Multipurpose Design and Creation of GSL Dictionaries

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Abstract

In this paper we present the methodology of data collection and implementation of databases with the purpose to create extensive lexical and terminological resources for the Greek Sign Language (GSL). The focus is on issues of linguistic content validation, multipurpose design and reusability of resources, exemplified by the multimedia dictionary products of the projects NOEMA (1999-2001) and PROKLISI (2002-2004). As far as data collection methodology, DB design and resources development are concerned, a clear distinction is made between general language lexical items and terms, since the creation of resources for the two types of data undergoes different methodological principles, lexeme formation and usage conditions. There is also reference to content and interface evaluation mechanisms, as well as to basic linguistic research carried out for the support of lexicographical work.

1. Introduction

A basic requirement for the treatment of signs or sign streams as linguistic input for NLP and for the development of applications that make use of linguistic data, is the existence of adequate linguistic resources in the form of electronic lexical databases and computational grammars.

The Greek Sign Language (GSL) has only recently started to be subject to systematic linguistic analysis. This is, on one hand, due to the fact that it was not until 2000 (Act 2817) that GSL was recognized by the Greek Parliament as an official language of the Greek State. On the other hand, this interest is directly connected to the development of technologies, which enabled the creation of electronic linguistic resources (including lexicons, grammars and sign language corpora) for languages that are uttered in the three-dimensional space (see also Efthimiou et al., 2004). Such resources can nowadays be adequately stored, retrieved and represented, exploiting the ability of current systems to incorporate various multimedia functionalities for the generation of signs, into a single platform.

2. GSL lexicography: the background

In contrast to other sign language systems, i.e. the ASL (Tennant & Gluszak Brown, 1998 ; Wilcox et al., 1998), systematic lexicographical work in respect to GSL has started only recently, within the framework of the NOEMA project (1999-2001).

This was the first attempt to create multipurpose reusable linguistic resources for GSL. Part of the project description was the creation of a digital sign stream narration corpus and an electronic dictionary of basic GSL vocabulary. The spin-off products of that project, among which are a 3,000 entry multimedia bilingual dictionary (GSL-Greek) of basic vocabulary and a multimedia children's dictionary of GSL (Kourbetis & Efthimiou, 2003), reflect the methodology for creating linguistic resources followed, the content and interface evaluation mechanism adopted, as well as the basic linguistic research carried out to support the lexicographical work (NOEMA Project, 2001).

The knowledge acquired with respect to the morpho-phonological operations the formation of simple and complex signs allowed for: a) the construction of rules for creating new valid signs, b) the denomination of relevant terms and c) the classification of GSL linguistic resources into terminological lists. All these have significant impact on the development of both communication and educational tools using technologies which allow the 3D representation of linguistic content.

3. Methodological principles of vocabulary formation

The initial steps of our work on GSL vocabulary included a survey of the existing lexicography (Logiadis & Logiadis, 1985) and syntax literature. It came out that the available knowledge of GSL was only based on individual fragmentary attempts. These usually lacked scientific criteria, did not derive from systematic scientific analysis and generally involved the creation of some kind of lexicon. This fact is directly connected with the prevailing assumption that GSL is not an autonomous linguistic system but, rather, some kind of representation of aural Greek.

Consequently, the creation of lexical resources had to take into serious consideration the linguistic material that would serve as the basis for the lexicographical work (Johnston & Schembri, 1999) and which should reflect linguistic synchrony, also allowing for an adequate grammatical description of GSL (Bellugi & Fischer, 1972).

Next, we will present the methodologies adopted for compiling two vocabulary lists: a general purpose basic vocabulary of 3,000 initial signs and a vocabulary of basic computer-skills terminology.

In both cases, extensibility and reusability were the main design principles, whereas lack of previous linguistic resources dictated specific methodological approaches to data collection (for the general purpose vocabulary), as well as to new sign formation (for the computer-skills terminology list).

3.1. Methodology of creation of a general purpose basic vocabulary: data collection

The first step of this task mainly involves the compilation of the basic sign vocabulary[1] of GSL. In the process of compiling a list of 3,000 basic signs of GSL without an appropriate corpus available, a decision had to be made as to whether statistical frequencies, every day use or vocabulary lists taught to young children would constitute our data.

In order to overcome the lack of GSL resources, we comparatively studied the proposed basic vocabularies or 'defining vocabularies' of three well analyzed aural languages: English, French and German (Mueller et al., 1995 ; Gougenheim, 1958 ; Longman Dictionary of Contemporary English). Based on this study, we gathered a core 3,650 lemma list, which was, then, compared to two other lists:

- the first one, containing 1,850 words, was provided by the Hellenic Federation of the Deaf (HFD) and derived from a previously videotaped and lemmatized corpus to serve as basic study material for GSL;
- the second one contained the 2,100 most frequent words in the Hellenic National Corpus (HNC), an electronic corpus of general Greek developed by ILSP, which contained 13,000,000 words at the period of study.

