of verbs, articles, pronouns, and prepositions. Word order may be disturbed, and there are few error-free sentences. Errors may decrease in number as subjects grow older but DLI sentences are still

more likely than those of age-matched controls to contain errors and less likely to contain complex structures (such as secondary clauses or passive constructions).

Typically, DLI subjects have no significant difficulty with object naming tasks aimed at evaluating progress made in the child's phonology as measured by ease and accuracy of articulation. Evidence of phonological impairments is the primary reason that motivates parents to seek language therapy for their child and is therefore the focus of much of the early stages of language therapy.

For example, GIM87CK[44], typical in many respects of the DLI subjects reported on in this study, had to repeat first grade primary school because of his language related difficulties. Although a shy boy, he cooperated with testing and had no apparent difficulty in understanding the tasks of the test, or in focusing his attention. He is the second of three sons born to a mechanic and a housewife. GIM87CK was diagnosed as language impaired by the Special Diagnostic Unit of the Doxiadis Centre consisting among others of a child psychologist, a pediatrician, and a special education teacher. At the time of testing, GIM87CK had had language therapy for a year. His phonology was impaired in that he showed omission, substitution, and simplification of consonant clusters. On a phonology

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[44] Participants in this thesis have each been given a code such that it contains the following information: mother tongue (G for Greek), status of language (I for Impaired and N for Non-impaired), sex (F for female, M for male), year of birth (82 for 1982, for e.g.), the subject's generation in the family tree (C is third generation) and initial of kindred name (S for Smith, for e.g.). In case of twins, the initial of the first name is also provided.

test to evaluate his progress in terms of his impaired phonology where the task consisted of object naming using a stimulus book (the target nouns varied in terms of syllable structure complexity), GIM87CK's object identification and naming was near perfect (47/50) with his misses being semantically related words.

The main observation was that his phonology was impaired on almost all utterances regardless of length but especially so for words with consonant clusters[45]. GIM87CK simplified and substituted phoneme sequences, although stress and extraprosodic features were not significantly affected. For example,

(5)	(Gloss)	Stimulus	Response
	(taxi)	taksí	kasí
	(basket)	kaláthi	kaláti
	(candy)	karaméla	ka:méla
	(moon)	fengári	fendáli
	(faucet)	vrísi	víti
	(soldier)	stratyotáci	kotáti
	(thermometer)	thermómetro	timó:mito
	(car)	aftocínito	akocí:nito

Unlike his phonology, his syntax (in the limited number of sentences he used in spontaneous speech) appeared only mildly impaired. His tense marking was mostly correct

[45] Consonant clusters are not characteristic for the phonetic shape of Greek inflectional affixes (they are V(C)); it appears that cluster reduction or simplification as a phonological phenomenon is not causally related to the morphological problems for DLI subjects.

and so was his number marking. It is important to note, however, that the context of spontaneous utterances and the level of their complexity were under the subject's control. When tested on the Greek DLI screening test, GIML87CK's performance on elicited number marking of novel words was much poorer than his spontaneous production of plurals. The same was true of his performance on the tense marking section of the test.

It is interesting to note that this subject used language minimally, although he communicated very effectively, supplementing his utterances with paralinguistic information. Furthermore, his use of lexical information in spontaneous speech may have been carefully monitored, as his slower than normal rate of speech and lack of egregious tense or plural errors suggest. This is to be contrasted with his performance on elicited tasks in which he is comparable to English DLI subjects. Moreover, GIM87CK's performance on both elicited language responses and spontaneous speech was poorer than that of his age-matched control.

The DLI individuals reported here have errors in language production, independent of medium of expression (i.e., oral and written). These errors consist of incorrect grammatical marking of gender, number, case tense, aspect, person, voice, and mood. The following are some examples from recorded spontaneous speech during play, story telling, picture descriptions and from written compositions (spoken utterances were recorded, transcribed and checked by a native Greek speaker).

Grammatical gender

(6a) *tría karékles
three-neuter.pl. chair-fem.pl.

should be:

tris karékles
three-fem.pl. chair-fem.pl.
(numeral and noun agree for gender)

'three chairs'

(spontaneous speech)

(6b) *ólo * físi khirótan
all-neuter.sg. no determiner nature-fem.sg. rejoiced

should be:

óli i físi kherótan
all-fem.sg. the-fem.sg. nature-fem.sg. rejoiced
(quantifier, determiner and noun agree for gender)

'All of nature rejoiced.'

(written composition on the subject of spring)

Grammatical Number

(7a)	Therapist:	Aftí	íne	mía	dhrakhmí.	Aftés íne dhío _____?
		This	is	one	drachma.	These are two _____?

GIF87CK: *dhrakhmúla
drachma-diminutive.sg.

should be:

dhrakhmés	or	dhrakhmúles
drachma-pl.		drachma-diminutive.pl.

(7b)	khánonde	*ikoyénia
	get lost-pres.3rd p. pl	family-sg.

should be:

khánonde	ikoyénies
get lost-pres.3rd p.pl	family-pl.

'Families get lost (die).'
(from a written composition on the consequences of war.)

Case

(8)	o	*adherfó	mu	ékhi	áli	dhuliá
	the-masc.sg.nom.	brother-masc.sg.acc.	poss.pro	has	other	work

should be:

o	adherfós	mu	ékhi	áli	dhuliá
the-masc.sg.nom.	brother-masc.nom.sg.	poss.pro	has	other	work

(determiner and noun agree for case)

'My brother has a different job.'
(spontaneous speech)

Gender and Case

(9)	ídha	*áli...	*ála...	*áli	líkus
	saw-I	other	other	other	wolves
		masc.pl.nom.	neut.pl.nom.	masc.pl.nom.	masc. pl. acc.

should be:

ídha	álus	líkus
saw-I	other-masc.pl.acc.	wolf-masc.pl.acc.

(specifier and noun agree for gender and case)

'I saw other wolves.'
(spontaneous speech)

Tense

(10)	píyena	nípio,	ómos	tóra	*	páo	próti
	go	kindergarten	but	now	no future marker	go-I	1st grade
	cont.past.1st p.						

should be:

píyena	nípio,	ómos	tóra	tha	páo	próti
go	kindergarten	but	now	will	go-I	1st grade
cont.past.1st p.						

'I was in Kindergarten but now I will be in First Grade.'
(School was out for the summer; from spontaneous speech)

Aspect

(11)	dhe	thélo	*	ki...kimi... dhe	*kimáme
	neg.	want-I	no particle for 2ndary clause	sl..slee... neg. (perf.root)[46]	sleep-cont.1st p. (non-perf.root)

should be:

dhe	thélo	na	kimithó
neg.	want-I to	particle for 2ndary clause	sleep-1st p. (perf.root)

'I don't want to sl...I do not sleep.'
(spontaneous speech)

Grammatical constructions that were likely to be produced incorrectly were more likely to be correct when they occurred within expressions or idioms. For example, DLI individuals often omit or misuse prepositions, determiners, particles and verb forms. The

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[46] There is more than one overt root form for most verbs; one root is used in perfective forms and the other in non-perfective forms. For example, we see partial supletion in the verb root 'to write' *graph-* (non-perfective) compared to *graps-* (perfective) and total supletion in the verb root 'to eat' *trogh-* (non-perfective) compared to *fagh-* (perfective). We see here that "the root used for the [perfective] has a different phonological shape from that found in the [non-perfective] form. In other words, the root exhibits allomorphy" (Spencer, 1991:6). This root allomorphy ranges from partial to complete suppletion and signals a perfective / non-perfective contrast and which root is appropriate is determined by morpho-syntactic criteria.

same DLI subject may, nonetheless, produce all the requisite lexical and non-lexical items which were missing or misused in earlier contexts if those elements occur in a set phrase. Consider the following two spontaneous speech utterances by the same DLI subject:

(12a)	fakés	*	kolío	mu
	lentils	no prep.no det.	school-neut.sg.	poss.pro.

should be:

fakés	sto	skholío	mu
lentils	at-the-neut.sg.	school-neut.sg.	poss.pro.

'Lentils at my school.'
(Subject responding to what he had for lunch.)

(12b)	pézi	sta	khómata
	plays-he	at-the-neut.pl.	earth-neut.pl.

'He plays with earth.'

(From spontaneous speech. The locative expression *sta khómata* is very common with children as it is used to express a variety of games with earth; the noun in this context is pluralized and treated as a count noun in an idiom.)

Similar linguistic patterns have also been observed in the English DLI data, in oral as well as written spontaneous expression (Miller, upublished ms.). Complex expressions or

idioms, for example, may be produced without error suggesting they may be treated as chunks.

Table 3.1 summarizes the average performance of Greek DLI subjects and controls on some of the elicited screening tasks (see Dalalakis, 1994b for more detail). DLI individuals' performance on judging sentence grammaticality correctly and providing appropriate corrections) is poorer (34%) than that of the controls' (92% accuracy on average). Correct sentences are accepted as correct 60.2% of the time on average by the DLI subjects and 96.6% of the time by the controls. DLI performance is even lower when identifying incorrect sentences as such (24.6% compared to 80.7% for controls). Furthermore, of the sentences identified as incorrect only 17.2% are corrected appropriately by the DLI individuals compared to 99.4% by the controls. Finally, controls, unlike DLI subjects, make an effort to respond to all stimuli.

Table 3.1 Overall Greek DLI performance on selected tasks

Test Section	DLI Average (% correct) n=8	Control Average (% correct) n=8
Grammaticality Judgement (n=48)	34	92.2
No response	2.6	0
Correct stimuli (n=17)	60.2	96.6
Incorrect stimuli (n=31)	24.6	80.7
Grammatical corrections	17.2	99.4
Tense Marking Production (n=10)	20	87.1
Sentence Construction (n=6)	30	100
Derivational Morphology (n=9)	13	84.1

DLI subjects do not indiscriminately accept all sentences as grammatical but neither are they able to accurately identify ungrammatical sentences. Moreover, they are likely to fail at correcting sentences judged to be ungrammatical, and it is often the case that they target for correction a part of the sentence that was not wrong. For example, a sentence with a gender agreement error may be corrected for tense, ignoring the gender agreement error that is obvious to controls:

(13a)	Adhiasa	*to	*meghálo	kanáta	stin	avlí.
	Emptied-I	the	big	pitcher.	in-the	yard
		neut.sg.	neut.sg.	fem.sg	fem.sg.	fem.sg.

should be:

Adhiasa	ti	megháli	kanáta	stin	avlí.
Emptied-I	the	big	pitcher.	in-the.	yard
	fem.sg.	fem.sg.	fem.sg	fem.sg	fem.sg.

Or:

Adhiasa	to	meghálo	kanáti	stin	avlí.
Emptied-I	the	big	pitcher	in-the	yard
	neut.sg.	neut.sg.	neut.sg.	fem.sg.	fem.sg.

'I emptied the large pitcher in the yard.'

The above incorrect stimulus was identified as an incorrect sentence by GIM80CM

and corrected as:

(13b)	Ádhiaza	*to	*meghálo	kanáta	stin	avlí.
	Was emptying-I	the-neut.sg.	big-neut.sg.	pitcher-fem.sg.	in-the	yard.

'I was emptying *the *large pitcher in the yard.'

What may appear as correct judgement of grammaticality by DLI subjects, therefore, may be based on different underlying criteria for DLI subjects compared to controls.

On tense marking, DLI subjects do worse on average (20% accuracy) compared to controls (87.1% accuracy). On sentence construction, DLI subjects have a very low score in producing grammatical sentences with the provided stimuli, averaging 30% on whole sentence accuracy compared to 100% by the controls. DLI subjects make morphological and syntactic errors, with sentences often missing obligatory elements (prepositions, articles). For example, [pencil, write-I, paper, white] elicited the following utterance from subject GIF88CL:

(14a)	*áspro	khartí	ghráfo
	white	paper	write-I

'*White paper I write.'

Subject GIM87CC, for the same stimulus set, produced the following:

(14b)	*molívi	ghráfo	to	khartí	ke	ídha	ti	éghrapsa
	pencil	write-I	the	paper	and	saw-I	what	wrote-I

'*Pencil I write the paper and I saw what I wrote.'

DLI subject utterances tend to have fewer errors when the syntactic structure chosen is simpler, that is when there are shorter constituents and when items are conjoined. For example, subject GIM80CM produced the following sentence when cued with the set of lexical items: [tree, green, leaf, see-I] as can be seen in (15):

(15)	ídha	to	fílo,	ídha	ke	to	dhéndro,	ídha	ke	to	fílo
	saw-I	the	leaf,	saw-I	and	the	tree,	saw-I	and	the	leaf

'I saw the leaf, and the tree, and the leaf.'

The utterance in (15) is, relatively speaking, better than (14a) or (14b) in that it is not missing obligatory articles and prepositions but its structure is very simple.

DLI subjects also do more poorly than controls on derivational morphology. DLI average was 13% compared to the control average of 84.1%. Errors consist mostly of substitutions with non-target words that were conceptually appropriate or wrong derivations (high-frequency, morphologically related but non-targetted forms). Age-matched controls perform well even when their response is a form they do not know the meaning of. Control

subject GNM87CN, for example, faced with producing a low frequency item, replied correctly and then asked the experimenter what the word he had produced meant:

(16) cue: O vasiliás Solomóndas íkhe polí sofía. Ítan _____?
King Solomon had much wisdom. He was _____?

response: Sofós. Ti siméni 'sofós'?
'Wise. What does 'wise' mean?'

In story telling situations, controls also tend to produce narratives that are structurally richer, that have appropriate tense sequences, and that make use of full sentences. DLI subjects give less detailed versions of a story, often keeping only to the bare essentials. Both spontaneous and elicited data strongly suggest that, to the extent that English, Japanese and Greek are comparable, Greek DLI subjects perform equally poorly in linguistic tasks[47]. Greek DLI individuals seem to have the same kind of linguistic competence impairment as their English and Japanese counterparts. Table 3.2 presents cross-linguistic findings on selected test sections for three languages (the percentages are means of accuracy per group).

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[47] See also Gopnik et al. (1996), Fukuda and Fukuda (1994a) and Fukuda and Gopnik (1994) for linguistically equivalent tasks in English and Japanese DLI testing.

Table 3.2 Comparison of English[48], Greek and Japanese DLI subjects on selected tasks[49]

Test Section	English	Greek	Japanese
Syntactic Comprehension	82.25%	56.3%	83.5%
Grammaticality Judgement Appropriate Correction of Incorrect Sentences	57% 37%	34% 17.2%	43% 35%
Tense Marking Production	38%	20%	48%

We now present Greek DLI performance on the main word formation tasks starting in chapter 4 with plural formation.

[48] English data from Gopnik and Crago (1991).

[49] Japanese data from Fukuda and Fukuda (1994a).

Chapter 4

Developmental Language Impairment and Pluralization in Greek

DLI spontaneous speech contains errors of grammatical number affecting noun forms in isolation and agreement in noun phrases. DLI inflectional errors show that although both singular and plural forms are used, their distribution is not consistently based on grammatical criteria. Singular forms are used as plurals, especially when modified by numeral quantifiers, so that conceptually, even if not grammatically, the noun phrase is marked for plurality.

The same pattern of number errors was also observed in elicited data. In a Grammaticality Judgement task where subjects are given a set of sentences to judge as correct or incorrect, Greek DLI subject GIF87CV was asked to judge the ungrammatical sentence in (1) which contained an error in Number agreement. Her response is rather common for a DLI subject on such a task. She identified the sentence as ungrammatical, and then corrected a section of the sentence that was grammatical. Her reaction suggests that she was unware of the Number agreement error present in the stimulus sentence and that she was focusing instead on pragmatic aspects of the sentence meaning.

(1a) Stimulus sentence from Greek DLI screening test:

I	Ánna	trói	tría	*biskóto.
the-fem.sg.nom.	Anna-fem.sg.nom.	eats	three	cookie-neut.sg.

*Anna is eating three cookie.

(1b) Greek DLI subject's correction to (1a):

I	Ánna	trói	dhío	*biskóto.
the-fem.sg.nom.	Anna-fem.sg.nom.	eats	two	cookie-neut.sg.

Coincidentally, the same type of response is reported for one of the English DLI subjects tested by Gopnik and Crago (1991):

(2a) Stimulus sentence from English DLI screening test:

The boy eats three cookie.

(2b) English DLI subject's correction to (2a):

The boy eats four cookie.

The hypotheses of the plural formation task below were based on observations from spontaneous speech and elicited data in Greek and on findings for novel plural formation of English DLI subjects.

4.1 Hypotheses

Non-impaired subjects' noun representations are assumed to have an internal structure as illustrated in (4a). It is also assumed that morphological features are represented. Non-impaired subjects' plural formation is expected to respect (a) morphological principles necessary to map features of affixes to those of roots, and (b) hierarchical morphological relationships among morphemes found in a single word as constrained by feature percolation conventions (Lieber, 1992) and relativized head properties (Williams, 1981; Di Sciullo and Williams, 1987)[50].

