

## The onomasiological dictionary: a gap in lexicography

Gerardo SIERRA, México, México

### Abstract

There is a need for a practical tool to find words from a concept, i.e. to carry out an onomasiological search. An analysis of current tools reveals that there is still a gap that has not been satisfactorily filled by traditional dictionaries or by those dictionaries that offer an onomasiological approach. Current onomasiological dictionaries are inadequate because they do not take into account the fact that the conceptualisations users engage in are different and variable, thus users' clue words do not coincide with those of the lexicographer. We test several dictionaries that can be used for an onomasiological search, and observe that the clue word to obtain a target word is not the same for these dictionaries. Our analysis leads us towards a practical solution beyond the printed dictionary. The on-line onomasiological dictionary presents the advantages of being easily updated and allowing users to look for information via a range of potential routes.

### 1 User needs

Early lexicographers published dictionaries as they thought there was a need for them, without asking about kinds of users or what was really wanted. Today, dictionary design recognises user needs and user skills [Cowie 1983]. However, not even the most complete dictionary can satisfy user needs if users do not know how to consult it or to utilise the information it contains.

Many studies based on direct observation identify user needs and how dictionary users can be helped to carry out diverse operations [Barnhart 1975, Béjoint 1981, Hartmann 1983, Hatherall 1984 and Kipfer 1987]. However, they only show users' preferences among the information available in a dictionary, such as meaning, spelling, usage notes, etc.; they do not show what users might want to find.

In order to identify the full range of user needs, it is necessary to identify and differentiate the objectives that users want to achieve, in terms of the four main linguistic activities: reading, writing, listening and speaking. Reading and listening imply a "passive decoding" state. Writing and speaking are used in "active encoding" [Svensén 1993].

There is general agreement that dictionaries are more frequently needed and used for decoding than for encoding. This finding has led to the compilation of numerous dictionaries to supply the demands of passive decoders. However, findings also show that the use of a dictionary for assistance with writing is very high. [Hartmann 1983] has observed that at least 75% of users need a dictionary for writing purposes, and that more than 50% of users felt regularly frustrated with dictionaries.

Nowadays some dictionaries help to solve the need for encoding, e.g. the Longman Language Activator [Summers 1993]. Unfortunately, when users want to find some word that they are thinking of but whose form they do not remember, rather than a set of possible synonyms or other related words, traditional dictionaries are not very helpful. To satisfy this requirement of

writers, attempts have been made beyond traditional lexicography, through reference tools that offer a concept-oriented approach and so provide help for those users who start from an idea and want to find the right word.

## **2 The onomasiological dictionary**

Many lexicographers recognise users need dictionaries to look for a word that has escaped their memory although they remember the concept. Names for such dictionaries include: ideological dictionary [Shcherba 1995], semantic dictionary [Malkiel 1975], conceptual dictionary [Rey 1977], speaker-oriented lexicon [Mallinson 1979], thematic wordbook [McArthur 1986], nomenclator [Riggs 1989].

Dictionary typologies group these works via several criteria. A first criterion separates "special purpose" dictionaries from general language dictionaries [Whittaker 1966; Svensén 1993]. The emphasis that dictionary typologies give to general language dictionaries over special purpose ones reduces the value of the latter, whose category is so wide that we find an endless number of special purpose dictionaries, covering such topics as etymology, pronunciation, idioms, rhyming, phrases, abbreviations, etc.

A second criterion considers entries in alphabetical vs. non-alphabetical order [McArthur 1986]. The latter can be semantic, systematic, thematic, logical, taxonomic or classificatory. This listing of simple alternatives is much too facile, as it ignores other arrangements, e.g. chronological, indexed, rhyming, reverse and etymological, by frequency and by number of letters. Also, concept-oriented dictionaries can be arranged alphabetically (most have an alphabetical index).

A third criterion refers to semantic point of view [Baldinger 1980]. It takes user needs into account and thus distinguishes dictionaries that serve as aids in encoding from those that help with decoding. The best known dictionaries of this type allow users to find the meaning of a word they already know. Such dictionaries are semasiological: they associate meanings with expressions/words, i.e. within entries we move from word to meaning. The second kind of dictionary helps those users who have an idea to convey and want to find a word to designate it. Such dictionaries are onomasiological: they connect names to concepts, i.e. within entries we move from meaning or concept to name or word.