The HNC (1999) word list is of significant importance, given that it contains words corresponding to existing appearances in text corpora. On the other hand, the words that consist the basic vocabularies of different languages carry an even heavier weight because they allow reference to a set of concepts rather than isolated words. Such concepts may be viewed as basic in respect to everyday communication. Since we proposed a concept-based approach to vocabulary building, we had to take into account the issue of the representation of these concepts through different grammatical categories. We noticed that in the vocabulary lists included in our study, concepts were represented either by a single or by more than one grammatical category, without following a systematic way of listing (i.e. in one case, the proposed representation involves *basic/base*(v) vs. *base*(n)/*base*(v) and in another *difference/differ* vs. *difference/different*).

In the case of GSL vocabulary, we either adopted the words suggested by HFD or followed suggestions made by individual native GSL informants. Specific grammatical categories were further excluded from the GSL list on the basis of the numerical restriction of 3,000 signs. Subject to this exclusion were adverbs (unless no equivalent adjective was available) and passive verb forms and participles (unless the latter had an adjectival function in the language).

As a result, a 2,800 concept list was formed, which was then presented to HFD for comments, enrichment with concepts specific to deaf communication and video recording (Efthimiou & Katsoyannou, 2001). For every concept on the proposed list three parameters are true:

- they have a high frequency rate in the vocabulary of Greek according to HNC data;
- they are included in at least two of the proposed basic vocabularies we took into account (Figure 1);
- they can be expressed by words of more than one grammatical category (i.e. love(n)/love(v)) or by a concatenation of synonyms (i.e. angry-furious).

The aim of this procedure was to form the basic sign list of GSL as used by native signers without being biased by external parameters. For this reason, our informants were asked to propose synonym or antonym signs for concepts, wherever possible, so that semantic relations be stated by means of GSL mechanisms rather than via influence from spoken Greek or other language systems.

3.2. Methodology of development of terminological resources

As far as GSL terminological resources design is concerned, we had to take into account that the introduction of specific concept systems in the language means creating new term systems for representing these concepts (Sager, 1994 ; Otman, 1996). In the initial stage of defining the methodology for term formation, we focused on the principle that new term denominations, term signs in our case, should incorporate and demonstrate the following properties innate to the language (Gee & Goodhart, 1985):

- GSL mechanisms of vocabulary organization;
- GSL mechanisms of word formation;
- GSL lexical unit function in sign stream production.

The task of term list formation (Rey, 1995) incorporates, to a considerable extend, the characteristics and conditions of lexicographical work. However, there is a crucial point of differentiation, as the items included in a terminology list carry a given semantic value only within a specific context of use, outside which they may carry different meaning or no meaning at all.

Furthermore, terms are one-to-one representations of concepts, which are organized into systems (Rey, 1996) and, in contrast to other lexical items, may consist of complex syntactic and/or semantic units which are formed not merely by linguistic but also by other (i.e. mathematical) symbols or a combination of them (Wright & Strehlow, 1995).

The primary task in terms of the initial linguistic data collection was defining the field of coverage (Sager, 1990). This was followed by a study of the content of term intensive corpora on the selected fields of knowledge. The result was the extraction of a set of concepts for each field. Our example case is the field of computer-skills terminology. In this specific case, the language of initial knowledge creation is English. As a result, a considerable proportion of the terms, denominating the relevant concepts, are transferred either directly or indirectly from English into receiver languages, such as Greek. Consequently, the concept list of computer-skills terminology had, in our case, two existing representation equivalents in the context of spoken languages: a set of English terms (source language) and a set of their Greek translations (receiver language).

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[1] One should notice that the notion of basic vocabulary is not uniformly defined in the relevant literature, which raises the issue of selecting the appropriate methodological approach to deal with the data.

The task was to create terms in GSL for the same concepts, allowing for the least possible influence by previously existing representations, while creating terminological items according to sign language word formation principles. This was a crucial prerequisite for the proposed denominations to be recognized by native signers as components of GSL with acceptable internal structure and specific cognitive content.

This task of concept denomination for the formation of a terminology list in GSL was undertaken by a working group of terminologists, computational linguists, computer scientists, GSL specialists and computer skills teachers which included members of the Greek Deaf Community.

The output of this group work was a list of video recorded terms, which were entered into a DB along with their Greek and English equivalents.