In contrast, DLI subjects are hypothesized to lack internal structure for inflected words such as plurals as illustrated in (4b)[51]. DLI representations are also assumed to be

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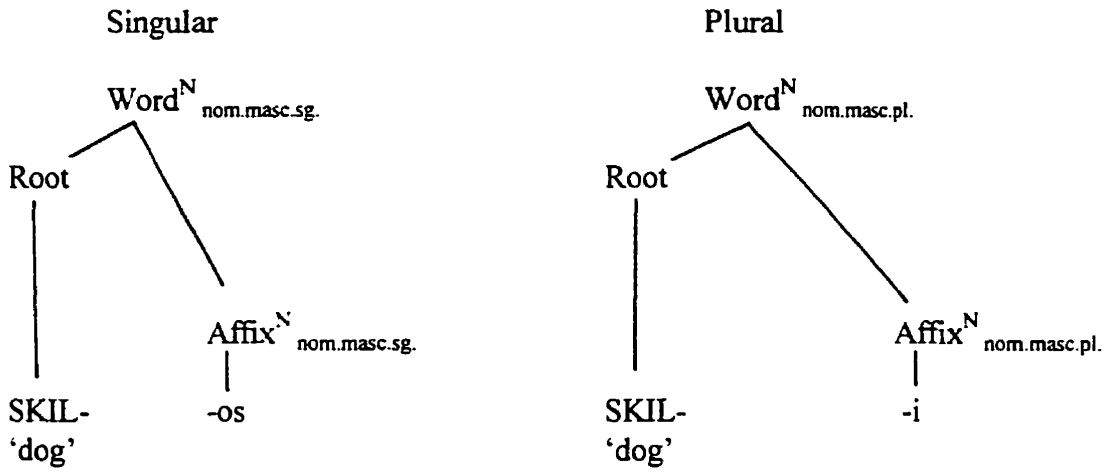
[50] Morphological headedness in Greek is always on the right with regard to complex forms with functional morphemes carrying morphological and morphosyntactic features , and almost always on the right with regard to semantic features in compounds (this is further discussed in Chapter 5).

[51] The hypothesis that DLI representations lack any sublexical features is strong or pessimistic but easier to test given our present knowledge compared to assuming a priori that some sublexical features would be more affected than others.

lacking morphological features for number. DLI plural formation, therefore, is assumed to be based not on morphological criteria but on conceptual appropriateness (as argued by Ullman and Gopnik, 1994 for tense marking).

(4a)



(4b)

Given these theoretical assumptions, the expectations for the performance on a pluralization task were that the impaired and control groups would differ significantly both

in response patterns and in error patterns[52]. Specifically, DLI subjects' nominal plural morphemes were not expected to have grammatical status. DLI subjects' pluralization attempts for novel words were expected to be surface phonetic analogies to any similar existing plural forms disregarding gender or class.

4.2 Methodology

Subjects

Nine DLI subjects (two female and seven male) ranging in age from (5;8) to (17;7) participated in the plural formation task. They were matched with 15 age-matched controls and 16 younger controls.

Materials and design

The plural formation task was a production task in which subjects were cued to produce 90 plural forms of which 30 were real and 60 were novel; one third of each type were masculine, one third feminine, and one third neuter. The novel nouns were introduced in a trigger sentence and the target was the final word in the plural equivalent of the same

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[52] Katis (personal communication) has unpublished preliminary data from a pluralization task which includes novel nouns that was administered to non-impaired native Greek youngsters.

sentence; in both sentences the gender and the number of the novel words were signalled by a deictic, a numeral and the inflectional ending on the novel noun itself.

Real and novel nouns used as stimuli were representative of the main noun classes of each of the three genders (Triantafillidhis, 1992). Half the stimuli used were two syllables long and half were three syllables long. This variable was meant to evaluate whether problem responses could be related to articulatory processing difficulties associated with word length. Both real and novel word stimuli can be found in Appendix B.

Procedure

Stimuli were introduced in a carrier sentence. The stimulus was part of a noun phrase constituent which was in the nominative case[53]. A deictic ('this') and a numeral ('one') both signalled the number, the case and the gender of the stimulus noun as in (1a). The novel noun itself had an inflectional affix which provided number, gender, and case information as well. The target response was prompted by a plural noun phrase also in the nominative.

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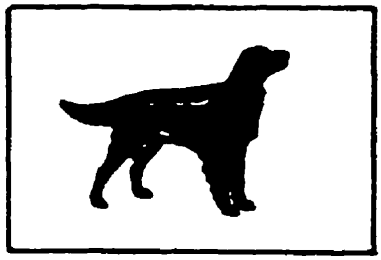
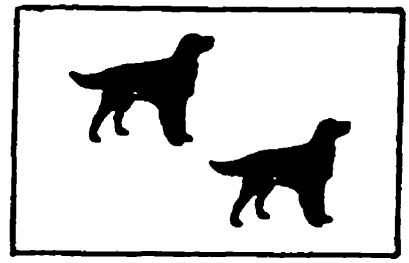
[53] Lakatela et al. (1980) have shown that in a language with a rich nominal inflection system the most frequent case and also default case, the nominative, has the most dominant representation effects in the mental lexicon. The nominative case was appropriate in this study for not only this reason, but also to be in accordance with other 'wug test' research where the stimulus was presented with the same experimental paradigm.

(1a) Example of real singular and cue





Aftós íne énas skílos.
This $_{masc.nom.sg.}$ is one $_{masc.nom.sg.}$ dog $_{masc.nom.sg.}$

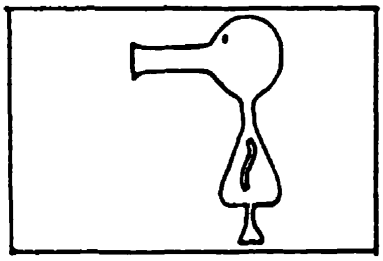
'This is a dog'.

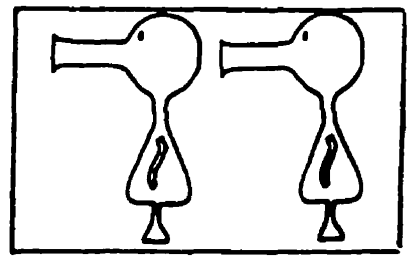
Aftí íne dhío _____*?*
These $_{masc.nom.pl.}$ are two

'These are two _____'?

Novel nouns were introduced in the same manner as real ones. An example of a novel noun is provided in (1b):

(1b) Example of novel singular and cue[53]





Aftí íne mía roliá.
This $_{fem.nom.sg.}$ is one $_{fem.nom.sg.}$ novel $_{fem.nom.sg.}$

'This is a *rolia.*'

Aftés íne dhío _____*?*
These $_{fem.nom.pl.}$ are two

'These are two _____'?

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[53] Drawings depicting novel nouns were drawn from a pool developed by Goad and Rebellati (1994) who run an extended wug task with English DLI subjects.

Scoring

For real nouns, responses were scored as correct only if they corresponded to attested plural forms. For real nouns, responses were considered correct only if they corresponded to the plural form of the noun that the novel was modelled on. Plural attempts with other inflectional affixes were considered class or gender errors depending on what features the affix marked.

4.3 Results

All subjects performed significantly better on real nouns than on novels. Younger and age-matched controls both did near ceiling level for real words (99.2% and 99.5% respectively) compared to DLI subjects (who had an average of 75.6%). DLI subjects did worse than either their younger or age-matched controls, however, on both real and novel nouns and for all three genders. Results by type of noun are summarized in Table 4.1.

Compared to scores for real nouns, scores for novel nouns were lower for all 3 groups. Controls still did better than DLI subjects; younger controls (YC) produced 78.7% correct

novel plurals and age-matched controls (C) produced 79.8% correct novel plurals compared to DLI subjects who had an average of 42.1%.

Although performance on real nouns was better than on novel ones, frequent real nouns were easier than infrequent ones for DLI subjects (real nouns: 75.6% accuracy vs. novel nouns: 42.1%). The non-impaired / impaired contrast was greatest for novel nouns, especially for those of neuter gender where DLI subjects scored an average of 18.1% compared to YC 64.1% and to C 60.7%.

Performance of DLI subjects seems to be affected by lexical learning as can be seen by the higher scores for real words compared to novel ones. Plural formation for novel words cannot be accomplished through access of learned forms but must be done using word formation rules. This rule-based route, more dominant in non-impaired controls in forming novel plurals, is also evident in their type of overgeneralization error patterns to be discussed shortly.

Table 4.1 Overall performance by group[55] on pluralization task

AVERAGE SCORES (%) N = 90	Younger Controls (YC) n = 16	DLI Subjects n = 9	Age-MatchedControls (C) n = 15
All Real Nouns (n=30)	99.2%	75.6%	99.5%
Real Masculine (n=10)	97.5%	66.7%	98.5%
Real Feminine (n=10)	100%	80%	100%
Real Neuter (n=10)	100%	80%	100%
All Novel Nouns (n=60)	**78.7%**	**42.1%**	**79.8%**
Novel Masculine (n=20)	80.1%	44.4%	81.7%
Novel Feminine (n=20)	91.7%	68.9%	97%
Novel Neuter (n=20)	64.1%	18.1%	60.7%

[55] Individual scores, when not provided, can be made available upon request.

The best performance is observed for feminine nouns and the worst for masculine which, as a pattern, is in accord with developmental data from non-impaired children for whom feminine noun pluralization also develops first and tends to be most accurately produced (Baslis, 1992; Stephany, 1995).

There was no word length effect for any of the three groups which suggests that articulatory factors do not affect the level of task difficulty in any significant way. DLI subjects did tend to pause between syllables more so than controls but that did not appear to affect the grammaticality of their responses. A frequency effect was observed, however, for the DLI group; novel nouns which were phonetically similar to existing frequent nouns (regular *and* irregular) were more likely to be pluralized even if not always grammatically.

Error patterns on novel items for DLI subjects, summarized in Table 4.2, were also informative. Unlike age-matched controls, DLI subjects tended to repeat singulars as plurals (e.g. *énas bírios - dhío bírios*), to substitute novel plural targets with real words (e.g. *énas bírios - dhío bóres* 'two storms'), to omit or avoid responding (DLI 3.8%; YC 1.3%; C 0%), and to produce ungrammatical plural forms (i.e. wrong gender or class affix).

Specifically, DLI subjects made errors in inflecting for correct gender or noun class and showed no *grammatical* over-regularization of any plural morphemes (i.e. consistency for gender or class features). For example, for DLI subjects, the singular stimulus *peró* $_{Neuter}$

became, in some pluralization attempts, *perí* $_{Masc}$ or *perés*$_{Masc/Fem}$ instead of the targeted *perá*$_{Neuter}$. This is not the case with the control groups who tend to consistently show overregularization of class while respecting gender. For controls, the stimulus *peró*, for example, tended to become *perá* which is a regular neuter plural subfamily paradigm.

Non-impaired subjects also tended to regularize irregular roots. This was true for the younger subjects when given either real irregular nouns or novel nouns based on irregulars; older non-impaired subjects regularized only novel irregulars and produced the irregular plural forms more reliably. For example, for non-impaired subjects, the irregular novel noun *thísimo*$_{neuter}$ consistently became *thísima*$_{neuter}$ instead of the targeted irregular plural *thisímata.* The plural affix *-a* is perfectly correlated with the neuter gender so that the gender feature constraint was respected during pluralization even when regularization occured. In contrast, for the impaired subjects, this irregular novel resulted in a number of different responses: *thísimo*$_{Neuter,\ singular}$, *thísimi*$_{Masculine.plural}$, *thísimes*$_{Manculine/\ Feminine.\ plural}$ as well as *thísima* $_{Neuter,\ plural}$

Table 4.2 Error types per group on pluralization task

Error types	Younger Controls (YC errors: 23% of all responses)		DLI Subjects (DLI errors: 52% of all responses)		Age-Matched Controls (C errors: 22.1% of all responses)	
	as % of all responses	as % of errors	as % of all responses	as % of errors	as % of all responses	as % of errors
Stimulus repeated	8.7%	37.7%	21.1%	40.5%	0%	0%
Substitution with real word	1.6%	6.9%	6.3%	12.2%	0 %	0%
Non-targeted plural form	12.2%	53.1%	21.6%	41.5%	3.4 %	15.4%

DLI subjects showed no sensitivity to grammatical features of plural allomorphs such as gender. For example, *-es* is, for the DLI subjects, the most commonly used ending for all three genders and present in 14.8% of all DLI ungrammatical pluralization attempts. This is a result of frequency rather than one modulated by grammatical constraints since /-es/ is ungrammatical if it appears with neuter words.

DLI subjects' performance varies from subject to subject in several ways. For example, older DLI subjects attempted more pluralizations than younger ones. Despite this, successful attempts do not increase. DLI subjects average only 57.3% pluralization attempts out of all responses but only 62.5% of those attempts are sucessful compared to age-matched controls' overall pluralization attempts being 91.8% of which 80.1% were successful.

In addition, DLI subjects' performance is more variable from subject to subject[56] in that younger DLI subjects seem likely to have more types of response strategies, considering perhaps more solutions as to how to solve the linguistic task. Older DLI subjects tend to use fewer plural morphemes across genders and noun categories but still perform much less accurately than their age-matched or younger controls.

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[56] DLI variance in performance is typically greater than that of control groups which may be a reflection of the use of different compensatory strategies even within subjects as well as across subjects (see also Paradis and Gopnik, 1994); it is due to this heterogeneity of variance across groups that powerful multivariate analysis is not always suitable.

This suggests that some type of non-morphological associative network for singular - plural forms (such as that proposed by Rumelhart and McClelland, 1986) may be in operation for older DLI subjects allowing them to form large conceptual plural families, such as those ending in *-es, -i,* and *-a* . Such an associative network, however, does not seem to be sensitive to grammatical features such as gender so that, for example, the *-es* affix is incorrectly used by DLI subjects for words of all three genders. DLI responses, in this respect, are not morphologically governed for gender or class features. Plural formation, for DLI subjects is influenced by phonetic similarity to real nouns of any gender or class and perhaps even number.

Non-impaired subjects, in contrast, limit their non-targetted plural forms from very early on to few plural families; the preferred plural morphemes tend to be *-es* for masculine and feminine nouns and *-a* for neutral ones, so that plural affixes are selected to respect gender feature requirements. The errors of the control subjects were grammatically based on gender features, and frequency of plural allomorph class did not override gender.

In short, although both DLI and control groups seem to overgeneralize novel plurals, DLI subjects made analogies by surface qualities whereas controls, especially younger controls, made analogies while satisfying both number and gender constraints. In this respect, DLI subjects are qualitatively different from non-impaired children at an earlier developmental stage.

With respect to control responses that were non-targetted forms, they were one of the following: (a) repetitions of singulars as plurals (8.7% of all responses for the younger

controls and 0% for the age-matched controls vs. 21.1% of all responses for DLI subjects); (b) substitutions with real words (1.6% of all responses for the younger controls and 0% for the age-matched controls vs. 6.3% of all responses for DLI subjects); and (c) non-targetted pluralization attempts phonologically related to the novel singular (12.2% of all responses for younger controls and 3.4% of all responses for age-matched controls (noting that both control groups tended to respect gender in their generalizations) vs.21.6% of all responses for DLI subjects (noting that these forms did not consistently respect gender constraints).

In addition, for control subjects, we observe generalizations which are similar to a default pluralization rule. Specifically, for masculine and feminine novel nouns, non-impaired subjects produced a number of plural forms,ending in /-Vdhes/ where the V (= vowel) varies depending on the stem. This ending is often used with assimilated noun borrowings (either borrowed roots or borrowed derivational suffixes) which do not have any close native subregular neighbours. Such generalizations of plural formation are absent in DLI subjects.

For example, the name *Avraám* 'Abraham' is used without any inflectional affixes by most Greeks. In areas where the name is popular, it is fully adopted into the inflectional system so that it is overtly marked for case, gender, and number becoming *Avrámis* in the nominative singular form and *Avrámidhes* in its nominative plural form. The stem *boyatzi-* (from the Turkish *boyá* 'paint' and *-tz-* 'agentive -er[57]') is inflected in its nominative

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[57] The derivational affix *-tz-* (sometimes realized as *-ts-*) is borrowed from Turkish *-ci-* and is used to denote 'one whose profession is x'. Stems with this affix subcategorize for the inflectional affix *-is* for

singular form as *boyatzís* 'painter' and as *boyatzídhes* 'painters' in its nominative plural form.

Novel nouns in this task, were often given this low-frequency plural morpheme by controls. For example, *rasés* (novel) became *rasédhes* in analogy with *kafés* - *kafédhes* 'coffee - coffees' but so did *kanistís* - *kanistídhes* (novel) which had been modelled on *dhanistís* - *dhanistés* 'lender - lenders'. This is morphological response pattern similar to that observed in the case of the low-frequency default plural allomorph *-s* used by German controls in novel pluralization tasks as reported by Marcus et al. (1992)[58].

DLI subjects sometimes also produce neologisms when attempting to inflect. In such cases, we observe that lexical category constraints are respected in that verb affixes will not attach to noun roots or vice versa but rather, what we see is the use of inappropriate suffix within each lexical category similar to paragrammatic errors of Greek aphasics (Kehayia, 1990). For example, when prompted for *mía vúrtsa* (a brush), GIF88CL produced *mía *vurtsíla* (neologism); *-ila* is a nominal suffix but not appropriate for this noun root.

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masculine nouns (e.g. *taksitzís* 'taxi-driver', *paputsís* 'shoe-maker') and *-u* for feminine nouns (e.g. *taksitzú* 'taxi-driver', *kafetzú* 'coffee reader /fortune teller').

[58] In German, where a number of plural allomorphs also exist, and where we also have the interaction of gender, Clahsen et al. (1992), and Clahsen and Rothweiler (1992) have shown that DLI subjects do form plurals, but it is not clear how the features for class and gender of the plural morphemes interact.