## **3 Printed onomasiological dictionaries**

Here the term onomasiological dictionary (OD) covers all dictionaries that are used for finding a word from an idea. Its special characteristics are that words are not isolated, but are usually arranged by shared semantic or associated features grouped under headwords.

Wordbooks that aim to satisfy writers who need to go from meaning or concept to a corresponding word can be classified in 4 groups, via the type of information contained, the structure and the type of search undertaken: thesauri, reverse dictionaries, synonym dictionaries and pictorial dictionaries.

### 3.1 Thesauri

Thesauri are the oldest type of OD [Shcherba 1995], with *Roget's Thesaurus of English Words and Phrases* (1852) as the most typical exponent. The macrostructure can be alphabetical or thematic. The microstructure can also be alphabetical or in some systematic order. Such dictionaries have a thematic classification table in which the world is arranged by the authors' points of view. This helps "disoriented users" who do not bring a word to start the search [Casares 1942].

[Hüllen 1986] states that a thesaurus facilitates finding "unknown words" for a given meaning, i.e. the user can find other words related to a given concept. Some lexicographers think thesauri solve writers' requirements. However, studies have shown that it is very frustrating and sometimes almost impossible to find a target word in e.g. *Roget's* as we must search through the conceptual schema of 6 classes, 39 sections and 990 heads. To help users put off by the schema, Roget added an alphabetic index. Most authors think the index is the best entry point for consulting thesauri.

Thus, the usual steps for finding a target word from a concept are: a) to get an approximation to the concept; and b) to choose a clue word to start the search, i.e. homing in on words that characterise the concept and then selecting a small number of words that appear most relevant for a search. However, sometimes users have difficulties in one or both steps [Sierra 1996] as well as in the identification of the exact search words that match with the headwords of the thesaurus.

### 3.2 Reverse dictionaries

'Reverse' is confusing, as it is also used for dictionaries where the arrangement of words is alphabetical from the rightmost letter. The justification of this name for the works discussed here stems from the search process from the concept to the word, instead of the sequence of traditional dictionaries from the word to the concept. Two such ODs, oriented towards encoding, are *Bernstein's Reverse Dictionary* [Bernstein 1975] and *The Reader's Digest Reverse Dictionary* [Reader's 1989].

To find a target word in either dictionary, users think of a concept and a clue word referring to it, then go to the main body of the dictionary, the "reverse dictionary". As the macrostructure is alphabetical, the user goes directly from the clue word to the entry with the target word, without an index. Every clue word has a reduced list of related words following a brief definition for each concept. However, two difficulties arise: there may be no suitable clue word or, if one exists, it may not lead to the target word. The *Digest* suggests trying different clue words, trusting that one of them will get a result. The *Bernstein* has 13,390 entries which can be accessed via approximately 8,000 clue words: about 2 entries for every clue. This is insufficient because there are many ways of thinking of a concept.

### 3.3 Synonym dictionaries

Synonym dictionaries are widely recognised as types of ODs [Malkiel 1975; Svensén 1993; Shcherba 1995]. They contain lists of related words, without any special order in the

macrostructure. Usually, the entries are sorted alphabetically, but the internal list of synonyms, near-synonyms or related words can be grouped alphabetically or otherwise.

Because such tools are oriented to synonyms, instead of concepts, users must think of clue words with a similar meaning to the target word, rather than of associated words leading to the concept. The purpose is to help discover an alternative for the word a person already knows. In this way, users (including second language learners) increase their lexicon. Unfortunately, they are not the most appropriate tools to find a target word expressing a given concept [Sierra 1996].

### 3.4 Pictorial dictionaries

Pictorial dictionaries are superior to other wordbooks, in some respects. As in conceptual dictionaries, the world is arranged in concepts, but each concept can be represented by pictures that illustrate the parts or species corresponding to the concept; a word then indicates the name of the part or the species. Definitions are unnecessary because there is a direct relationship between name and object. Plates illustrate the vocabulary of a whole subject which is grouped in a classification. There is usually an alphabetic index to enable searching from word to object and identifying related words.

Such works help find a forgotten target word because their onomasiological approach permits the user to look up an image of the concept and find the target word. However, it is important to keep in mind limitations to the visual representation of concepts, as they are only suitable for physical objects and their parts or species that can be represented visually.

### 3.5 Contrastive analysis

The above ODs try to solve the problem of looking for a word when only the concept is known. Differences in size, content, type of searching and way of presentation yield different results. Thus, we now investigate the performance of each tool and determine if it fulfils user needs.