4. Organization of vocabulary databases

The internal organization of the lexical resources database differs from the one designed for storing terminological items with respect to lemma-related information as far as the expected functionality of resources is concerned. Thus, synonyms and antonyms (Figure 2) are included only in the case of general vocabulary, whereas standard GSL phonological features such as handshapes are included as lemma related information in both DBs. For the same reasons, lemmas in the terminology DB are related not only to field but also to sub-area of use, in order to allow for greater precision and clear lemma interrelations.

4.1. Design and development of the general purpose vocabulary DB

Given the specific goal of creating exhaustive reusable vocabulary resources of GSL, the design of the general purpose vocabulary DB incorporated a number of properties which include fields for:

- video recorded signs,
- grammatical category of lemmas,
- synonyms,
- antonyms (Figure 3),
- interpretations,
- lemma classification by thematic category,
- lemma translation into Greek and
- HamNoSys annotation features of lemma phonology (Prillwitz et al., 1989).

The DB was then enriched with lexical content following the methodology for data collection described above.

Experience gained by lemma analysis of the selected video signs enabled a number of assumptions regarding the morphological structure and sign formation mechanisms of GSL (Efthimiou & Katsoyannou, 2002). This knowledge provided the grounds for introducing new signs as in the case of GSL terminology items.

The implementation of the DB has already proven that the above structure allows for a multi-dimensional use of the resources created. The reusability of the general GSL vocabulary resources has already been tested by the fact that these resources provided the lexicographical content for a number of dictionary products. The same DB content also draws on on-going research with respect to efficient sign representation.

4.2. Design and development of the terminological DB

The design of the terminological resources DB is based on a term list, the formation of which was described in the methodology section 3.2 above. Each entry corresponds to a term and includes fields for:

- the video recorded term-sign,
- a video capture file serving as a visualized definition (Rousseau, 1983),
- the equivalent Greek term,
- the equivalent English term,
- a lemma identification code number,
- a code indicator corresponding to the basic handshape for the term-sign formation in GSL,
- a link to HamNoSys features other than the handshape, and
- sub-area fields in which each term is used.

In the case of computer-skills terminology, the sub-area fields include the following categories:

- General Notions,
- Word,
- Excel,
- Access,
- Internet Explorer,
- Power Point and
- Windows.

By adopting this architecture, the extensibility of the DB is guaranteed through the possibility of adding new terms, entry fields or terminology domains. Moreover, DB maintenance through addition, deletion or modification of term entries is possible without crucial or risky changes in terms of programming (Sowa, 2000).

5. Dictionary implementation

To exemplify the (re-)usability of the lexical resources discussed here, we make a short reference to two relevant products: a bi-directional (aural Greek-GSL and GSL-aural Greek) dictionary, compiled after a systematic survey of linguistic structure and a computer-skills trilingual dictionary (GSL-Greek-English).

As far as the dictionary making process is concerned, the organisation of entries was based upon the principle of usability in terms of the two user groups. Thus, each sign-lemma is followed by different defining / exemplification elements in both cases. In the general purpose dictionary (Efthimiou & Katsoyannou, 2001 ; 2002), entry structure provides the following set of information with respect to each GSL lemma:

- translation equivalent(s),
- an explanation in Greek,
- synonyms in GSL,
- antonyms in GSL,
- illustrative image (whenever possible),
- thematic category for lemma classification.

The inclusion of a Greek definition and translation helps non-native GSL signers enrich their vocabulary of modern Greek. At the same time, thematic categorization enables the learning of groups of signs which relate to each other semantically or pragmatically.

Lemma search is possible in the following manners:

- by order of handshapes within lemmas (Figure 4),
- by thematic category (e.g. «plant names»),
- by alphabetical order of the modern Greek translations.

Dictionary users perceive the special features of GSL in direct reference with Greek, while thematic fields function as a bridge between each sign and its Greek equivalent.

Concerning the terminology dictionary, as soon as the application starts, the items in the DB are processed so as to filter the lemmas corresponding to the user selection criteria (PROKLISI Project, 2003).

The lemma screen includes the following elements:

- thematic category,
- a list of every lemma in this category, from which users can select,
- the selected lemma in Greek,
- the selected lemma in English,
- a video-lemma in GSL,
- a list of all sub-area fields in which the selected lemma appears,
- a screen capture example of the term,
- a videotaped text in GSL with a concise presentation of the selected thematic category.