4.4 Summary

The hypotheses outlined in section 4.1 were supported. Non-impaired subjects' performance suggests that they are more sensitive to the correlations between inflectional affixes and morphological features compared to even older DLI subjects. For real subregular nouns (i.e., belonging to different morphological classes), associative networks between singular and plural forms are built early. In contrast, pluralization attempts of DLI subjects are fewer and less likely to be accurate than those of controls even in a highly constrained task which clearly requires that plural forms be produced.

DLI subjects do not seem to have obligatory marking for grammatical number. This is in accord with Gopnik's (1995) findings that English DLI subjects do not mark grammatical tense in obligatory context consistently across modes and modalities.

Although both DLI and control groups seemed to overgeneralize novel plurals, DLI subjects had more errors (52% of all their responses were ungrammatical vs. only 23% for younger controls and 22% for age-matched controls). Younger controls, even when they generalized, satisfed both number and gender constraints. In this respect, DLI subjects were not qualitatively similar to non-impaired children at an earlier stage of language development.

Chapter 5

Developmental Language Impairment and Compound Formation In Greek

Greek DLI subjects produce compounds in a pragmatically correct manner during spontaneous speech and seem to comprehend compound words in their environment. For example, during language therapy, in a story telling situation, Greek DLI subjects produce compounds that had been learned the previous session. Although spontaneously produced compounds such as *akroyaliá* 'seaside' were produced, no DLI subject was observed to produce novel compounds, as was the case with non-impaired children[57].

The fact that attested compound words can be found in spontaneous speech samples of DLI subjects, does not inform us of what the representation or word-internal structure of such words may be. The absence of novel compound production for DLI individuals suggest that the attested compound words that they do produce may have been learnt as simple words and that productive compound formation may be impaired. Such a possibility

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[57] Non-impaired children also reported in the literature (e.g. Thomadaki, 1986) produce a number of novel compounds.

is empirically tested here. The compound formation task reported in this chapter investigates the types of representations that DLI individuals may have for nominal compounds.

DLI subjects can and do produce compounds. In experimental research, DLI subjects do use compounding as a word formation strategy, but not always in the same manner as non-impaired individuals. English DLI subjects, for example, produce compound structures when required to inflect; compounding, therefore is used to compensate for impaired inflectional skills (Goad and Rebellati, 1994). Japanese DLI subjects, when required to form compounds, are observed to have impaired phonological rules of obligatory voicing agreement for obstruents within compound formation (Fukuda and Fukuda, 1994b) but compounding as an operation is attempted. It remains to be examined what the limitation of complex structure representation for DLI subjects is.

5.1 Hypotheses

It is hypothesized that although compound formation for DLI subjects is possible as an operation, the word-internal structure of DLI compound representations may be impaired. The hypotheses are presented and discussed in terms of morphological representational structure and in terms of morphological operation (i.e., word formation rules).

First, in terms of morphological representation, it is hypothesized that word-internal structure will be impaired. It is hypothesized that DLI subjects will perform better when asked to produce real compounds and they are expected to perform poorly when required to produce novel compounds. DLI novel compound attempts are expected to have structural errors because it is assumed that the representation of the roots which are necessary as constituents to form compounds is impaired.

DLI errors when required to produce novel compounds are expected to be not only structural (e.g., wrong root boundaries), but also operational (i.e., not knowing the word formation rule that compounding requires the use of the linking morpheme -o-).

It is therefore expected that DLI responses for novel compounds will be: (a) substitution with real word, (b) root errors for compound constituents, (c) incorrect realization of the linking morpheme -o- . (d) or no response.

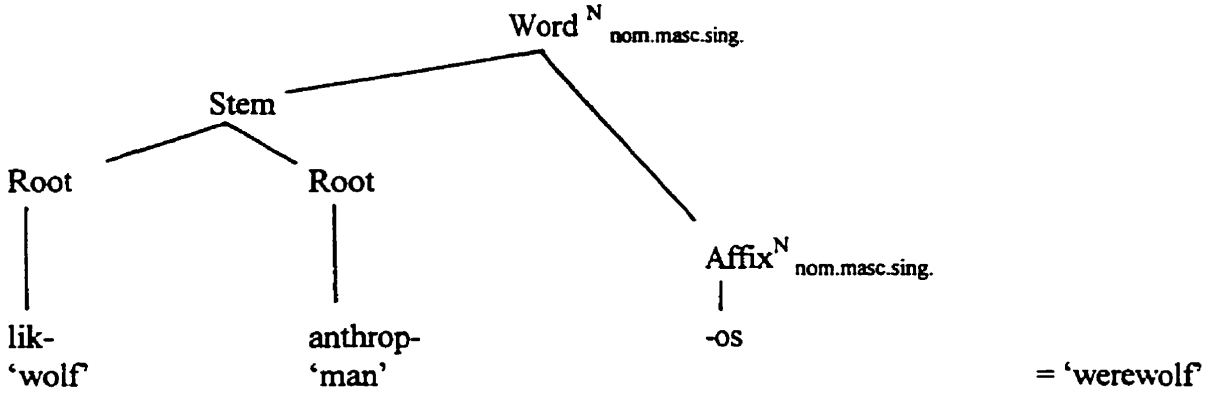
Non-impaired controls are hypothesized to have compound formation rules that use as input correctly abstracted representations of roots in terms of root boundaries and in terms of morphological features. Controls are therefore expected to produce novel compounds that do not contain root errors. We do not expect controls to produce errors where they inflect the first element. Moreover, non-impaired subjects are expected to have the knowledge that the linking morpheme -o- is used in compounding and that it appears immediately after the first root when the second element is consonant initial.

If attested compounds are represented as simple words, over-regularization errors will not be likely. The attested form is expected to block the online construction of a new

compound (Pinker, 1991; Badecker and Caramazza, 1989; Caramazza et al., 1988; Laudanna et al. 1989). Over-regularization errors with regard to the realization of the linking morpheme -o- will be more likely to appear in novel compounds which must be constructed since they cannot be retrieved from memory. The use of novel licit compound formation is critical allows us to see if DLI subjects will do better on real compounds (where lexical retrieval is possible) and worse on novel compounds for which complex structure has to be created.

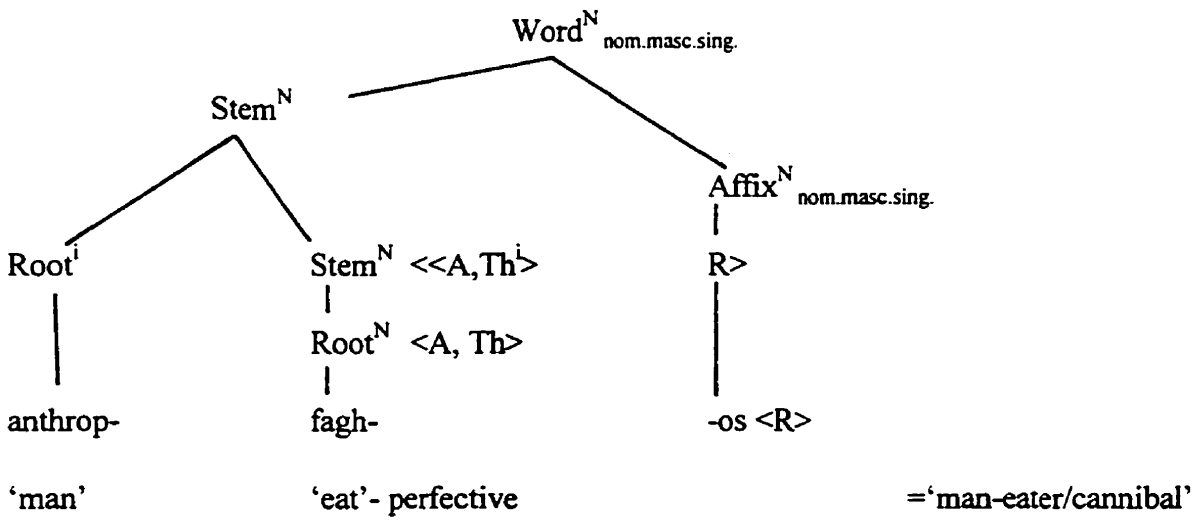
For real compounds, non-impaired subjects are assumed to have morphological representations such as those illustrated in (1a) and (1b) below whereas DLI subjects are assumed to have simpler representations (with impaired internal word structure) such as those illustrated in (2a) and (2b):

(1a) Real Noun + Noun compound representation: non-impaired



For novel compounds, non-impaired subjects are assumed to know that they must compound a non-inflected element with another before inflecting the output. They are therefore not expected to make errors of internal word structure. DLI subjects are expected to have errors where they will attempt to compound first elements which do not correspond to roots. They are expected to attempt using inflected forms more than the controls.

(1b) Real Noun + Deverbal Noun compound representation: non-impaired

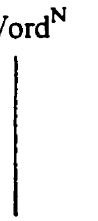


(2) Real compound representation: impaired

(a) Noun + Noun

likanthropos
'werewolf'

(b) Noun + Deverbal Noun



anthropofaghos
'cannibal'

The rationale for including this synthetic set in the study was as follows. Unlike primary compounds, the head of a synthetic compound is not a licit word if it is given an inflectional ending (to produce, for example, **fághos* 'eater'). This is due to the argument structure of the denominal verb stem; it is derived from a transitive verb root and therefore requires that it discharge its Theme role onto another nominal element, namely the first element of the compound. As a result, not only is a form such as **fághos* 'eater' ungrammatical, but also, more importantly, it cannot possibly be learnt from the environment in the way that the rightmost root in primary compounds can be learnt as a word (*ánthropos* 'man', for example).

This kind of nominal compound was meant to highlight DLI bound root difficulties more than the first N+N kind. The N+DevN compounds might be more difficult to construct because no element within them can surface as a word. In (12a) the root *mirmig-* 'ant' combines with the root *fagh-* 'eat-perfective root' and the inflectional suffix *-os* to form

the real compound *mirmigofághos* 'ant-eater'. Unlike *ánthropos* 'man' in *likánthropos* 'werewolf', *-fághos* cannot surface outside compound constructions because it is a deverbal nominal form derived from a transitive verb.

Nominal compounding also involves the insertion of -o- between lexical elements. The variable realization of -o- raises three main questions with regard to the DLI population: (a) Are DLI individuals aware of the function of -o-? (b) Do DLI individuals know that -o does not surface before a vowel-initial element when the product is a noun? and (c) Will they know that -o- surfaces exactly between the two elements being compounded? DLI subjects' competence with regard to the use of -o- is assumed to be impaired.

5.2 Methodology

Subjects

Seven DLI subjects participated in the compound formation task DLI subjects ranged from (6;6) to (17;7) in age and only one was female. Each DLI subject was matched with 7 age-matched and 7 younger controls (to reduce variance). Given the overlapping ages of some of the DLI subjects, some controls were used for more than one DLI subject.

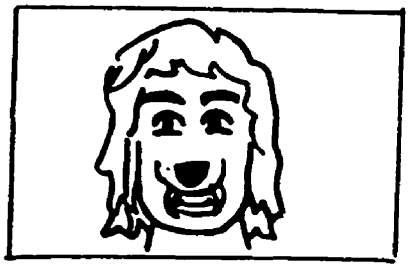
Test design

The compound formation task was a production task where the subjects were cued to produce 40 compounds (20 real compounds and 20 novel) half of which were primary endocentric and half of which were synthetic endocentric. Half of the stimuli required the linking morpheme -o- and half did not. All compounding elements used were real words. All trigger stimuli and the compounds they targeted can be found in Appendix C.

Procedure

For the N+N compounds, the subjects were shown a pair of drawings (as illustrated in (2a) and were read the following instructions: 'Here is a (wolf)'. 'Here is a man who becomes a (wolf) when we have full moon. Do you know what we call him? We call him a _____.' The noun in parenthesis is what varied from question to question. In the (wolf) case, the expected response was *likánthropos* (wolf-man) 'werewolf', which is a real compound.

(2a) Example of real N–N compound



Na énas líkos.

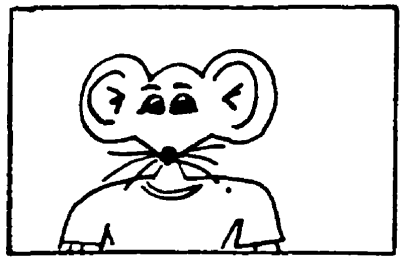
'Here is a wolf.'

Na énas ánthropos pu yínete líkos otan ékhume pansélino.Kséris pos ton léme? Ton léme _____?

'Here is a man who becomes a wolf when we have full moon. Do you know what we call him? We call him a _____?'

An equal number of questions cued for nouns which would produce novel compounds. For example (see (2b), 'Here is a (mouse)'. 'Here is a man who becomes a (mouse) when we have full moon... We call him a _____?' For this case, the expected response was *pondikánthropos* 'mouse-man' which is a possible but non-attested (i.e. novel) compound. All target compounds were masculine, singular, and requested in the same case (nominative) and all compound elements for the novel compounds were introduced with real words.

(2b) Example of novel N+N compound

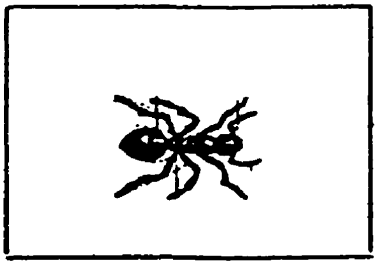


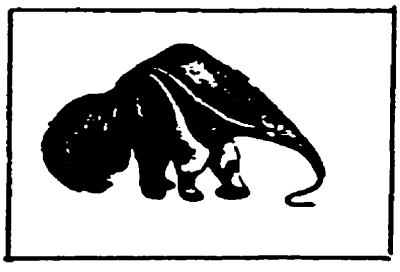
Na énas pondikós. Na énas ánthropos pu yínete pondikós ótan ékhume pansélino.Kséris pos ton léme? Ton léme _____?

'Here is a mouse.' 'Here is a man who becomes a mouse when we have full moon. Do you know what we call him? We call him a _____?'

For the real N+DevN compounds. subjects were shown a pair of drawings and were read the following instructions: 'Here is an (ant). Here is an animal that eats ants. Do you know what we call him? We call him a _____?' (see also (2c). The expected response here is *mirmigofághos* 'ant-eater' which is a real compound.

(2c) Example of real N+DevN compound

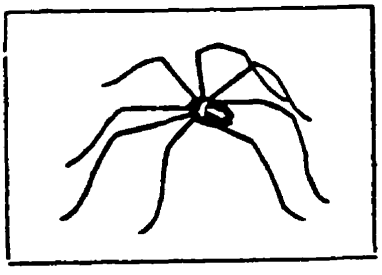


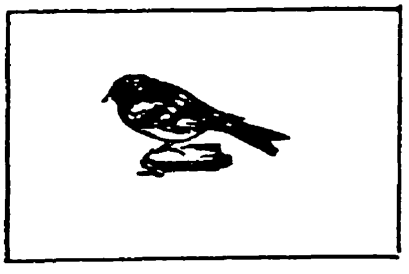


Na éna mirmíngi. Na éna zóo pu trói mirmíngia.Kséris pos ton léme? Ton leme _____?
'Here is an ant.' 'Here is an animal that eats ants. Do you know what we call him? We call him a _____?'

An equal number of questions cued with nouns which would produce novel compounds. For example (see also 2d), 'Here is a (spider). Here is a bird that eats spiders. Do you know what we call him? We call him a _____?'. The expected response for this example would be *arakhnofághos* which is possible but not attested in the language.

(2d) Example of novel N+DevN compound





Na mía arákhni.
'Here is a spider.'

Na éna pulí pu trói arákhnes. Kséris pos ton léme? Ton léme _____?
'Here is a bird that eats spiders. Do you know what we call him? We call him a _____?'

Scoring

Responses were coded by type: (a) compounding attempt (correct or incorrect for (i) root boundary, (ii) realization of -o-), (b) substitution with another word (real, neologism), (c) no response, or (d) repeating the trigger stimulus (simple noun form). Multiple errors

were each coded separately; for example, if the response given was a word that contained parts of both lexical elements but had a shortened root for the first element, it was coded as pluralization attempt with a root boundary error.

5.3 Results

The main findings are presented in terms of correct responses by group and by compound type as well as in terms of an error analysis again by group and by compound type. First, the main findings with regard to correct responses, by group, are summarized below, and can be also seen in Figures 5.1 to 5.3. All results reported are statistically significant at a 99% Confidence Interval unless otherwise noted.

For all compound types, DLI subjects performed the poorest among the three groups. Younger Controls did better than the DLI subjects but worse than Age-matched Controls. The Young Controls' performance was closer to that of the Age-Matched Controls than to that of the DLI subjects. The age-matched controls were at 90%+ accuracy (by their seventh year) whereas the most successful (and oldest) DLI subject achieved 18 correct responses out of 40 (by 17;7) using a broad phonological analysis and the least successful (and youngest) control achieved 19 correct responses out of 40 (at 4;11).

DLI subjects made more root boundary errors than either of the other two groups; boundary errors consisted of truncated or lengthened roots.

Younger controls tended to overregularize the compounding rule of -o- realization so that -o- surfaced before both consonant-initial and vowel-initial second elements. This realization of -o- however, respected root boundaries even when -o- should not have surfaced, suggesting that the the rule for using the compounding morpheme existed but its constraints had not yet been mastered. DLI subjects, in contrast, tended to realize -o- in non-root boundary positions suggesting that -o- realization for them was random.

Figure 5.1 shows the overall performance of the three groups by type of response. DLI subjects had the fewest correct responses, the most incorrect responses, and were most likely not to respond at all compared to either control group.