We consider here: a thesaurus, the Internet *Roget's* [Olsen 1997]; 2 reverse dictionaries, the *Bernstein* and the *Digest*; and a synonym dictionary, the *Chambers*. To enrich the evaluation, the Internet version of *WordNet* [Peterson 1996; Fellbaum 1998] is also analysed, as it can be considered as a mix of thesaurus and synonym dictionary. Pictorial dictionaries were discarded because of their encyclopaedic nature and their limitation to images, stated above.

Our analysis assumes a user looking for several target words, sequentially, and thinking of clue words for each search (Table 1). Target words were chosen at random. Clue words in the sample were extracted from definitions but restricted to those that allow us to conduct the contrastive analysis. Thus, a clue word must lead to a target word in at least one of the analysed dictionaries besides *Roget's*, in which, because of its size, we are likely to find a target word from multiple clue words.

For a given user query (e.g. from the clue word 'death'), a successful result means retrieving the target word ('euthanasia'). From the table, we confirm the well known observation that the organisation of the world varies from author to author. E.g., in spite of the size of *Roget's*, some clue words did not lead to the target word, even when they were typical for the other dictionaries

Target word	Clue word	Roget's	WordNet	Bernstein	Digest	Chambers
Euthanasia	death	+	+	+	+	
	killing	+	+		+	
	mercy			+	+	
	suicide		+			
Monopoly	control	+	+		+	
	exclusive	+		+	+	+
Aberration	behaviour	+			+	
	derange	+		+		+
	deviation	+	+	+		+
	insanity	+				+
	lapse				+	+
	mental	+		+	+	
Hilarity	fun		+		+	
	gaiety		+	+		+
	laughter	+			+	+
	merriment	+	+			+
	noisy			+		
Barometer	air	+				
	measure	+	+			
	pressure				+	

Table 1: Successful queries

(e.g. ‘gaiety’ → ‘hilarity’). In the case of *Digest*, there are 71 measure devices given from the clue word ‘measure’, but not including ‘barometer’.

There are moreover several ways to express a word, and the analysis confirms this. The ODs were tested by expanding the search from several clue words. The assumption of the clue word to get a target word is not the same for the dictionaries. We conclude there is a lack of good printed dictionaries to provide help for users who start from an idea and want to find the right word, and that it would be very difficult to create such works. The best solution is to go beyond printed dictionaries.

## 4 On-line onomasiological dictionaries

Paper dictionaries have limitations that, thanks to computational lexicography, can today be avoided. An on-line dictionary is more up-to-date and more easily updated than a printed book. On-line dictionaries allow users to look for information via a range of potential routes.

It has been shown that machine readable dictionaries (MRDs) which are conventional semasiological dictionaries (SDs), can be used for onomasiological searches. This is based on the assumption that SDs have the necessary information in the first place. A dictionary is a matrix that maps between words and senses; an on-line dictionary can be entered via words or senses and a word can be found by following semantic links [Kipfer 1986]. E.g., if a user needs the

word expressing a group of ducks ('flock'), he can check the entry for 'duck'. A MRD can be used as an OD when seeking a word whose definition contains the "search key" [Calzolari 1988]. The output can be an alphabetic list of words or lists of words according to concepts, as in a thesaurus. In MRDs, we can also extract "canonical forms" from "natural language definitions".

#### **4.1 DEBO**

The name *DEBO* stands for "Diccionario Electrónico para la Búsqueda Onomasiológica" and translates as Electronic Dictionary for Onomasiological Searching. Its purpose is to help users find a word when they only have the concept, expressed in natural language. The prototype was elaborated for searching 33 terms in the domain of destructive phenomena which are taken from a Mexican conceptual framework on the topic of Disasters [Sierra 1995].

The system shows a first window which allows the user to use natural language to present an idea or concept related to 33 terms that he does not know how to designate correctly. A second window appears displaying a set of suitable terms for the input concept.

The system reads the clue words and matches them via an inverted file to identify the possible terms. It gives a weight to the clue words, according to the paradigms belonging to the term. It does not read negative functional words, such as "no" and "neither", so that antonyms appear for the same concept, e.g. "flood" and "drought".

The identification of the 835 clue words was hand-elaborated, based mainly on definitions and the conceptual framework of disasters, supported by experts and the context given by the literature [Sierra 1997]. It is anticipated that the identification of clue words for a bigger corpus will be very difficult for human selection and processing.