Users can access the content in the following ways:

- by the main handshape which forms the sign corresponding to each term. In this case, each sign is also accompanied by equivalents in both Greek and English, a list of thematic categories relevant to the term, a video presentation of the term, and a videotaped text with an introduction to the selected sub-area;
- by the Greek or English term equivalents in alphabetically ordered lists (Figure 5). The sign which corresponds to the selected term can appear either by clicking on the list or by typing it in, in one of the suggested languages. Items of information available for this search option include: a list of every sub-area in which the selected lemma appears, a video exemplifying the lemma and the videotaped text with an introduction to the selected thematic sub-area;
- by thematic sub-area. In this case, users can select among seven thematic categories (Figure 6) corresponding to the sub-areas in which computer-skills terminology is categorized. This option retrieves the corresponding terms in three lists of equivalents: GSL-Greek-English. Items of information available for this search option also include the other sub-areas in which the term appears, a video capture explanation of the term or an image, and an informative sign stream presentation of the selected sub-area.

6. Evaluation criteria and procedure

Evaluation procedures for both dictionary products were carried out by user groups of native GSL signers in real use environment. The basic vocabulary dictionary was tested in two rounds, in the context of various communicative situations. The evaluation body was composed of GSL native signers of various age groups, who were asked to use the dictionary in school, work and home environment and complete an evaluation criteria list. The related questionnaire contained 26 multiple choice questions and 5 free input slots. The main evaluation criteria comprised educational and communication needs, type of profession, source that disseminated the NOEMA product, interface design (screen organization, menus, help provided), efficiency of information accompanying the entry for each sign, adequacy of information introducing general aspects of GSL grammar incorporated in the product, period for getting used to navigating through the product and possible recommendations for future versions. The output of that first circle of evaluation served as feedback for making improvements to the final dictionary product. The second evaluation step followed the same methodology, with the purpose of verifying the acceptance of the product by the Greek Deaf Community. More information on the evaluation of the basic vocabulary dictionary can be found at the related project deliverable (NOEMA, 2001).

A first version of the computer-skills terminology dictionary was experimentally introduced as an education support tool in a continuous education class. Comments on both system functionality and content efficiency were incorporated in the final product version to be released on 30th March 2004.

7. Future research & development goals

Future development efforts in respect to both platforms (basic vocabulary dictionary and computer terminology dictionary) include investigation of the possibility of implementing smarter search options, in relation to the ongoing extension of the basic vocabulary DB content. Efficient sign-based user look-up features will also be incorporated along with fuzzy search capabilities (as proposed, for instance, by Wilcox et al. (1994)).

Based on the proposed methodology for the creation of the computer-skills terminology dictionary, other specialized dictionaries, intended to serve knowledge transfer in several areas of interest, are foreseen to be created, in order to meet a wider range of educational and communication needs (Dowdall et al., 2002) of the Greek Deaf Community.

Closing, we may notice that a children's dictionary (Kourbetis & Efthimiou, 2003) has already been developed, following the release of the NOEMA dictionary, which will provide further linguistic material for educational applications addressing early primary school needs.

Acknowledgments

References

Bellugi, U. & Fischer, S. (1972). A comparison of Sign language and spoken language. Cognition, 1, 173--200.

Dowdall, J., Hess, M., Kahusk N., Kaljurand, K., Koit, M., Rinaldi F. & Vider, K. (2002). Technical Terminology as a Critical Resource. In Proceedings of the Third International Conference on Language

Resources and Evaluation (LREC 2002), (pp. 1897--1903), Las Palmas de Gran Canaria, ELRA.

Efthimiou, E., Sapountzaki, G., Carpouzis, C., Fotinea, S-E. (2004). Developing an e-Learning platform for the Greek Sign Language. Lecture Notes in Computer Science (LNCS), Springer-Verlag Berlin Heidelberg (in print).

Efthimiou, E. & Katsoyannou, M. (2002). NOEMA: a Greek Sign Language Modern Greek bidirectional dictionary. Modern Education Vol. 126/127, 2002, 115--118 (in Greek).

Efthimiou, E. & Katsoyannou, M. (2001). Research issues on GSL: a study of vocabulary and lexicon creation. Studies in Greek Linguistics, Vol. 2 Computational Linguistics, 42--50 (in Greek).

Gee, J. & Goodhart, W. (1985). Nativization, Linguistic Theory, and Deaf Language Acquisition. Sign Language Studies, 49, 291--342.

Gougenheim, G. (1958). Dictionnaire fondamental de la langue française. Didier.

Hellenic National Corpus, Statistics. ILSP (Institute for Language and Speech Processing) (1999). Available at: http://www.xanthi.ilsp.gr/corpus/

Johnston T. & Schembri, A. (1999). On defining Lexeme in a Signed Language. Sign Language and Linguistics 2:2, 115--185.

Kourbetis, V. & Efthimiou, E. (2003). Multimedia Dictionaries of GSL as language and educational tools. Second Hellenic Conference on Education, Syros (in Greek), (in print).