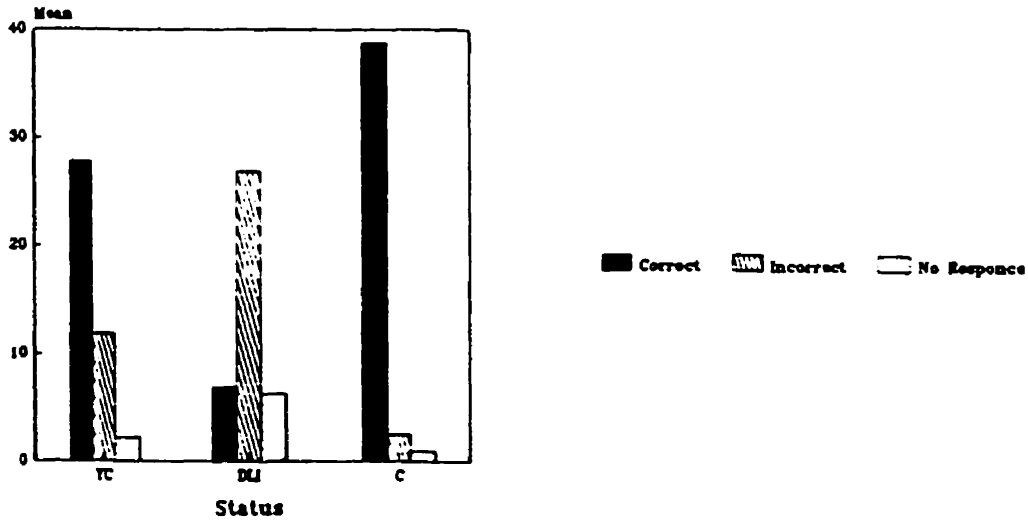


Figure 5.1 Responses by group

Figure 5.2 shows that although DLI subjects had great difficulty with both real and novel compounds, novel ones were even more challenging (although not in a statistically significant manner; both real and novel proved to be very difficult for DLI subjects). It

should be noted that compound words in general are of lower frequency in the language as a set compared to non-compound words.

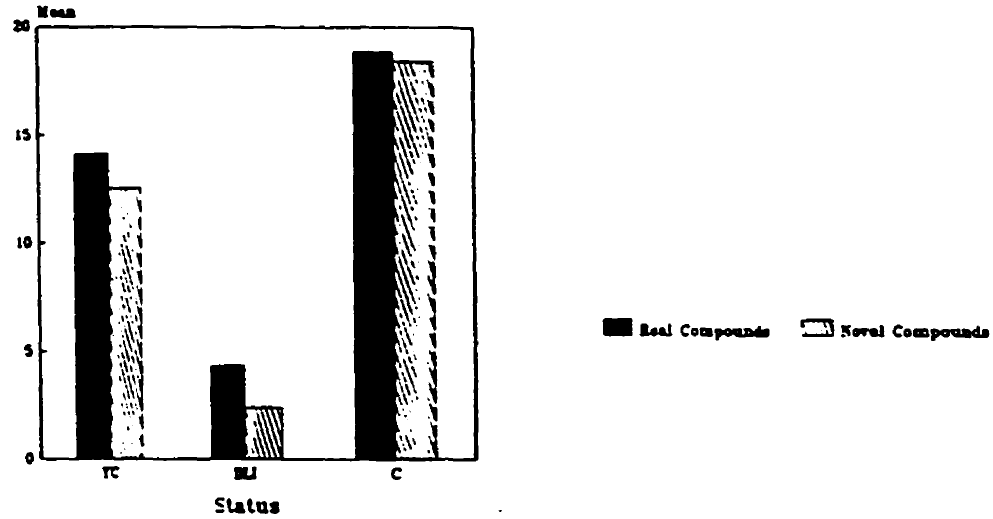


Figure 5.2 Real vs. Novel Compounds

Compounds that had first elements with two syllables were slightly less likely to result in compounding errors. Both two- and three-syllable first elements were difficult for the DLI group, suggesting that errors were not affected by word length.

Figure 5.3 shows that both N+Deverbal Nominal and N+N compounds were very difficult for the DLI group: there is no significant difference between types since performance on both was very poor). In contrast, age-matched controls did very well on both types.

Young controls also had some difficulty with N+N compounds. They show a tendency to generalize the -o- to compounds that do not require it; the over-regularization decreases with age so that the age-matched controls do not exhibit the tendency. Because of the over-

regularization of -o- in the N+N type, controls appear to do better in the N+Deverbal Nominal type. The prediction, therefore, that N+Deverbal Nominals would be more difficult than N+N compounds for young controls was not supported.

In overregularizing -o-, young controls seemed not aware that vowel-initial second elements do not require -o- so that while they showed knowledge of its linking role in compound formation, they did not show knowledge of the restriction of when it was not needed. DLI subjects, in contrast, tended to use -o- less in general, and often inserted it in inappropriated positions (i.e. not between roots).

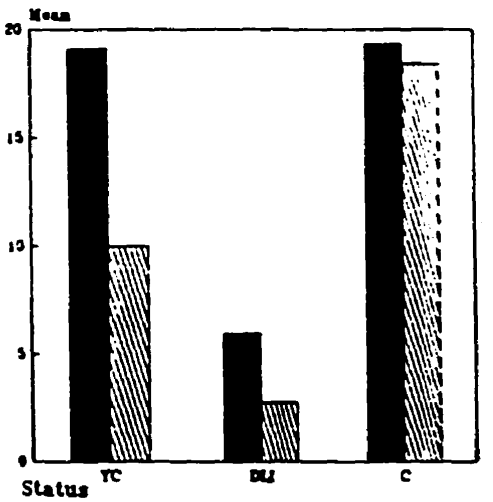


Figure 5.3 N + Deverbal Nominal vs. N+N compounds

We now consider the performance of the three groups by type of response, and we turn to error analysis. Table 5.1 gives example of each type of non-targeted response.

The inappropriate responses of DLI subjects were of more types than those of either control group. DLI subjects had more substitutions of real words (conceptually compatible

with target), more repetition of the stimulus, more attempts at alternative marking, and more incorrect attempts at compounding.

One DLI subject gave most of his responses in the following pattern: without attempting to compound, he modified the ending of the trigger stimulus by shifting the stress to the ultimate syllable which was in these cases given the rime *-as*. The derivational affix *-as* is correlated with an agentive meaning similar to the English agentive '-er'. The result was sometimes a possible but non-attested word and sometimes an ugrammatical word. It may be that this strategy was easier than attempting to compound, but there is no indication why this was preferred by one subject and not the others.

Table 5.1 Types of DLI Incorrect Responses and examples

Type of Response	Example
1. No response	"I don't know".
2. Substitution of target with real word	fitofághos for milofághos [stimulus: mílo] 'herbivore' 'apple-eater' Novel Compound
3. Echo of trigger stimulus	álogho for alogánthropos [stimulus: álogho] 'horse' 'horse-man' Novel Compound
4. Trigger stimulus stressed on ultimate syllable *-as* (neologism)	*falenás for falenánthropos [stimulus: fálena] *?whaler (masc.) 'whale-man' Novel Compound
5. Incorrect attempt to compound	*arniánthropos for arnánthropos [stimulus: arní] 'sheep-man' Novel Compound
6. Other neologistic forms	*fidhída for fidhofághos [stimulus: fídhi] *?neologism (fem.) 'snake-eater' (masc.) Novel Compound

DLI subjects did attempt to use -o- but did so inconsistently, and invariably failed to use it correctly. Examples (3a) and (3b) illustrate how DLI responses deviated from the target response.

			Given response	Target
(3a)	the + anthrop os =		*thoanthropos	theánthropos [stimulus: theós]
	'god' 'man'			'Jesus Christ' Real Compound
(3b)	psar + fagh os		= *psaraofaghos	psarofághos [stimulus: psári]
	'fish' 'eater'			'fish-eater' Real Compound

In (3a), we see that the root has been reduced and that -o- has also been. Missing root elements may be vowels (as in (3a)), consonants, or syllables. The stimulus for the root *the-* 'god' was the nominative case form *theós.*

In (3b), we see root extension, also with an attempt to use -o-. We note that the root *psar-* 'fish' does not surface with any inflection that would result in the form *psara.* The trigger stimulus used was *psári* 'fish' in the singular nominative case; the plural nominatve form is *psária.* As with root reductions, root extensions may affect phonemes or syllables, not in any predictable manner (see also further discussion below and examples (4a) to (5c)).

Young controls over-regularized -o- in a more predictable manner: Specifically, -o- surfaced even when not required, namely when the second element was vowel-initial.

In such cases, -o did invariably surface at the correct root boundary (i.e., in the correct place but not restricted to consonant-initial second constituents).Consider (3c):

			Given response	Target	
(3c)	alogh + anthrop os 'horse' 'man'	=	*aloghoánthropos	aloghánthropos 'horse-man'	[stimulus: álogho] Novel Compound

Considering errors by compound type, DLI subjects were more likely to have wrong root boundaries, truncating roots or lengthening them. Root truncation was more likely to occur when the first compound element had three-syllables but only for younger DLI subjects. Consider examples (4a) to (5c):

(4) Root reduced:

Compound elements			Given Response	Target	Trigger stimulus
(4a)	anthrop + fagh os 'man' 'eater'	=	*anthrofághos	anthropofághos 'man-eater'	ánthropos Real Compound

Problem: missing last consonant from first root: /p/

Compound elements			Given Response	Target	Trigger stimulus
(4b)	pondik + anthrop os 'mouse' 'man'	=	*pondánthropos	pondikánthropos 'mouse-man'	pondíki Novel Compound

Problem: missing rime from first root: /ik/

(5) Root lengthened:

	Compound elements	Given Response	Target	Trigger stimulus
(5a)	hin + anthrop os = 'goose' 'man'	*hinothánthropos	hinánthropos 'goose-man'	hína Novel Compound

Problem: extra phoneme in beginning of second root: /th/

(5b)	alogh+anthrop os = 'horse' 'man'	*aloghoránthropos	aloghánthropos 'horse-man'	álogho Novel Compound

Problem: extra phoneme in beginning of second root: /p/

(5c)	falen +anthrop os = 'whale' 'man'	*falenapánthropos	falenánthropos 'whale-man'	fálena Novel compound

Problem: extra phoneme in beginning of second root: /p/

An error analysis by group is summarized in Table 5.2 where errors are presented by type and scores are out of all compounding attempts. As DLI attempts to compound increased, so did root errors. Young controls have a relatively high score of incorrect -o- realizations due to their tendency to overregularize -o- whereas DLI subjects do not attempt to use -o- consistently. The most striking difference between the control groups and the DLI group is their root boundary errors so that 81.25% of DLI compounding

attempts result in a reduced or extended root compared to 5% for young controls and 1.25% for age-matched controls.

Table 5.2 Errors by type over all responses (mean per group).

ERROR TYPE out of all responses	Young Controls	DLI Subjects	Age-Matched Controls
Alternative Marking (stress shift)	0%	14.75%	0%
Subst'n with Real Word	0%	6.5%	1%
Repetition of Stimulus	0%	1%	1%
ERROR TYPE out of compounding attempts	Young Controls	DLI Subjects	Age-Matched Controls
Incorrect -o Realization	0.75%	6.3%	0%
Possible Over-regularization of -o	23%	2.5%	0%
All Reduced Roots All Lengthened Roots	2.5% 2.5%	49.86% 31.39%	1% 0.25%
Sum of Root Errors	**5%**	**81.25%**	**1.25%**

5.4 Summary

The results of the compounding task support of the main hypotheses. In terms of morphological representations, DLI subjects do not seem to have reliably abstracted bound roots of known nouns as shown by their difficulty with root boundaries and fewer

attempts to form novel compounds. In addition, in terms of morphological processing, DLI subjects seem unable to use the compounding morpheme -o- in a morphologically constrained way.

The next chapter also aims to provide supporting evidence to this effect from a production task on diminutive formation which requires not only the use of bound roots but also the use of derivational affixes and inflectional affixes.

Chapter 6

Developmental Language Impairment and Diminutive Formation in Greek

Experiment 1: Production

6.1 Hypotheses

Greek diminutive formation is a very productive process that is observed early (2;0) in language development (Stephany,1995). Non-impaired controls are therefore expected to be able to easily form novel diminutives and their errors are expected to be overgeneralization errors similar to those reported in the spontaneous language production literature (see also chapter 2). Specifically, non-impaired subjects are expected to neutralize masculine and feminine nouns when forming diminutives and in doing so are expended to use the high-frequency *-ak-* diminutive allomorph.

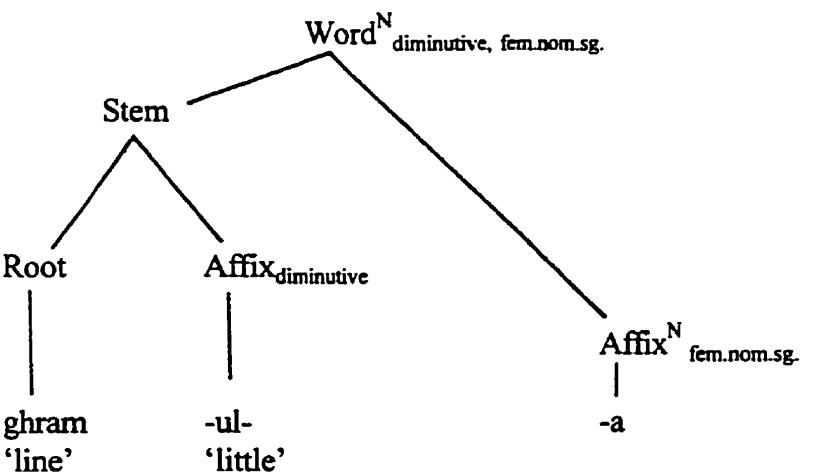
Moreover, non-impaired subjects are not expected to have root boundary errors for regular diminutives but are expected to regularize irregular real or novel diminutives.

In forming novel diminutives, DLI subjects are expected to make feature agreement errors in selecting diminutives subcategorized by the root. DLI subjects are also expected to make structural (i.e. root boundary) errors when forming novel compounds. In producing real diminutives, DLI subjects are expected to do better than on novel ones since they may rely on lexical retrieval.

Greek DLI subjects are expected to understand the conceptual aspects of using diminutives. The subjects participating in this study were observed, in spontaneous speech, to produce diminutives. They did so in the pragmatically appropriate context but produced only high-frequency attested forms.

It is assumed here that diminutive representations for non-impaired subjects are as in (1). The linguistic structure is fully abstracted to include a bound root, a derivational affix and an inflectional affix. DLI subjects are assumed to have impaired internal word structures for diminutives similar to simple representations as illustrated in (2).

(1)



= 'little line'

(2)

Whether DLI diminutive representations have more word internal structure than that proposed in (2) will be empirically determined by the findings. The absence of evidence for a representation such as (1) for DLI subjects should be most apparent when DLI subjects are required to form novel diminutives when prompted with novel nouns.

6.2 Methodology

Subjects

Nine DLI subjects participated in the diminutive formation task. DLI subjects' ages ranged from (5;0) to (16;0) and only one was female. Each subject was matched with an

age-matched control and a younger control. An independent group of adults also participated in the task.

Test design

This was a production task where the subjects were cued to produce 100 diminutives (80 real, 20 novel ones). Of the real diminutives, 30 were real regular ones (10 for each gender), 10 were irregular ones (all neuter), 10 were fillers to control for word length given that the diminutive is always at least one syllable longer than the base noun, and 10 were non-diminutive base nouns whose ending is [-aki] but are not diminutives (all neuter). This last type of real noun will be referred to as [aki] base noun; these nouns are not real diminutives because the [ak] in their ending is part of the noun's root and the [i] is the phonetic form of the inflectional ending.

Of the novel diminutives, 30 were based on real regular base nouns (10 of each gender) and 10 were based on irregular real base nouns (all neuter). The list of stimuli used can be found in Appendix D.

The order of the pictures on each page was semi-randomized and so was the order of the stimuli through the test. Twenty real and ten novel stimuli items were semi-randomly distributed through the test to be used as distractors by triggering the base noun so that the subjects would not have to continuously produce diminutive nouns. This switching from

triggering the diminutive to triggering the base was meant to discourage perseveration of response patterns.

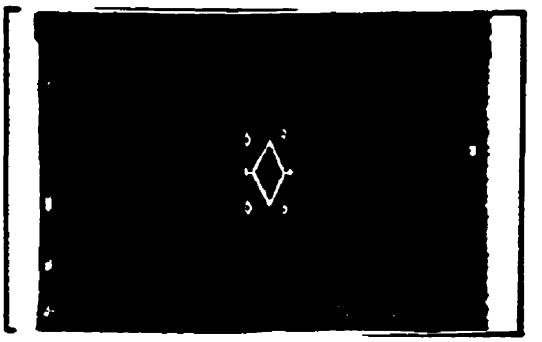
Procedure

Each base noun was presented with a corresponding picture and was paired with a picture of the same object but smaller; the smaller picture appeared immediately under that of the base noun on the same page. An example is provided in (3a).

The same procedure was followed for novel stimuli as in (3b). For example, for a base - diminutive pair, as in (3a), the subjects were first shown a picture of a (rug) and were told: 'Here is a big (rug)'. They were then shown a picture of a much smaller (rug) and were told: 'Here is a little (rug). Do you know how else we call it? We call it also a _____.' The diminutive noun in parenthesis is what varied from question to question. In the (rug) case, the expected response was *khaláki* 'rug-dim.', which is a real diminutive.

Subjects were also requested to repeat the base noun used as the trigger in order to ensure that they could articulate it.