Logiadis, N. & Logiadis, M. (1985). Dictionary of Sign Language. Potamitis Press (in Greek).

Longman Dictionary of Contemporary English.

Mueller, J., Bock, H. & Georgiakaki, M. (1995). Grundwortschatz Deutsch. Langenscheidt.

NOEMA Project (2001). Deliverable titled "Final implementation report". ILSP, 6/2001 (in Greek).

Otman, G. (1996). Les représentations sémantiques en terminologie, Paris, Masson.

Prillwitz et al. (1989). HamNoSys. Version 2.0. Hamburg Notation System for Sign Language. An Introductory Guide. Broschur / Paperback (ISBN 3-927731-01-3).

PROKLISI Project: WP9: Development of a GSL based educational tool for the education of people with hearing impairments, Deliverable II: GSL linguistic material: data collection methodology. ILSP, May 2003.

Rey, A. (1995). Essays on terminology, Amsterdam/ Philadelphia, John Benjamins.

Rey, A. (1996). Beyond terminology.In Somers, H. (ed.), Terminology, LSP and Translation. Studies. in Language Engineering in Honour of Juan C. Sager (99--106), Amsterdam, John Benjamins.

Rousseau, L.-J. (1983). La définition terminologique. In Duquet-Picard, D. (ed), Problèmes de la définition et de la synonymie en terminologie: Actes du Colloque international de terminologie (35--46), Québec, GIRSTERM.

Sager, J. C. (1990). A Practical Course in Terminology Processing, Amsterdam, John Benjamins.

Sager, J. C. (1994). Terminology: Custodian of knowledge and means of knowledge transfer. Terminology 1/1, 7--16.

Sowa, J. F. (2000). Knowledge Representation: Logical, Philosophical, and Computational Foundations, Pacific Grove, Brooks Cole Publishing Co.

Tennant R.,A. & Gluszak Brown, M. (1998). The American Sign Language Handshape Dictionary. Clerc Books, an imprint of Gallaudet University Press.

Wright, S.-E. & Strehlow, R. A. (1995). Standardizing and harmonizing terminology: theory and practice, Philadelphia, American Society for Testing Materials.

Wilcox, S., Scheibmann, J., Wood, D., Cokely, D. & Stokoe, W. (1994). Multimedia dictionary of American Sign Language. In Proceedings of ASSETS Conference, Association for Computing Machinery, (pp. 9--16).

Λήμμα	Αντώνυμα	Συνώνυμα	Προέλευση	Γρα	Γνωστικός Τομέας Α	Γνωστικός Τομέ	Παιδικό	Δόθη
ναυάγιο			ΚΟΙ +		ΣΥΓΚΟΙΝΩΝΙΑ - ΜΕΤΑΦ		☐	
νότιος, νότια	βόρειος, βόρι		ΚΟΙ +		ΠΕΡΙΒΑΛΛΟΝ		☐	
ρίζα			ΚΟΙ +		ΦΥΤΑ		☐	
μπουκάλι			ΚΟΙ +		ΤΕΧΝΟΛΟΓΙΑ - ΕΡΓΑΛΕ		☑	
μήκος, μάκρος		μάκρος (!!!)	ΚΟΙ +		ΧΡΟΝΟΣ - ΧΩΡΟΣ - ΔΙΑΣ		☐	
μονός			ΚΟΙ +		ΕΝΟΤΗΤΑ - ΔΙΑΙΡΕΣΗ -		☐	
αποδεικνύω, απόδ			ΚΟΙ +		ΥΠΑΡΞΗ - ΤΑΥΤΟΤΗΤΑ		☐	
δηλητηριάζω, δηλ			ΚΟΙ +		ΣΩΜΑ - ΕΜΦΑΝΙΣΗ - ΑΙΣ		☐	
ξεχωρίζω			ΚΟΙ +		ΥΠΑΡΞΗ - ΤΑΥΤΟΤΗΤΑ		☐	
δεξιός, δεξιά	αριστερός, αρ		ΚΟΙ +		ΧΡΟΝΟΣ - ΧΩΡΟΣ - ΔΙΑΣ		☐	
μόνο, μονάχα		μονάχα (!!!)	ΚΟΙ +		ΕΝΟΤΗΤΑ - ΔΙΑΙΡΕΣΗ -	ΓΡΑΜΜΑΤΙΚΗ	☐	
νησί			ΚΟΙ +		ΠΕΡΙΒΑΛΛΟΝ		☐	
ωραίος	άσχημος	όμορφος	ΚΟΙ / παρ+ / Δη		ΣΩΜΑ - ΕΜΦΑΝΙΣΗ - ΑΙΣ		☐	
καινούριος	παλιός		ΚΟΙ / παρ+		ΧΡΟΝΟΣ - ΧΩΡΟΣ - ΔΙΑΣ		☐	
ακόμα, ακόμη			ΚΟΙ / παρ+		ΓΡΑΜΜΑΤΙΚΗ		☐	
δεν, μην			ΚΟΙ / παρ+		ΓΡΑΜΜΑΤΙΚΗ		☐	
ακούω			ΚΟΙ / παρ+		ΣΩΜΑ - ΕΜΦΑΝΙΣΗ - ΑΙΣ		☑	
μεγαλώνω	!!!		ΚΟΙ / παρ+		ΧΡΟΝΟΣ - ΧΩΡΟΣ - ΔΙΑΣ	ΧΡΟΝΟΣ - ΧΩΡΟΣ	☐	
καθόλου, διόλου		διόλου (!!!)	ΚΟΙ / παρ+		ΕΝΟΤΗΤΑ - ΔΙΑΙΡΕΣΗ -		☐	
κάθομαι			ΚΟΙ / παρ+		ΕΝΕΡΓΕΙΑ - ΑΔΡΑΝΕΙΑ -		☑	
με	χωρίς		ΚΟΙ / παρ+		ΓΡΑΜΜΑΤΙΚΗ		☐	
δένδρο			ΚΟΙ / παρ+		ΦΥΤΑ		☑	
άκρη, ακμή	μέση		ΚΟΙ / παρ+		ΧΡΟΝΟΣ - ΧΩΡΟΣ - ΔΙΑΣ		☐	
και			ΚΟΙ / παρ+		ΓΡΑΜΜΑΤΙΚΗ		☐	