(3a) Example of triggering a real diminutive.



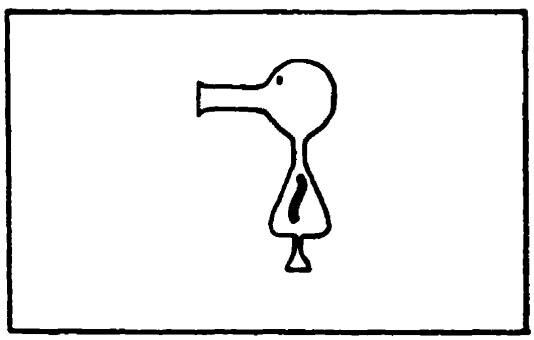
Na éna meghálo khalí.
'Here is a big rug.'

Na éna mikró khalí. Kséris pos aliós to léme? To léme ke ____?
'Here is a little rug. Do you know how else we call it? We also call it a _____?'

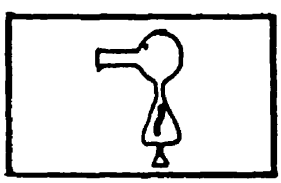
A novel noun triggered the novel diminutive in a similar manner. The subject was shown a drawing of a novel object or creature and was told, 'Here is a big (*roliá* 'wug')'. The subject was then shown a picture of a much smaller (wug) and was told: 'Here is a little (*roliá* 'wug'). Do you know how else we call it? We call it also a _____.' In the (*roliá*) case, the expected response was *rolítsa* 'wug-dim.', which is a novel diminutive formed on analogy to the attested noun base - diminutive pair *foliá - folítsa* 'nest - little nest'.

The way in which the base noun was triggered was as follows: the subjects was given the diminutive of the trigger noun in the carrier sentence. 'This is a small (X-diminutive)' and shown the small object in the picture; they were then shown the bigger object in the other drawing and were asked. 'And this is a large _____?' expected to provide the base noun.

(3b) Example of triggering a novel diminutive.



Na mía megháli roliá.
'Here is a big wug.'



Na mía mikrí roliá. Kséris pos aliós tin léme? Tin léme ke ____?
'Here is a little wug. Do you know how else we call it? We also call it a _____?'

Scoring

Responses from the production task were coded as: (a) dimininutivization attempt (correct or incorrect for (i) root boundary, (ii) choice of diminutive affix (class, boundaries), (iii) choice of inflection (gender, class), (b) substitution with another word (real, neologism), (c) no response, or (d) repeating the trigger stimulus (simple noun form).

6.3 Results and discussion

The performance of DLI subjects on the production task was significantly worse than that of any of the control groups (see also Table 6.1). This was especially true for novel diminutives, as expected. DLI subjects had 42.4% correct responses compared to 84.5% of age-matched controls and 88.4% of younger controls. On novel diminutives (as well as on other stimulus types) age-matched controls and younger controls performed closer to the non-matched adult control group (84.7%) than they did to DLI subjects.

Table 6.1 Production task scores on real and novel words by group

Stimulus type		Adult controls n=5	Age-matched controls n=9	DLI subjects n=9	Younger controls n=7
All stimuli	n=100	**89%**	**85.6%**	**54.9%**	**88.3%**
All Real stimuli	n=60	**91.6%**	**86.2%**	**62.6%**	**88.3%**
Real regular	n=30	83.9%	81.7%	56.3%	84.8%
Real irregular	n=10	98%	84.4%	49%	85.7%
Real -aki base	n=10	100%	98.9%	75.6%	100%
Real multisyll.	n=10	100%	95%	70.1%	97.4%
All Novel stimuli	n=40	**84.7%**	**84.5%**	**42.4%**	**88.4%**
Novel regular	n=30	82.8%	84.7%	40.2%	88.7%
Novel Irregular	n=10	91.1%	84%	50.6%	87.7%

DLI subjects did relatively well on the [áki] ending base nouns (DLI correct responses = 75.6%) which suggests that their difficulties in diminutivization production are not due to articulatory problems. Similarly, DLI subjects did well on base nouns that were multisyllabic (70.1%) which indicates that long word production difficulties alone cannot account for the diminutive errors we observe.

Performance by noun gender is uneven for all groups. Masculine bases have the lowest scores compared to feminine and neuter in that masculine nouns (both real and novel) are most likely to undergo gender change or gender neutralization. Even neuter nouns, especially novel ones, however, have low scores for DLI subjects. DLI performance

on regular nouns is not significantly different from that on irregular nouns. Table 6.2 presents the group's scores by gender breakdown.

Table 6.2 Group scores for production of real and novel diminutives by gender.

Group	Real Diminutives					Novel Diminutives				
% correct	all reg n=30	masc.n =10	fem. n=10	neut. n=10	irreg. n=10	all reg. n=30	masc. n=10	fem. n=10	neut. n=10	irreg. n=10
DLI	**56.3**	8.9	78.8	78.9	49	**40.2**	17.8	46.9	56.7	50.6
YC[58]	**84.7**	62	85.5	98	85	**40.2**	76	86.7	98	87.3
AMC[59]	**81.7**	42.2	79	76.7	84.4	**84.7**	58.9	60.5	72.2	84
AC[60]	**83.9**	50	100	100	98	**82.8**	70	80	98	91.1

Age effects are noticeable in that DLI and control subject performance improves with age. Older DLI subjects perform better as they grow older although not as reliably so as do control subjects and only for real nouns. Pearson's correlation of age and performance for DLI subjects is 0.52 for real nouns (AMC: 0.43) compared to 0.29 for novel nouns (AMC: 0.49) . Table 6.3 shows performance by subject on regular real and regular novel diminutives in order of increasing age.

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[58] YC denotes Younger Controls.

[59] AMC denotes Age-matched Controls.

[60] AC denotes Adult non-matched Controls.

Table 6.3 Production scores by subject for real and novel regular diminutives.

DLI Subjects		Regular Diminutives % correct		Age-Matched Controls		Regular Diminutives % correct	
Code	(age)	Real n=30	Novel n=30	Code	(age)	Real n=30	Novel n=30
GIF91CAA[61]	(5;6)	36	7	GNF80CK	(5;11)	70	59
GIM91CAM	(5;0)	0	0	GNM90CA	(5;6)	47	45
GIM89CSY	(6;11)	63	59	GNM89CP	(7;2)	97	93
GIM89CSV	(6;11)	67	45				
GIM89CSP	(6;11)	67	41				
GIM87CCC	(8;11)	60	21	GNM88CT	(8;5)	87	97
GIM87CKA[62]	(9;5)	93	100	GNM87CY	(9;2)	90	100
GIM82CKM	(13;6)	70	62	GNM82CP	(14;0)	100	100
GIM80CMT	(16;0)	65	28	GNM80CK	(15;9)	77	83

Error patterns and response types are also informative. We now consider errors by type; diminutivization attempts compared to other responses, gender neutralization, root errors and non-diminutivization errors. Table 6.4 summarizes error types by group.

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[61] Subject GIF91CAA is the focus of Stavrakakis' (1996) case study on Greek specific language impairment and feature agreement in the verb phrase.

[62] This subject's score is high but he was included in the DLI group nevertheless because he took a long time to respond, did so effortfully, and seemed very unsure about his responses. The same pattern has been noted in some English DLI subjects who do well on elicited production tasks (see Gopnik, 1995).

Table 6.4 Production errors by type for each group.

Group	*Σ % of dim'n attempts out of all responses*		*% of dim'n errors with gender change*		*% of dim'n errors with root changes*		*% of all errors substituting real word*	*% of all errors no response*	*% of all errors repeating trigger*
	% ✓		*real word*	✗	*regularized*[63]	✗[64]			
DLI	75	73	27	30	10	16	4	8	7
YC	98	89	47	31	22	0	<1	0	3
AMC	98	88	44	37	23	0	<1	0	2
AC	99	90	47	31	6	2	5	0	7

Non-diminutivization errors consisted, as expected, in substitution of the target with real words, no response, repetition of the trigger or production of neologisms.

Whereas non-impaired subjects substituted only novel diminutives, DLI subjects substituted in more directions[65]. They substituted, for example, when asked to give a novel

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[63] In the context of irregular diminutives.

[64] Root reduced, extended or degraded through loss of phonemes or loss of phoneme features, resulting in a neologism.

base and were provided with a novel diminutive by giving a phonetically similar real base or a real diminutive, and when asked to give a novel diminutive by giving a phonetically similar real diminutive (see also (3a) to (3f):

(3) Substitution errors

(a) Novel Base triggers Real Base instead of Novel Diminutive

Novel Base: tála Given Response: ghála 'milk'

(b) Novel Diminutive triggers Real Diminutive instead of Novel Base

Novel Diminutive: sunaláki Given Response: kunelάki 'little rabbit'

(c) Novel Base triggers Real Diminutive instead of Novel Diminutive

Novel Base: bíghos Given Response: baláki 'little ball'

All groups attempted to produce diminutives more than any other type of response. Successful attempts, however, distinguished the DLI group from the control groups. When diminutives were produced, groups also tended to differ in the types of errors they made.

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[65] The phonological factors that affect real word substitution specifically, and lexical retrieval in general, have to be further investigated; data from acquired aphasia and very early stages of normal language development show similar patterns (I would like to thank Lise Menn for pointing this out).

DLI subjects' responses had multiple errors as can be seen in (4a) where the masculine novel stimulus trigger is *fámbos* and it triggers the real neuter noun *vambáki* which is phonologically related but not targetted and not even a diminutive. This response example is a base form that happens to be morphologically not related and coincidentally ends in a diminutive-like phonetic shape without being diminutive. Example (4b) illustrates an error which is a diminutive attempt with a gender change; the produced form is attested. Example (4c) illustrates an error which is a neologism.

(4)	Trigger noun	Given Response	Targetted Response	Subjects
(a)	fámbos novel $_{masc.}$	vambáki 'cotton' $_{neut.,base\ noun}$	fambákos	GIM87CCC
(b)	arkúdhos 'bear' $_{masc.}$	arkudháki 'teddy bear' $_{neut.,\ dim.}$	arkudhákos 'teddy bear' $_{masc.,\ dim.}$	GIF90CK GIM87CCC
(c)	lemós 'throat' $_{masc.}$	lemóli neologism $_{neut.,\ base}$	lemudhákos 'little throat' $_{masc.,\ dim.}$	GIM89CSV

All the control groups, in contrast, were more likely to produce diminutives that were morphologically related to the trigger noun and were either attested forms or novel ones which had been given a neuter gender. Moreover, whereas the most common type of gender change direction for novels and real was for masculine (mostly) and feminine nouns

to neutralize in the diminutive (5a), DLI subjects were more likely than controls to have other directions of gender change as in (5b).

(5)	Base Noun	Targetted Diminutive	Given Response	Subject
(a)	thípos$_{masc.}$ novel	thipákos$_{masc.}$	thipáki$_{neuter}$	GNM90CA
(b)			thipúla$_{fem.}$	GIF91CAA

It should be noted that some responses contained multiple errors (as in (6)) which meant they were coded for more than one error type.

(6)	Trigger	Targetted Form	Given Form	Problems	Subject
(a)	trólos novel$_{masc}$	trolákos novel-dim.$_{masc.}$	zonáki 'belt' -dim.neut.	real word gender change	GIM80CTM
(b)	sódhi novel$_{neuter}$	sodháki novel-dim.$_{neut.}$	zóri 'effort'-base$_{neut.}$	real word no diminutivization	GIF91CAA

In terms of root changes, younger controls (YC) and age-matched controls (AMC) root errors consisted entirely of irregular diminutives becoming regularized by producing the base root followed immediately by a diminutive affix as in (7) whereas the attested irregular diminutive for this example *mílo - milaráki* 'apple - little apple' has two phonemes [ar] between the root and the diminutive affix .

(7)	Trigger	Root	Targetted Form	Given Form
	mílo 'apple'	MIL-	milaráki 'little apple'	miláki regularized root + dim.

Root errors of DLI subjects affected both irregular and regular diminutives and resulted in the base root becoming extended (8), reduced (9) , and also, even if less likely, regularized as in (7) suggesting that the root boundary was randomly chosen. Phonological errors were also more likely for DLI subjects; such errors involved phonological features or syllables as in (10).

(8) Extended Roots

(a) Base Trigger	Targetted Diminutive	Given Response	Inserted material
trólos $novel_{masc.}$	trolákos $novel\text{-}dim_{masc.}$	tralaláki $novel_{neut.}$	syllable [la]

(b)	bíghos novel	bighákos novel-dim	bighokákis[66] novel-dim	phonemes [ok]

(c)	Base Trigger	Targetted Diminutive	Given Response	Inserted material
	réfkos novel	refkákos novel-dim	refkokákos novel-dim	phonemes [ok][67]

We note also that there is more variance in DLI subjects' novel diminutive formations compared to control subjects. Control subjects have less within subject and across subject variance.

(9) Reduced Roots

	Trigger form	Expected form	Given Response	Missing material
(a)	dhakhtilidháki 'ring' -dim.	dhakhtilídhi 'ring'-base	dhaktíli neologism	phoneme [dh][68]

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[66] The diminutive affix is added most likely to the form *bigho* rather than the root *bigh-*; the phoneme [k] before the diminutive may fill in for a missing onset to the following syllable given that DLI subjects prefer core syllables and sometimes insert onsets to vowel-initial words (e.g. *ómos* becomes *kómos* for one of the DLI subjects in a different context). The removal of the word-final [s] as in *bíghos - bígho* is a common DLI error in attempting to get a root in the pluralization task as well.

[67] See previous footnote.

[68] The related word *dhákhtilo* also exists the root of which is DHAKHTIL- so that the subject's response is, in this broader interpretation, based somewhere between a rather opaque shorter root and a more transparent root.

(b)	polithronúla 'armchair'-dim.	polithróna 'armchair'	polithrúla[69] neologism	phonemes [on]

The reduction of root material by DLI subjects contrasts with the regularization of irregular roots that we see in young and age-matched controls. A minimal pair of errors in this sense is provided by the the irregular diminutive *khoryudháki* 'little village' which is regularized as *khoryáki* 'neologism' by several young controls but as *khoráki* 'neologism' by two DLI subjects; the base form is *khoryó* 'village'.

Young controls will often 'regularize' diminutives by giving the root of the base noun followed by a diminutive affix and an inflectional affix without the intervening material which makes it irregular. Examples of this include the base noun *mílo* 'apple' which becomes *milaráki* 'little apple' instead of *miláki* and the base noun *vunó* 'mountain' which becomes diminutivized as *vunaláki* 'little mountain' instead of *vunáki*; control subjects often gave *miláki* and *vunáki* as diminutives for these base nouns respectively.

(10) Phonological errors affecting the root:

Base Form	Repeated as	Diminutive attempt	Target Diminutive
vátrakhos 'frog'	vátatos	vananáci 'neologism'	vatrakhákos / vatrakhaki

[69] The same subject has successfully repeated *polithronula* before attempting to give its base.

Neologisms were most likely to result from DLI root errors and diminutivization attempts in general.

As for phonological errors to note in terms of DLI produced forms, there are omissions, insertions, and substitutions of phonemes, phoneme features and syllables (sometimes reduplication). DLI errors (even neologisms) typically do not result in forms longer than four syllables. Long vowels or intersyllabic pauses sometimes marked missing material. This is compatible with the prosodic analysis of data from English DLI subjects (cf. Piggott and Kessler Robb, 1994).

There is support for the two main hypotheses of the production task, namely, that DLI subjects would be more likely to produce feature errors and root errors when attempting to diminutivize. The first finding corroborates the results of the pluralization task and the second those of the compounding task.

Experiment 2: Comprehension

6.4 Hypotheses

The diminutive comprehension task aimed to bypass any production processing difficulties that the subjects might have and presented them with choices of possible matches between diminutive or base forms to a set of pictures, aiming to see whether novel diminutives would be understood, if provided, in a more accurate manner than when they

had to be formed. In this sense, it was anticipated that the comprehension task would be easier than the production one for both impaired and control subjects. It was also expected that, for DLI subjects, the novel diminutives would be easier to recognize than were to produce.

6.5 Methodology

Subjects

The same subjects who participated in the diminutive production task participated in the comprehension task.

Test design

This was a comprehension task where the subjects were cued to point to picture in a set of four pictures on a single page. The same set of target pairs was used as for the production task. The list of stimuli (triggers and targets) and the semantic foil for each pair are given in Appendix D.

There were 100 pages in the task binder, each page containing two pairs of pictures: One pair depicted a picture of the trigger base noun and a smaller picture depicted its respective (target) diminutive. The other pair depicted a picture of a base noun of the same

semantic category as the trigger base noun and a smaller picture of the diminutive of this semantic foil base noun. For example, the two pictures of the stimulus pair 'door - little door' appeared with a pair of pictures that had the semantic foil 'window - little window'.

The real and novel trigger and target pairs of base noun and diminutive were the same as in the production. The real noun base-diminutive pairs were matched with a real pair of base-diminutive semantic foil nouns. The semantic foil for the pair of novel-diminutive nouns had to be equally without meaning as the novel noun. A large X and a little X therefore functioned as the semantic foils for the novel target noun pair of base-diminutive stimuli.

For all base nouns, each was presented with a picture and was paired with a diminutive the picture of which appeared next to the base noun on the same page. Either over or under this pair (randomly) there was a similar pair but of a semantic foil. The same procedure was followed for novel stimuli. The order of the set of pictures on each page was semi-randomized and so was the order of the stimuli through the test.

Twenty real and ten novel stimuli items were semi-randomly distributed through the test to be used as distractors to trigger the base noun so that the subjects would not have to continuously identify diminutive nouns and therefore to discourage perseveration of response patterns.

This comprehension task was given to subjects in a session after the production task, whenever possible, in order to avoid cuing or learning effects since the experimenter here

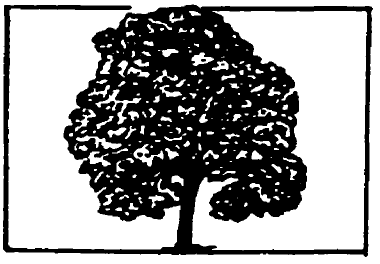
used the diminutive forms herself and asked the subject to point to the corresponding picture.

Procedure

For each base - diminutive pair, the subjects were first shown a picture of a (tree) and were told: 'Here is a big (tree)'. They were then shown a picture of a much smaller (tree) and were told: 'Here is a little (tree)'. In the same way, the semantic foil was introduced: 'Here is a big (flower).' 'Here is a little (flower)'. The diminutive noun in parenthesis is what varied from question to question. All four pictures were on the same page and could be viewed by the subject as long as necessary .

The subject was then requested to point to one of the four pictures with the following instructions: 'Show me the (tree-diminutive) please'. This was when the subject hear the diminutive form of the target picture for the first time during the task. No diminutive form had been used when introducing the items depicted in the pictures. In the (tree) case, the targetted response was for the subject to point to the small tree.

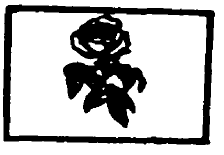
(4a) Example of a real base-diminutive pair with a base-diminutive foil.



Na éna meghálo dhéndro.
'Here is a big tree.'

Na éna mikró dhéndro.
'Here is a little tree.'

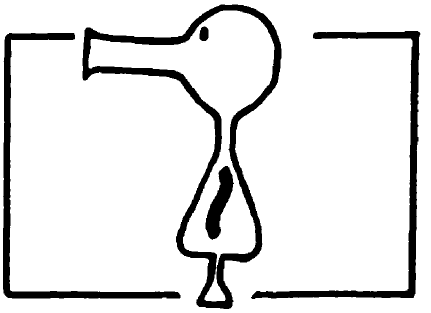
Na éna meghálo lulúdhi.
'Here is a big flower.'

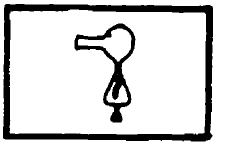


Na éna mikró lulúdhi.
'Here is a little flower.'

Dhíkse mu to dhendráki.
'Show me the tree-dim.'

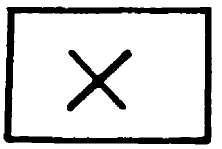
(4b) Example of a novel base-diminutive pair with a base-diminutive foil.

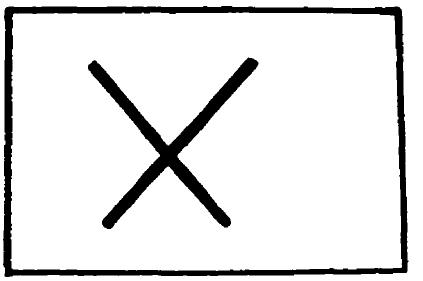




Na mía megháli roliá.
'Here is a big (novel noun-fem).'

Na mía mikrí roliá.
'Here is a little (novel noun-fem).'





Na éna mikró X.
'Here is a little X.'

Na éna megháloX.
'Here is a big X.'

Dhíkse mu ti rolítsa.
'Show me the (novel noun-dim).'

A pre-trial established understanding of the task by targetting three diminutives and one base using the same instructions and stimuli style as the test itself. The subjects were also asked to point to a little (example noun) and the big (example noun) independent of the task paradigm to ensure that they could distinguish two different items in terms of size. This independent checking is useful to show that subjects know the conceptual difference between two objects which differ only in size in case they cannot morphologically distinguish a base noun form from its diminutive form.

Visual stimuli (pictures for the target nouns and semantic foils) were presented simultaneously with the aural stimuli which were embedded within a sentence. Subjects' responses were noted by hand on a separate scoring sheet coded so that the subject would not know what picture was being requested or whether the response was appropriate.

Scoring

For the comprehension task, a response could be incorrect in the following ways: (a) choice of picture depicting the bigger item when requested to show the diminutive (b) choice of picture depicting the semantic foil instead of the targetted form. Choosing the diminutive foil when asked to choose the non-diminutive base would be coded as two errors: wrong root and wrong derivational affix.

6.6 Results and discussion

As expected, DLI subjects performed more poorly than any of the control groups in all types of diminutives. The contrast between DLI and non-impaired performance, however, was not as extreme as it had been for the production task. DLI subjects all did better on the comprehension task than on the production task.

Table 6.5 provides DLI scores for real and novel diminutives by subject compared to age-matched controls' scores, and Table 6.6 summarizes all groups' performance by type of stimulus, diminutive and non-diminutive forms.

Table 6.5 Comprehension scores by subject for real and novel regular diminutives.

DLI Subjects		Regular Diminutives % correct		Age-Matched Controls		Regular Diminutives % correct	
Code	(age)	Real n=30	Novel n=30	Code	(age)	Real n=30	Novel n=30
GIF91CAA	(5;6)	58	53	GNF80CK	(5;11)	97	100
GIM91CAM	(5;0)	10	43	GNM90CA	(5;6)	100	100
GIM89CSY	(6;11)	58	78	GNM89CP	(7;2)	97	100
GIM89CSV	(6;11)	97	97				
GIM89CSP	(6;11)	71	68				
GIM87CCC	(8;11)	97	83	GNM88CT	(8;5)	100	93
GIM87CKA[70]	(9;5)	90	97	GNM87CY	(9;2)	100	97
GIM82CKM	(13;6)	100	97	GNM82CP	(14;0)	100	100
GIM80CMT	(16;0)	97	90	GNM80CK	(15;9)	100	100

[70] This subject's score is high but he was included in the DLI group nevertheless because he took a long time to respond, did so effortfully, and seemed very unsure about his responses. The same pattern has been noted in some English DLI subjects who do well on elicited production tasks (see Gopnik, 1995).

As a group, DLI subjects did not perform as well as control subjects (DLI average was 79.1% compared to young controls' 96.5%, age-matched controls' 96.9% and adult controls' 100%) but did better on the comprehension task than they had on the production task (where DLI group average was 54.9%). This was especially true for the younger DLI subjects.

Whereas control subjects' performance is high for all diminutives regardless of what diminutive affix they have, DLI subjects' performance is better on *-aki* diminutives than on diminutives with other endings. This may be due to the high-frequency of the *-ak-* diminutive affix. DLI subjects also did well on multisyllabic words for which they had to choose the base.

Further evidence that the low DLI scores are not due to a general learning impairment comes from their better performance on diminutives that end in the higher frequency neuter [áki] compared to other lower-frequency endings. Younger controls or age-matched controls show no such frequency or learning effect at this stage.

As can be seen in Table 6.6, higher scores are associated with neuter diminutives. Neuter diminutives are not subject to regularization or neutralization effects that lower performance on masculine and feminine nouns for control subjects in the production task. For controls, comprehension of neuters is not that different from that of diminutives of other genders. Recognition of frequent and non-frequent diminutive affixes is not

significantly different for controls whereas DLI subjects are more likely to do well on the high-frequency diminutive affix *-ak-*.

Table 6.6 Comprehension task average group scores on all real and novel stimuli

Group	Total average	Real				Novel	
% correct		Regular	Irregular	-aki Base	multis base	Regular	Irregular
DLI	79.1	73.5	84.4	82.2	92.9	77.8	81.1
YC	96.5	99.4	94	94	92.7	98	98
AMC	96.9	99.3	96.7	96.7	96	98.9	98
AC	100	100	100	100	100	100	100

The following section of the discussion compares the comprehension and production scores on diminutives for all groups for all types of stimuli.

Comprehension of diminutives or recognition of the contrast between diminutives and base forms was easier than production of diminutive forms for all groups, including DLI subjects, as we can see from Table 6.7.

Table 6.7 Average scores by group on production and comprehension of diminutives.

Group	Diminutive Comprhension task			Diminutive Production task		
Average % correct	Total	Real regular	Novel regular	Total	Real regular	Novel regular
DLI	79.1	73.3	77.8	54.9	56.3	40.2
YC	96.5	99.4	98	88.3	84.7	40.2
AMC	96.5	99.3	98.9	85.6	81.7	84.7
AC	100	100	100	89	83.9	82.8

For both real and novel nouns, neuter ones were the most likely to have the highest performance scores for all groups compared to masculine and feminine nouns. DLI subjects had their highest score (85.6% accuracy) for the comprehension with neuter nouns. In other words, the words ending in [áki] were most likely to be recognized reliably as diminutives compared to diminutives with other suffixes.

Gender effects are summarized in Table 6.8 for both the comprehension and the production task. Masculine nouns had the lowest scores in comprehension and production for DLI subjects. Controls had more errors in producing correct real and novel masculine diminutives as well, although they did better than DLI subjects, and had few errors in the comprehension task. Errors were most likely to occur during diminutive formation of masculine nouns and this was particularly true for DLI subjects. This pattern of difficulty is in accord with developmental data (Stephany, 1995).

All DLI subjects, even in the cases when they point to the base instead of the required diminutive, are fully aware of which of the two pictures depicts the smaller item and which the bigger item. If asked to point to the smaller item, they will do so even if they have just pointed to the bigger of the two following a request to point to the diminutive form. One of the older subjects, despite his apparent good score, was so unsure of his response that he asked several times "The big one?" when he was asked to point to a base.

Table 6.8 Average performance on comprehension and production by noun gender.

Real Regular						
Group	Comprehension			Production		
% correct	Masculine	Feminine	Neuter	Masculine	Feminine	Neuter
DLI	63.3	71.1	85.6	8.9	78.8	78.9
YC	100	98.2	100	62	85.5	98
AMC	100	98	100	42.2	79	76.7
AC	100	100	100	50	100	100
Novel Regular						
Group	Comprehension			Production		
% correct	Masculine	Feminine	Neuter	Masculine	Feminine	Neuter
DLI	73.3	80	80	17.8	46.9	56.7
YC	100	96	98	76	86.7	98
AMC	100	97.8	98.9	58.9	60.5	72.2
AC	100	100	100	70	80	98

The semantic foils did not detract the DLI subjects' choice which suggests that they were focusing on pointing to an item that is both phonetically and conceptually related to the trigger. In the production tasks, when DLI subjects substitute the target with real words, we notice that some times these substitutes are phonetically related and some times they are conceptually related. In the comprehension task, DLI performance may be higher than production due to the fact that the requested item is primed both phonetically and conceptually.

It should also be noted that all DLI and control subjects found the comprehension task "easy" when debriefed, but interestingly, DLI subjects consistently found the comprehension task "harder than the production task", unlike controls, even though all groups did better on the comprehension task. This may be due to the DLI subjects having more control of response choices in the production task.

DLI subject GIM87CCC found the comprehension task "easy" and spontaneously started naming many of the real items, both base and diminutive pictures, even though the task did not require him to do so. His naming was quite accurate even though his responses to requests to point to particular stimuli were not always accurate, especially when it came to novel items.

The two diminutive tasks have given us two types of evidence. First, that DLI subjects have trouble matching the appropriate inflectional affix to the stem once the diminutivization process has taken place. Second, that DLI subjects have trouble judging

where the lexical root ends and the affix begins which is reflected in the root boundary errors which we also saw occuring in the compounding task in chapter 5.

The diminutivization tasks not only corroborate the earlier evidence, but they also support the hypothesis that DLI morphological problems are due to an impaired linguistic competence to building representations of bound morphemes and an insensitivity to word-internal structure. We now need to discuss whether this impairment is due to lexical and non-lexical features not being morphologically visible to DLI subjects as they are to non-impaired subjects. Moreover, we need to consider whether morphological feature abstraction is critical in order to notice morphological paradigms which is necessary in building word formation rules. These issues, in view of the experimental evidence in chapters 3 to 6, are further examined in chapter 7.

Chapter 7

Implications of Experimental Findings

This chapter re-evaluates the theoretical issues introduced in chapters 1 and 2 concerning DLI explanations, theories of morphological representation, processing and acquisition in view of the experimental findings presented in chapters 4 to 6.

7.1 Implications for the nature of DLI

In terms of whether DLI is due to a deficit in linguistic competence or linguistic performance, the findings here support the hypothesis of a linguistic competence deficit. DLI subjects'degree of uncertainty and their inability to correct themselves distinguishes them as different from non-impaired subjects. It is therefore unlikely that DLI difficulties are limited to linguistic performance. Performance (processing) limitations, if there should be any, are likely to occur for DLI subjects no more than for non-impaired controls due to non-linguistic factors such as fatigue, stress, and other psychological factors known to affect performance.

We see evidence that DLI subjects understand that words may be modified in their effort to provide some novel plurals, compounds and diminutives. It is not clear whether what DLI subjects produce is the output of word formation as word formation is understood to apply to the outputs of non-impaired controls. Impaired word formation of DLI subjects as it is evidenced in this thesis is not incompatible with the observations in word access experiments (Kehayia, 1996) where word decomposition of DLI subjects is also impaired (or even absent).

This thesis has confirmed that the grammar of DLI has lexical representations with impaired morphological features. Also, it has shown for the first time that DLI subjects have impaired word-internal structure. Specifically, in forming novel words, Greek DLI subjects have difficulty (a) mapping sublexical features of affixes with the feature requirements of roots and stems[70] and (b) knowing where root and stem boundaries are.

There have been previous reports on DLI subjects having difficulty with inflectional affixes, but here we also have seen evidence that DLI affects derivational affixes. Unlike controls, DLI subjects have impaired lexical representations of inflected words, derived words, and compounds. Outputs of word formation rules are impaired in that the bases or inputs to the rules are underspecified for sublexical features.

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[70] I use the terms sublexical and subcategory as synonyms to mean features such as gender, or class (arbitrarily associated with a root) and features such as number and case that are assigned through or checked by morphosyntactic operations.

What I conclude in this thesis is that the impairment we observe is inherent to the lexical representations built in the DLI lexicon and that this impaired representation of subcategory features has consequences for the operations that these representations participate in.

The proposal that DLI subjects' difficulties are related to morphological features is not new. Gopnik (1990a; 1990b) has argued that DLI individuals may be blind to morphosyntactic features necessary for inflection in non-impaired grammars. Clahsen (1989; 1992) has argued that principles of agreement control are impaired for sublexical features. Rice (1994) has proposed that agreement involving specifier-head features is impaired. Whereas Gopnik's (1990a; 1990b) view assumes an impairment of the features themselves, the accounts of Clahsen (1989;1992) and Rice (1994) assume that operations involving morphosyntactic features are affected.

Oetting and Rice (1993) suggest three possible explanations as to why English DLI subjects show frequency effects for regularly inflected forms. One proposal is that the frequency with which inflected words occur in their plural may affect the building of the inflectional paradigm. Thus a rule such as that of pluralization may be acquired but later than usual in that it depends on frequency effects for much longer than it would for non-impaired children. The second proposal made by Oetting and Rice is that the word formation elicited tasks may be too difficult and the observed findings a methodological artifact. The third proposal is that the development of a DLI inflectional paradigm such as

the plural formation rule continues to depend on input frequency because the DLI lexicon is poorly or inefficiently organized. More specifically, when DLI children first notice plural paradigms, they abstract a rule for plural formation but also retain non-productive forms in their lexicon much longer than non-impaired children. This third proposal has elements of the delayed rate of development hypothesis. The DLI lexical representation forms are assumed to be specified for subcategory features and what is assumed impaired is the development of the operations that are triggered by the paradigms as well as the dissociation between the regular and irregular plural formation routes proposed by Pinker (1991).

We now consider the different proposals made in the literature in more detail and evaluate how they can or cannot account for the findings in this thesis. First, we consider what assumptions or proposals are supported and then we examine how the findings here would require some proposals to be modified. Table 7.1 outlines the main theories proposed for DLI, what their predictions are and whether the findings substantiate their expectations. We note that no single hypothesis, as formulated originally, predicts both the sublexical feature difficulties and the word-internal structure difficulties that were observed in this thesis. Those hypotheses arguing for a performance deficit (perceptual or articulatory processing deficit) or developmental delay deficit are not supported at all whereas those arguing for a feature deficit, feature agreement deficit or a rule deficit are each partially supported.