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Figure 1: Part of the GSL basic vocabulary DB; the 3rd column from left provides information as regards original (co-) appearance of lemmas in source lists.

Λέξη αναζήτησης	Video	Ερμηνεία	Αντώνυμα	Συνώνυμα	Γνωστικός Τομέας
επάνω	1981pano-sto.avi	πάνω σε			ΤΟΠΙΚΕΣ ΕΝΝΟΙΕΣ
επάνω	1980epano.avi	πάνω από			ΤΟΠΙΚΕΣ ΕΝΝΟΙΕΣ
επαρχία	1099eparxia.avi	επαρχία	1513protevusa.avi		ΚΡΑΤΟΣ - ΔΙΟΙΚΗΣΗ
επείγον	905epigon.avi	επείγον			
επειδή	319dioti.avi	διότι, επειδή			
επεισόδιο	320episodio.avi	επεισόδιο, τσακωμός, φασαρία			
έπειτα	1982epita.avi	έπειτα, μετά	2132prin.avi, 2135proigumenos	2064meta.avi	ΧΡΟΝΙΚΕΣ ΕΝΝΟΙΕΣ
επεξεργάζομαι	321epexergazome.avi	επεξεργάζομαι			
επί	1647epi.avi	επί (σύμβολο πολλαπλασιασμού)			
επί τοις εκατό	1100epitisekato.avi	επί τοις εκατό			ΟΙΚΟΝΟΜΙΑ
επιβάλλω	2338epivalo.avi	επιβάλλω			
επιβάτης	3322epivatis.avi	επιβάτης (άντρας ή γυναίκα)		3323epivatis2.avi	ΣΥΓΚΟΙΝΩΝΙΕΣ - ΜΕΤΑΦΟΡΕΣ
επιβάτης	3323epivatis2.avi	επιβάτης (άντρας ή γυναίκα)		3322epivatis.avi	ΣΥΓΚΟΙΝΩΝΙΕΣ - ΜΕΤΑΦΟΡΕΣ
επιγραφή	776epigrafi.avi	επιγραφή			
επιδιορθώνω	531sintiro.avi	επιδιορθώνω, συντηρώ			ΡΗΜΑΤΑ ΕΝΕΡΓΕΙΑΣ
επιδοκιμάζω	2448penevo.avi	επιδοκιμάζω		2451epeno.avi	
επίδραση	323epiroi.avi	επιρροή, επίδραση			
επίθεση	1101epithesi.avi	επίθεση	996amina.avi		

Record: |◄ ◄ 977 ► ►| ►* of 3197

Figure 2: Part of the GSL basic vocabulary DB; synonym and antonym association to video-lemmas.
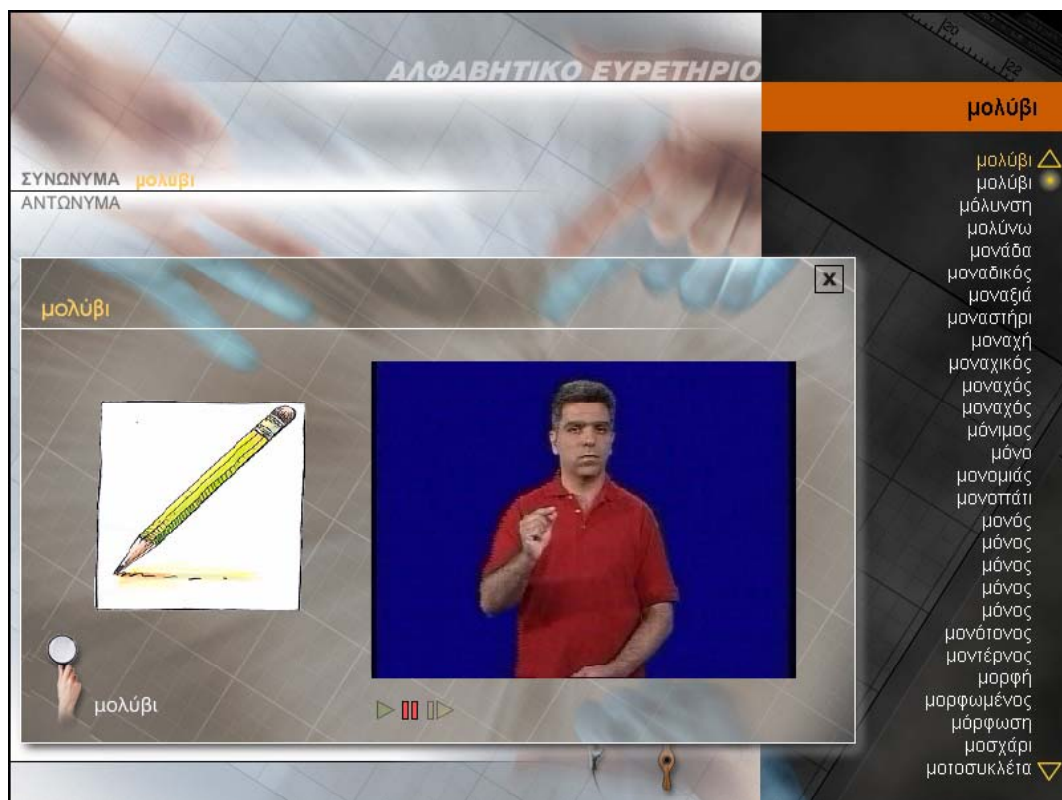
Figure 3: Synonym/antonym screen incorporated in alphabetical search capability.
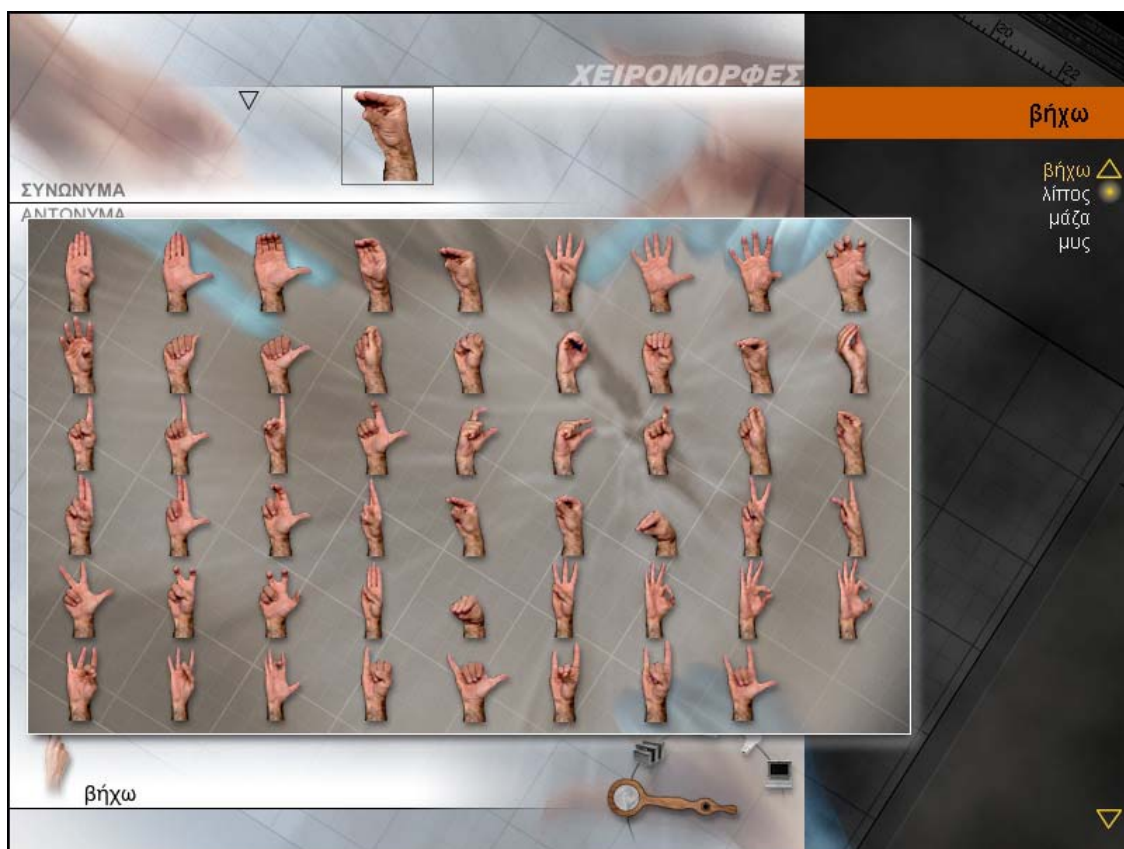