Table 7.1 Main DLI proposals, predictions and support

DLI as a Deficit of	Predictions	Supported
Phonological processing Saliency (Leonard, 1989) Temporal (Tallal et al., 1996)	• no difficulties with affixes that contain vowels and occur in stressed word final syllables	• no: plural forms problematic even though vowel-final & regardless word-final stress
Articulatory processing (Fletcher, 1990)	• equal difficulty with simple and complex words of equivalent segmental structure	• no: diminutive and base nouns ending in [aki] not equally difficult
Rate of development (Ingram, 1976)	• DLI errors would be equivalent to those of younger children	• no: younger subjects over-generalized inflectional endings while respecting gender; younger subjects regularized irregular stems
Missing features from affixes (Gopnik, 1990b)	• affixational difficulties • no boundary errors	• yes: both inflectional and derivational affixation outputs impaired • no: morpheme boundary errors
Rule building (Gopnik, 1994d)	• irregular morphology not impaired; • word formation impaired	• no: subregular plural formation impaired • yes: outputs of word formation impaired
Feature control agreement (Clahsen, 1992)	• inflectional and derivational difficulties • no boundary errors	• yes: both inflectional and derivational outputs impaired • no: morpheme boundary errors
Extended optional infinitive (Rice, 1994)	• not relevant to nominal word formation	• not applicable
Specifier-head feature agreement (Rice, 1994)	• inflectional and derivational difficulties • no boundary errors	• yes: outputs of inflectional and derivational affixation impaired • no: morpheme boundary errors

If we assume that word-formation rules are part of the lexicon (e.g. Halle, 1973; Aronoff, 1976), the findings in this thesis show that the DLI lexicon is impaired in that word formation rules of DLI subjects are impaired. This is in support of the linguistic rule

deficit account proposed by Gopnik (1994d) in that the product of word formation rules is ungrammatical. DLI subjects, unlike controls, cannot produce well-formed complex words. In order to account for the word structure difficulties of DLI subjects (root boundary problems), we need to expand the rule-deficit hypothesis to include both word formation rules and word-decomposition rules. Non-impaired decomposition rules can be active if the representations they are to work on can be decomposed. If lexical representations do not have word-internal structure and their primitives do not represent subcategory features, word decomposition rules will inevitably be impaired in that they do not have access to decomposable representations.

The findings here also support Gopnik's (1990a; 1990b) hypothesis that DLI individuals are impaired in recognizing or 'seeing' features necessary for morphological and morphosyntactic operations in that sublexical features do not seem to be significant for DLI subjects during word formation. Both hypotheses can be interpreted to affect the type of lexicon that DLI individuals can build in terms of primitives and the rules that govern well-formedness of word formation outputs.

Gopnik's two hypotheses can be interpreted as claiming that DLI is both an impairment of feature representation (or recognition) and rule-building. The impaired sublexical feature representations of a DLI lexicon would have consequences for building a linguistic competence. If lexical representations are affected then inevitably so are the products of morphological operations (i.e., Gopnik's rules) that use impaired primitives.

Impaired sublexical representation also implies that neither word nor morpheme representations of DLI subjects will have the structural information that is assumed for non-impaired individuals. In order for bound morphemes to be noticed as part of a paradigm and therefore be abstracted, sublexical features of lexical representations must be visible. Then particular word-final segmental material can be conceptually and morphologically associated with one another to form lexical representations of bound morphemes (or lexemes, in Aronoff's terms).

DLI lexical representations appear to be missing both sublexical features and structure. DLI is similar to a very early stage (before the two-word stage) in non-impaired language development. The underlying linguistic competence or potential of DLI individuals, however, does not appear to be the same as that of very young non-impaired individuals. DLI is likely to be a linguistic impairment that is permanent rather than a delay in the development of language acquisition. The grammar built by DLI individuals is qualitatively different from that of controls. If DLI competence is similar to the competence of very young children, it is so only in some respects[71], and one has to question whether it could ever have the potential of developing into any other state.

Errors of controls, especially young controls, show that when they overgeneralize, they regularize root boundaries (in their formation of irregular diminutives) and regularize

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[71] This uneven competence is observed also in other levels of analysis of DLI difficulties such as syntax (see also Stavrakakis, 1996).

morphological features of class (in plural or diminutive formation) toward frequent inflectional paradigms. Young controls, unlike DLI subjects, are thus sensitive to word-internal structure and subcategory features and use this information during novel word formation.

The primitives stored in the DLI lexicon may be impaired with regard to the range of possible morphological representations but some lexical representations are still being stored and accessed. We therefore need to consider the type of features and structures that can be represented in the lexicon of DLI individuals.

Both simple and complex forms may be represented as simple morphemes by DLI subjects due to all forms being treated as morphologically opaque. Even forms that are simple for non-impaired individuals, however, are impaired for DLI subjects with regard to their feature representation.

There is common agreement among researchers working on DLI (see also Rice, 1994) that DLI subjects do not produce errors at the level of lexical features (lexical features being features of the major lexical categories such as Noun or Verb (Chomsky, 1965)). Both spontaneous and elicited data across studies show that the distinction between the categories Noun and Verb is intact for DLI individuals. In contrast, sublexical features (features that are important for the syntax of word formation and are one level lower than lexical ones such as those for gender or number or class (Aronoff, 1994)) play no significant role in word formation for DLI subjects. If lexical features are represented

in the DLI lexicon but not sublexical ones, then operations which depended on accessing subcategory features would be impaired. Sublexical features may be more susceptible to impairment because they are more marked in that they develop later than lexical features in non-impaired lexicon acquisition and in that not all languages mark sublexical features morphologically whereas lexical features are universal .

The extent to which word-internal structure in DLI is apparent depends on the types of complex words a language may form. In languages such as Greek where roots are bound, we see impaired root boundaries as well as impaired affix boundaries (specifically, diminutive affixes). Impaired word internal structure is also evidenced in DLI subjects' attempts to use inflected nouns as first elements in compounds as well as in DLI subjects' being inconsistent in estimating root boundaries.

Can affixes be represented at all in the DLI lexicon, perhaps with no subcategory features but at least with lexical ones, similar to lexical morphemes? Independent work has found no evidence for access to affixes for DLI individuals (Kehayia, 1996) suggesting that affixes may not be represented at all as affixes in the DLI lexicon[72]. DLI

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[72] Bound morphemes may be represented as free forms under some conditions. Goad and Rebellati (1994; 1995) and Goad (1995) argue that when DLI subjects attempt pluralization in their extended English Wug Test, the use of English phonological rules of pluralization is not consistent in that voicing assimilation and schwa epenthesis do not apply in obligatory contexts which results in ugrammatical responses. Consider examples (3a) through (3c) taken from Goad and Rebellati (1995):

	Singular stimulus	DLI pluralization attempt	Problem
(a)	page	[paydʒs]	no voicing assimilation; no epenthesis

individuals then may have a lexicon that is impoverished in the types of primitives it can store and access. Only free forms may be stored with any certainty and even those will not necessarily have word-internal structure.

The findings suggest that bound morphemes do not have the same morphological status for DLI subjects as they do for non-impaired controls but word endings do seem to be noticed by DLI subjects. Word endings may be modified by DLI subjects when prompted to produce novel complex words but it is not certain whether word endings have the status of affixes as they have for non-impaired individuals. For DLI subjects, word endings, as segmental shapes, may become associated with conceptual features without the necessary subcategory features requisite in abstracting inflectional morphemes.

To summarize, the types of representations (with regard to morphological structure) that are possible for DLI individuals seem to be more limited in range and type than they are for non-impaired individuals. Simple morphological representations are

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(b) wug	[wʌgs]	no voicing assimilation
(c) drish	[drɪšs]	no schwa epenthesis

One of the error patterns in DLI pluralization, especially when forming novel plurals, that Goad and Rebellati identify is the use of [es] as an ending added to novel singulars. The segment [s] is associated with the conceptual feature of 'many', is assigned the lexical feature Noun and it is used as a compound element that attaches to nouns. It does not behave, however, as an inflectional affix. Based on their observations of DLI subjects' stress patterns during pluralization attempts and voicing violations for inflectional contexts, Goad and Rebellati argue that DLI pluralization is more similar to compounding nouns to /s/ rather than to inflecting /z/ and propose that DLI subjects have an impaired representation for the plural affix, namely /s/ instead of /z/.

formed regardless of the underlying structure of the input. Moreover, DLI representations are missing morphological features. Only in a language with no subcategory features or complex words would DLI not be noticeable on the morphological level. The range of types of normal and impaired morphological representations that DLI subjects are assumed to build are summarized in Table 7.2:

Table 7.1 Morphological structure representations possible for DLI subjects

Structural status: simple	*Examples*	Structural status: complex	*Examples*
represented as simple structure	Free morphemes in any language e.g. English roots e.g. Function words	represented as simple structure	Inflected forms in any language e.g. English regular plurals e.g. Greek nominals
not possible to represent as true bound morphemes	Bound morphemes in any language e.g. Greek roots e.g. Derivational affixes e.g. Inflectional affixes	represented as simple structure	Derived items in any language e.g. Greek compounds e.g. Greek diminutives

Let us now consider some of the explanantions proposed for DLI that are not fully supported by the findings in this thesis. Non-linguistic explanations for DLI language difficulties cannot account for consistent errors in judging root boundaries or morphological feature agreement, as we see in the compounding and diminutivization

tasks. A non-linguistic explanation that views DLI as an auditory signal processing deficit (Tallal et al., 1996) or an articulatory processing impairment (Fletcher, 1990) cannot account for the following findings. First, DLI subjects are more likely to err when faced with producing or judging morphologically complex words than simple ones. Second, DLI subjects can understand and produce multisyllabic words with phonetic shapes mirorring those of complex words better than actual complex words. Thirdly, DLI subjects have analogous morphological difficulties cross-linguistically although phonological shapes differ across languages.

The findings of this thesis also pose some problems for those linguistic deficit hypotheses that have been proposed in the literature which argue for an impairment of feature agreement. The morphosyntactic deficit hypotheses (e.g. Rice, 1994; Clahsen, 1992) which aim to account for DLI problems within noun phrases and verb phrases do not speak directly to the findings in this thesis.

Agreement errors, however, are not the only errors we observe for DLI subjects. Therefore, the specifier-head agreement deficit hypothesis is too narrow. If we assume that DLI individuals are impaired in coordinating agreement of features between specifiers and heads (Rice, 1994), we could not account for impaired root and stem boundary errors evident during word formation[73]. In fact, both Rice's specifier-head agreement deficit

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[73] Pronoun-antecedent agreement errors also suggest that the specifier-head agreement hypothesis would be too restrictive (I would like Brendan Gillon for pointing this out).

hypothesis (1994) and extended optional infinitive hypothesis (1994) assume that the structure of the primitives involved in agreement relationships and their subcategory features are not affected.

According to Clahsen's (1992) control-agreement deficit hypothesis, inflectional systems that should not be affected by DLI, such as plural formation, do seem to be impaired. Furthermore, an impaired agreement hypothesis (such as Rice's (1994) account or Clahsen's (1989) account) tend to be too restrictive and would have to be modified or expanded to be able to account for DLI problems with free functional morphemes (closed class items) such as particles, prepositions, reflexive pronouns and determiners that are omitted or substituted in DLI spontaneous speech, despite the fact that they can be repeated as part of a given sentence. Closed class morphemes can be of use in non-impaired syntactic structures only if syntactic operations can access non-impaired representations of such morphemes. If DLI subjects can represent only lexical features without difficulty, then we would expect syntactic operations involving words with mostly functional features (such as closed class words) to be impaired. This seems to be supported by van der Lely's (1992 and later) findings that DLI subjects have syntactic impairments in operations that involve both pronouns and inflection.

The hypothesis that seems to best account for the findings of this thesis is that DLI difficulties start with lexical representation and specifically with subcategory feature

representation. The findings of this thesis have implications for theoretical linguistics and psycholinguistics.

7.2 Implications for theories of word structure

Assuming that non-impaired lexical representations can include information for morphological features and structure, it is not necessarily the case that all representations need to have both. There are representations that may be specified for features of number, gender, for example, but have no word-internal structure themselves. Such representations would be appropriate for simple morphemes, opaque stems, or irregularly inflected words as proposed by lexicon theories such as those of Halle (1973), for example, and as illustrated in (1).

(1) Structurally simple lexical representations

(a) simple morpheme

(i) $Word^{N}_{singular}$ (ii) $\{N\} + Affix^{N}$

(b) opaque stem

Stem + {N, Adj.}

|

politic-

(c) irregularly inflected word

$Word^{N}_{plural}$

|

mice

Complex representations are assumed for words that undergo transparent inflection, derivation or compounding and therefore have a branching structure representing the different primitives concatenated and the hierarchical relationship between them. DLI individuals appear to have impaired root and stem structures (i.e., Aronoff's lexemes). The performance of the control subjects in this thesis provides support for the lexicon models that assume representation of lexical and sublexical features and representation of both simple and complex structures. There is also support that bound roots are represented since we observe their use in novel word formation.

Class features become represented late for young non-impaired subjects in accord with earlier reports in the literature in that we see generalizations of class within noun genders. Nevertheless, subcategory features of gender and number are more likely to be respected by non-impaired individuals, even if they are young, compared to DLI individuals.

7.3 Implications for theories of processing

Abstraction of inflectional and derivational morphemes entails intact word decomposition. DLI subjects do not seem able to use decomposed units such as bound morphemes. This may be due to representational difficulties as discussed above in that impaired word decomposition rules may be a consequence of the impaired representations.

DLI individuals' better performance on real words suggests that lexical retrieval may be unimpaired to the extent that the retrieved word matches the conceptual requirements of the target. Low performance on novel words, however, suggests that DLI subjects are not able to construct complex words themselves but can only retrieve them as whole forms if they have been stored.

In non-impaired individuals, we see knowledge of word structure and representation of morphological features during both word formation and word decomposition. DLI individuals behave as though their lexicon lists only whole-word representations, in the manner posited by Butterworth (1983). DLI representations, however, are underspecified for features, unlike the lexical representations of controls. Moreover, controls, may use more than one strategy in word access in decoding input (Taft and Forster, 1976; Caramazza et al., 1988) in that they may use whole-word access

for morphologically opaque or high-frequency words and also use decomposition for complex words when these are morphologically transparent and low-frequency. Controls may also use more than one strategy in word access in encoding output as well (Pinker, 1991). In contrast, DLI subjects seem to be restricted to whole-word access alone (Kehayia, 1996) and grammatical word formation may be reliably observed only when compounding free uninflected (i.e. 'whole') forms as first elements of compounds (cf. Oetting, 1992)).

If we consider morphological feature agreement or morphological feature checking (Hale and Keyser, 1993; Keyser and Roeper, 1992; Pesetsky, 1994; Fabb, 1988) as part of processing, then these operations are impaired (Clahsen, 1992; Rice, 1994) but this could be regarded as a consequence of their input being impaired.

If we consider word formation rules as part of the lexicon, then they are specifically impaired in DLI. Word decomposition rules, however, although part of one's linguistic competence, are not assumed to be part of the lexicon proper. DLI then has consequences for both representation, organization and access of words, even if we assume that only the lexical representations are part of the inherent problem in DLI and that the atypical performmace of DLI subjects are the effects of this lexicon-based impairment.

The findings in this thesis also provide the second part of a double dissociation between lexical representation and lexical access. DLI performace here shows that lexical

representations (storage) may be differentially impaired independent of word processing (access). Specifically, DLI subjects seem to use (access) words that appear complex on the surface but these words are underlyingly unanalyzed chunks and lack internal structure. This is dissociated in the opposite direction in agrammatic aphasics, who are sensitive to normal morphological representations in lexical decision tasks even though complex word output is impaired (e.g., Kehayia, 1994; Kehayia and Jarema, 1995). The agrammatic difficulties thus appear to be a problem of accessing underlyingly spared representations during language production and their performance suggests a relatively sound linguistic competence. In contrast, DLI subjects can access stored forms but cannot build underlyingly grammatical word-internal structures.

Finally, the findings in this thesis are in accord with the frequency effects that are noted in earlier studies. That DLI subjects do better on diminutives ending in the high-frequency neutral ending [aki] than on forms with other diminutive affixes shows that they rely on phonetic matching strategies more than non-impaired subjects who tend to do well on diminutive recognition regardless of which diminutive affix is used[74]

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[74] This contrasts with the non-impaired subjects' tendency in the production task to produce more diminutives with the diminutive affix *-ak-* and neutral inflection *-i*.

7.4 Questions for further research

It remains to be investigated how early and at what rate controls develop this sensitivity to subcategory features of bound morphemes. Subcategory features play an important role in setting morphosyntactic parameters (Lightfoot, 1992). It remains to be investigated if and to what extent DLI subjects are impaired in setting language-specific parameters in morphology, especially with regard to word structure. DLI may provide clues as to what effect universal principles of word structure can have in setting word structure parameters in the absence of sublexical features.

Empirical research is necessary to determine to what extent morphological features are accessible to DLI subjects. Psycholinguistic experiment can be used to investigate the status of different types of bound morphemes. One psycholinguistic experimental paradigm to investigate the morphological structure of DLI subjects in comparison to control populations would be to use simple and primed lexical decision tasks. Both reaction time patterns and error patterns of compared groups are informative about the morphological processing of given stimuli and the implications that can be drawn about lexical organization. Specifically, forms that are related more closely tend to prime one another so that by introducing one, we facilitate access to the other. Reaction times and priming effects, therefore, inform us as to how closely base forms are related to complex

they occur in. For example, bound roots can prime their inflected forms (Kehayia and Jarema, 1994).

A lexical decision task to complement each of the tasks presented here would be useful; whereas controls involuntarily decompose and match units to stored items which exist in the language and therefore are slowed down, DLI subjects would be expected to search only for a match of the whole given form. Kehayia's (1996) lexical decision findings suggest that Greek DLI subjects would be impaired in any primed lexical decision tasks where controls show priming for roots and stems.

Rejection of words that are complex but novel should be faster for DLI subjects than controls, whether we use stimuli with inflections or stimuli with both derivational and inflectional affixes because we expect no decomposition and no delay upon recognition of real affixes. In controls, the presence of real derivational affixes in novel words should delay their decision to reject the novel stimuli as non words in the same manner that the presence of real inflectional affixes does in other tasks.

Given that much of the evidence is based on groups of uneven numbers and age ranges, the claims made here remain to be investigated with a longitudinal test design..

Off-line derivational/ inflectional morphological operations which also require the use of roots and affixes as input could also be. Specifically, a derivational task with real and novel adjectives derived from nouns could be designed. Greek adjectives may be formed by concatenating a root to a derivational affix and inflecting the stem. For

example, *ksil-* 'wood' combines with *-in-* to become inflected as *ksilin-o* 'wooden'. Such a task can examine root boundaries, the status of derivational affixes that change lexical category, and inflectional affixes as they are used by non-impaired and DLI Greek youngsters. Real and novel roots could be used in such a task to test productivity of linguistic rules and help us refine our understanding of DLI linguistic competence.

In addition to comparing DLI performance to young L1 controls, it would also be fruitful to compare DLI performance to adult control groups. Adult Greek DLI individuals whose linguistic capacity has reached a plateau and therefore can inform us of the final state that can be reasonably expected of young DLI subjects (as has been done in English (Gopnik and Crago, 1991) and in French (Royle, 1996)).

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Appendices

Appendix A: Subject Profiles

Table 1 Profiles of Greek subjects who participated in the plural formation task

Subject code[1] and age tested		DLI \ Control[2] Group[3]	DLI family history
GIF88CL	(5;8)	DLI	- mother
GNF88CA	(5;10)	Control	-
GIM87CS	(6;5)	DLI	- paternal uncle
GNM88CL	(6;3)	Control	-
GIM87CC	(6;7)	DLI	- father, paternal uncle, 2 male cousins
GNM87CN	(6;6)	Control	-
GIF86CK	(7;7)	DLI	- brother, father, paternal aunt
GNF86CA	(7;9)	Control	-
GIF87CV	(7;10)	DLI	- sister, father, paternal uncle
GNF87CV	(7;11)	Control	-
GIM86CG	(7;10)	DLI	? reported learning difficulties in family
GNM86CL	(8;2)	Control	-
GIM80CM	(14;6)	DLI	- paternal uncle and great uncle
GNM80CM	(14;2)	Control	-
GIM76CA	(17;7)	DLI	? family history not completely available
GNM77CD	(16;7)	Control	-

[1] Participants in this study have each been given a code such that it contains the following information: mother tongue (G for Greek), status of language (I for impaired and N for non-impaired), sex (F for female and M for male), year of birth (82 stands for 1982, for e.g.), the subject's generation in the family tree of living relatives (C is for third generation in life), and initial of kindred (S for Smith, for e.g.).

[2] The controls were matched for age, sex, socio-economic status, and geographic area (for dialect control); none of the controls had any reported language difficulties, learning impairments, cognitive impairments, hearing problems, psychoemotional problems, or known neurophysiological or motor impairments.

[3] DLI subjects are presented in rising chronological age, each followed by an age-matched control.

Table 2 Greek subjects who participated in the Compound formation task

DLI Subjects[4]		Age-Matched Controls		Younger Controls	
GIF87CS	(6;6)	(6:3) to (6;8)	n=7	(4:11)	female
GIM87CC*	(6;7)	(6:3) to (6;8)	n=7	(5;6)	male
GIM87CK*	(7;2)	(7:3) to (7;5)	n=7	(5:9)	male
GIM86CA	(7;7)	(7:3) to (7;5)	n=7	(5:10)	male
GIM80CM*	(13;5)	(13:3) to (13:8)	n=7	(5:11)	male
GIM79CK	(13:11)	(13:3) to (13;8)	n=7	(6:0)	male
GIM76CA*	(17;7)	(16:9) to (17:8)	n=7	(6:0)	male

Table 3 Greek subjects who participated in the Diminutive tasks

DLI Subjects[4]	Age-Matched Controls	Younger Controls	Adult Controls
GIF91CAA (5;6)[5]	GNF90CK (5;11)	not available	
GIM91CAM (5:0)	GNM90CA (5;6)	not available	
GIM89CSY* (6;11)[6]	GNM89CP (7;2)	GNM90CA (5:6)	
GIM89CSV* (6;11)	GNM89CP (7;2)	GNM90CA (5;6)	
GIM89CSP* (6;11)	GNM89CP (7;2)	GNM90CA (5;6)	GNM77CA (19;0)
GIM87CCC* (8;11)	GNM88CT (8;5)	GNM89CP (7;2)	GNM77CG (19;1)
GIM87CKA (9;5)	GNM87CY (9;2)	GNM88CT (8;5)	GNF56CC (39;11)
GIM82CMK*(13;6)	GNM82CP (14;0)	GNM87CY (9;2)	GNF60CZ (36;6)
GIM80CMT*(16;0)	GNM80CK (15;9)	GNM82CP (14;0)	GNM44CD (52;1)

[4] * denotes positive family history for DLI.

[5] Age at the time of testing.

[6] Subjects GIM89CSY, GIM89CSV and GIM89CSP are identical triplets so that subject codes for the DLI group had to be supplemented by a final character denoting the initial letter of the subject's first name. The same age-matched and younger controls were used for all three.

Appendix B: Plural formation task stimuli

A. Real nouns used in the pluralization task:

	Masculine		*Feminine*		*Neuter*	
1.	skílos	'dog'	sávra	'lizard'	dhéndro	'tree'
2.	gháidharos	'donkey'	fókya	'seal'	liondári	'lion'
3.	pinguínos	'penguin'	ayeládha	'cow'	eláfi	'deer'
4.	vátrakhos	'frog'	gháta	'cat'	karávi	'ship'
5.	stratyótis	'soldier'	arkúdha	'bear	lulúdhi	'flower'
6.	vasilyás	'king'	milyá	'apple-tree'	psári	'fish'
7.	laghós	'hare'	kamíla	'camel'	ghuruúni	'pig'
8.	yípas	'vulture'	khelóna	'turtle'	vyolí	'violin'
9.	távros	'bull'	arákhni	'spider'	fídhi	'snake'
10.	náftis	'sailor'	séla	'saddle'	fitó	'plant'

B. Novel nouns used in the pluralization task:

	Masculine	*Feminine*	*Neuter*
1.	vítoras	rolyá	féras
2.	dháftis	tíza	redhí
3.	kanistís	kíki	vatsíki
4.	píghas	sálaga	thísimo
5.	rasés	vési	mirío
6.	thoryás	táli	móma
7.	ramías	dhíra	kákhos
8.	maós	móra	peró
9.	rolítis	vándra	gákri
10.	fokhías	dolyá	ghosó
11.	thípas	félisa	ksómi
12.	bórakas	dholóna	trádhi
13.	gínas	vésti	gápi
14.	dhínas	ksási	dhélino
15.	volínas	zípsa	mídhiro
16.	rapús	mínami	túmbi
17.	dafés	mardhyá	bóri
18.	bírios	zíra	dídhi
19.	grómos	dífi	vatáki
20.	méfkos	ríki	tsérma

Appendix C: Compound formation task stimuli

A. Real noun triggers and real compounds

1st Element Trigger		*Compound*	
fitó	'plant'	fitofághos	'herbivore'
mélisa	'bee'	melisofághos	'type of bird'
lotós	'parsimon'	lotofághos	'lotus-eater'
mirmígi	'ant'	mirmigofághos	'ant-eater'
éndomo	'insect'	endomofághos	'insect-eater'
psári	'fish'	psarofághos	'piscivore'
ánthropos	'man'	anthropofághos	'man-eater'
khórta	'greens'	khortofághos	'plant-eater'
ksíla	'wood'	ksilofághos	'plane'
kréas	'meat'	kreatofághos	'carnivore'
píthikos	'ape'	pithikánthropos	'ape-man'
vátrakhos	'frog'	vatrakhánthropos	'sea diver'
çóni	'snow'	çonánthropos	'snowman'
líkos	'wolf'	likánthropos	'werewolf'
fílos	'friend'	filánthropos	'philanthropist'
ághrios	'wild person'	aghriánthropos	'savage'
arkúdha	'bear'	arkudhánthropos	'big hairy person'
theós	'god'	theánthropos	'Jesus Christ'
ómorfos	'good-looking'	omorfánthropos	'handsome'
árkhondas	'lord'	arkhondánthropos	'dignified person'

B. Real noun triggers and novel compounds

1st Element Trigger		*Compound*	
papútsi	'shoe'	paputsofághos	'shoe-eater'
pondikós	'mouse'	pondikofághos	'mouse-eater'
laghós	'hare'	laghofághos	'hare-eater'
skulíki	'worm'	skulikofághos	'worm-eater'
arákhni	'spider'	arakhnofághos	'spider-eater'
kóta	'hen'	kotofághos	'hen-eater'
kíknos	'swan'	kiknofághos	'swan-eater'
fídhi	'snake'	fidhofághos	'snake-eater'
mílo	'apple'	milofághos	'apple-eater'
mígha	'fly'	mighofághos	'fly-eater'
pondikós	'mouse'	pondikánthropos	'mouse-man'
kunéli	'rabbit'	kunelánthropos	'rabbit-man'
fálena	'whale'	falenánthropos	'whale-man'
próvato	'sheep'	provatánthropos	'sheep-man'
çína	'goose'	çinánthropos	'goose-man'
psári	'fish'	psaránthropos	'fish-man'
gháta	'cat'	ghatánthropos	'cat-man'
álogho	'horse'	aloghánthropos	'horse-man'
arní	'sheep'	arnánthropos	'sheep-man'
maimú	'monkey'	maimudhánthropos	'monkey-man'

Appendix C: Diminutive task stimuli

1. Real words, regular

Masculine Base Noun		*Diminutive Noun*	*Semantic foil*[7]
skílos	'dog'	skilákos	cat
lemós	'throat'	lemákos	foot
dhrómos	'road'	dhromákos	bridge
kípos	'garden'	kipákos	pool
ómos	'shoulder'	omákos	hand
tíkhos	'wall'	tikhákos	roof
ghlároς	'seagull'	ghlarákos	airplane
skíuros	'squirrel'	skiurákos	bear
arkúdhos	'teddy'	arkudhákos	doll
vátrakhos	'frog'	vatrakhákos	duck

Feminine Base Noun

gháta	'cat'	ghatúla	mouse
pórta	'door'	portúla	window
kardhiá	'heart'	kardhúla	smiley face
ghramí	'line'	ghramúla	dot
míti	'nose'	mitúla	mouth
zóni	'belt'	zonúla	glasses
várka	'boat'	varkúla	car
ksístra	'sharpener'	ksistrúla	rubber eraser
vrísi	'fawcet'	vrisúla	watering can
tsánda	'handbag'	tsandúla	shoe
ghlástra	'flower pot'	ghlastrúla	water glass

[7] Semantic foils (base noun and diminutive) were used in the comprehension task only

Neuter Trigger Noun		*Diminutive Noun*	*Semantic foil*
kerí	'candle'	keráki	desk lamp
dhéndro	'tree'	dhendráki	sunflower
psomí	'bread'	psomáki	pizza
kutí	'box'	kutáki	bucket
pulí	'bird'	puláki	airplane
psári	'fish'	psaráki	steak
fídhi	'snake'	fidháki	turtle
kumbí	'button'	kumbáki	earring
khartí	'paper'	khartáki	ruler
piáto	'dish'	piatáki	bottle

2. Real words, irregular

mílo	'apple'	milaráki	strawberry
pódhi	'foot'	podharáki	hand
ksílo	'stick'	ksilaráki	stone
vivlío	'book'	vivliaráki	television
khorió	'village'	khoriudháki	city
kafés	'coffee'	kafedháki	ice-cream
fílo	'leaf'	filaráki	grape bunch
paltó	'coat'	paltudháki	boot
vunó	'mountain'	vunaláki	field
avghó	'egg'	avghulaki	grape bunch

3. Real base nouns ending in [aki] without being diminutive; target is base noun

Base Noun Target		*Semantic foil*
spanáki	'spinach'	strawberry
sakáki	'jacket'	swimsuit
mustáki	'mustache'	mouth
mandaláki	'clothes pin'	paintbrush
koráki	'crow'	parrot
kapáki	'lid'	baking pan
suvlaki	'food item'	hamburger
plakáki	'tile'	vase
tzáki	'fireplace'	storm lamp
skáki	'chess'	backgammon

4. Real words, mulitisyllabic fillers given as diminutives, targetting base

Noun Base Target		*Semantic foil*
polié́leos	'chandelier'	desk lamp
papaghálos	'parrot'	penguin
odhondóvurtsa	'toothbrush'	glasses
polithróna	'armchair'	stool
petalúdha	'butterfly'	bird
maksilári	'pillow'	clock
aftokínito	'car'	bicycle
paráthiro	'window'	door
triandáfilo	'rose'	orange
dhakhtilídhi	'ring'	cross pendant
kalambóki	'maize'	carrot

5. Novel base nouns modeled on real regular base nouns: triggers

Masculine	*Feminine*	*Neuter*
grómos	roliá	loró
mákos	tíza	daní
réfkos	kíki	redhí
bíghos	vési	zídhi
thípos	dhíra	peró
lónos	móra	batí
dámos	vándra	gákri
perós	bími	ghosó
fámbos	ksási	trádhi
trólos	zípsa	bóri

6. Novel base nouns modeled on real irregular base nouns; triggers

Neuter

dílo

sódhi

krílo

dhóma

tála

fóma

báma

sunó

ngíma

léma

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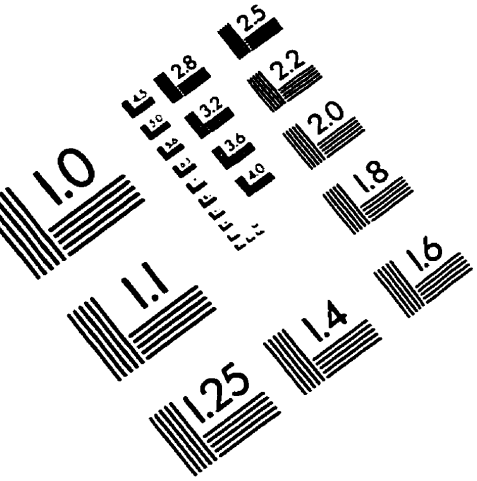
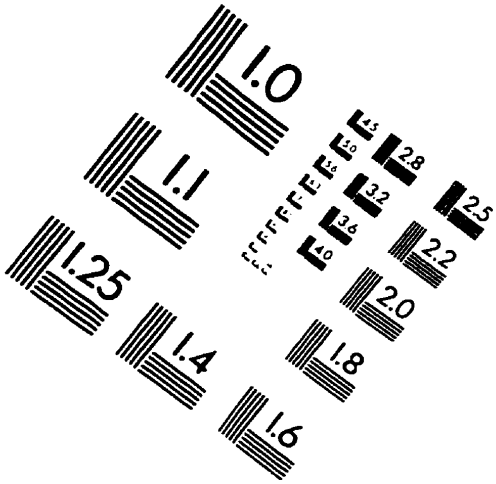
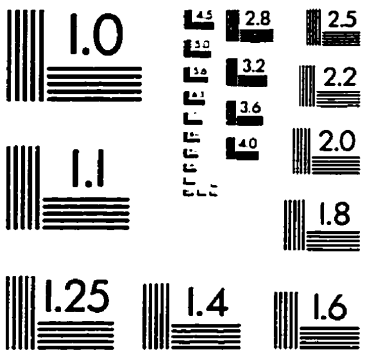
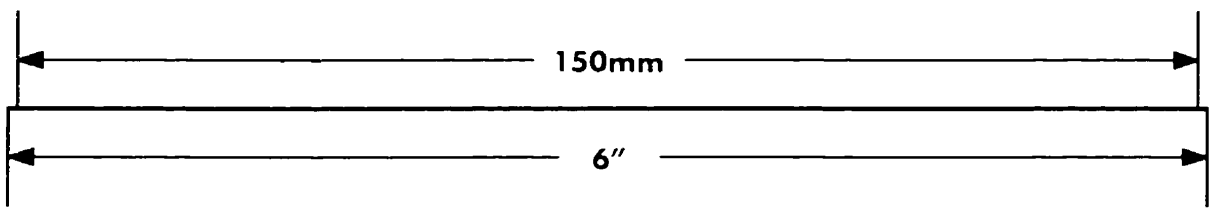
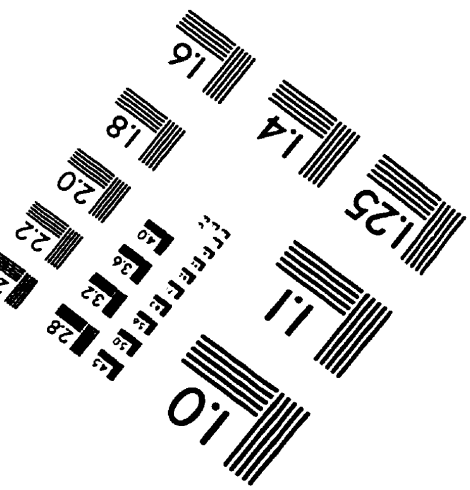
TEST TARGET (QA-3)

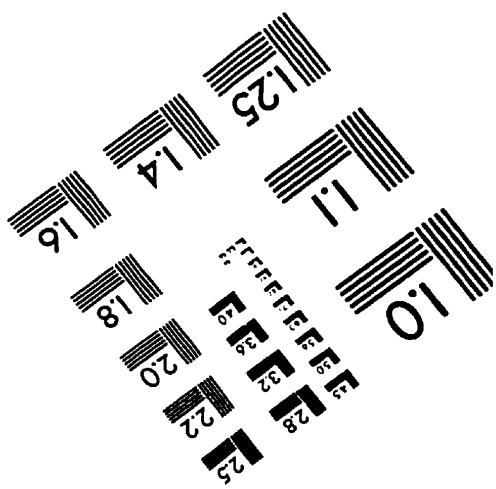












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