Figure 4: Lemma search by handshape in the GSL – Modern Greek basic vocabulary dictionary.
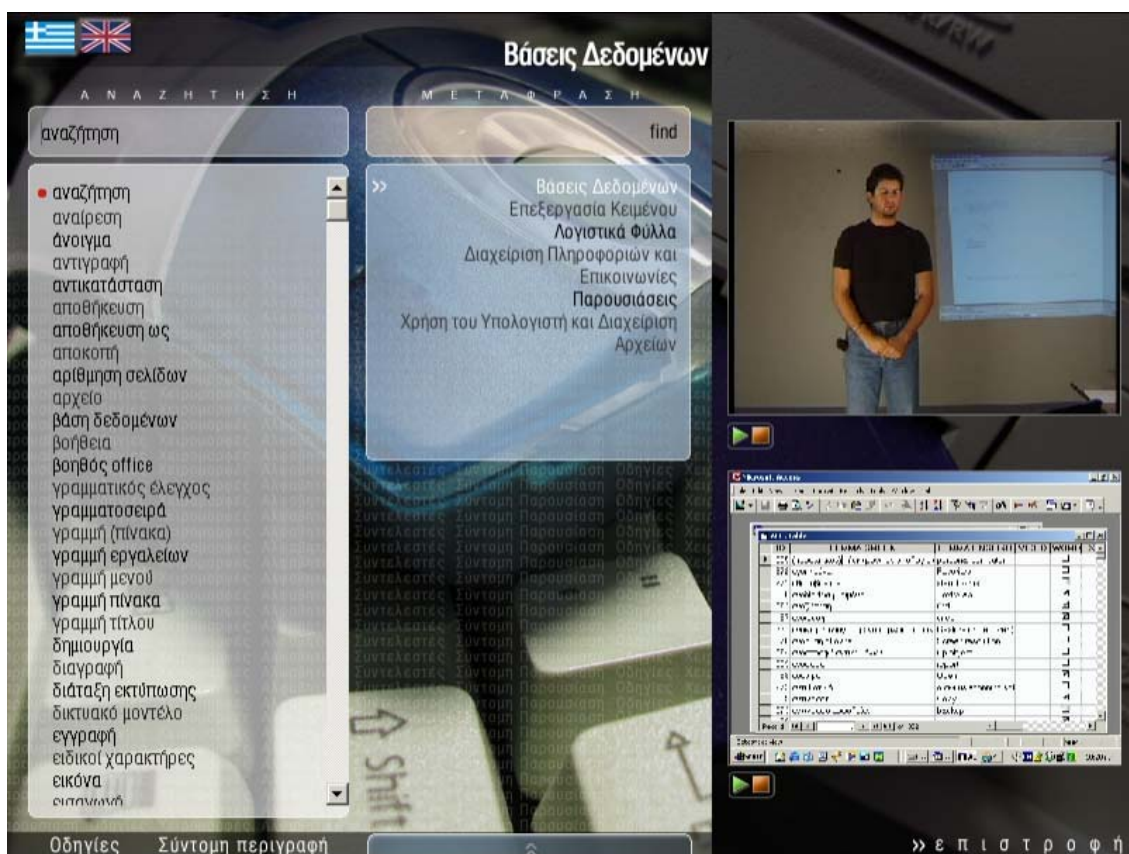
Figure 5: Computer-skills term dictionary: alphabetical search screen.

Figure 6: Association of lemma to sub-area of field in computer-skills terminology DB.