The prototype was tested successfully on several kinds of users: children, adults; laymen, academics, experts. Fails were due to the fact that some users thought in associated concepts, rather than in the concept of the term. For example, some queries for the target word "flood" were expressed as "bridge" or "ship", even though there is not a direct relationship between them. A likely reason is that users knew both the restricted domain of the system and the possibility to enter "any idea". Few fails occurred because of a lack of relevant clue words in the database.

#### **4.2 Casey's Snow Day Reverse Dictionary**

The most recent multi-user on-line OD, that can be consulted via a Web page, is *Casey's Snow Day Reverse Dictionary* [Faber 1996]. It claims to solve the problem of the user who does not remember a word but who can describe what he is looking for. The user submits the query in a window using natural language, either a definition, a question or a set of words. The system matches the input text and the database definitions through a n-gram analysis [Frakes 1992]. The output is a list of up to 48 single terms, apparently sorted according to a similarity measure of occurrence of n-grams.

Searches were carried out to test the efficiency and performance of the dictionary. Mostly, the expected words were not output, and only a few of the 48 words were related to the concept queried. Variations of the same definition were input to analyse differences in results, when

Q1:	a device used to measure air pressure
Q2:	a device used to measure atmospheric pressure
Q3:	an instrument used to measure atmospheric pressure
Q4:	an instrument for measuring atmospheric pressure
Q5:	an used instrument to measure pressure atmospheric
Q6:	advice for measuring the pressure of the atmosphere
Q7:	measures atmospheric pressure
Q8:	atmospheric pressure
Q9:	pressure of the atmosphere
Q10:	determining the pressure
Q11:	an instrument for determining the atmospheric pressure
Q12:	an instrument for determining the weight or pressure of the atmosphere
Q13:	a device for determining the pressure of the atmosphere

Table 2: Queries for the target word ‘barometer’

searching for ‘barometer’ (Table 2). Query Q5 is not grammatically well constructed, but is a variation of Q3.

A hit for a query is when the target word appears anywhere in the list of 48 words. Queries Q1 to Q8 were unsuccessful. Only queries Q9 to Q13, where the clue word ‘measure’ is not included, are successful. Even when query Q8 is near to Q9, one has a hit, located at number 38 in the list, while the other does not. However, the most valid findings are that the system restricts the search to the input word without reference to synonyms. The system will e.g. output one list for the word ‘device’ and another for ‘instrument’. We note also the difference between the clue words ‘measure’ and ‘determine’ which leads to success or failure in finding the target word.

## 5 Outline of an onomasiological dictionary

An onomasiological dictionary can be considered as an information retrieval system, as it provides the user with the data that satisfy his information need. The lexical knowledge base (LKB) of such dictionary can be stored either as an inverted file or full-text database. The former means a structured database containing an indexed vocabulary of keywords, with each keyword having links to the items that carry the corresponding clue words given in the query. An example is the DEBO prototype, which consists of an index of indexes, hierarchically co-ordinated, resulting in various databases, each with its own index. The latter contains unprocessed texts and do not require an index of keywords. As in the case of the Casey’s dictionary, the text is processed during retrieval to see if it contains the words given in the query.

[Calzolari 1988] suggests the use of dictionaries as full-text databases for practical terminological searching, because dictionaries can populate a database, either via using a machine readable dictionary or via scanning or capturing a printed dictionary. In full-text databases, the attributes used to identify a set of terminological data might be the head of a dictionary entry, the meanings

or definitions of each entry, as well as the etymology, examples and encyclopaedic information. Moreover, as stated above, nowadays most of the dictionaries available on CD-ROM offer the user an onomasiological search facility.

## 5.1 Expanded searching

The success of an onomasiological search relies upon the accuracy of all clue words in the concept that might represent the target word the user is looking for. Since the user often does not employ precisely the same terminology as the indexed keywords or stored full-text database, the retrieved words may be far from the concept desired. As a result, it has been found advantageous to automatically expand the original query with closely related keywords [Fox 1988].

The best known approach to expand a search is to assign all morphological variants or inflected forms to the same word. As a result, every keyword is automatically reduced to a *stem* or *lemma*. For inverted files, this technique allows compression of the database file and expansion of the initial query keywords. As a result of stemming the words of the query, the original keywords are mapped to the file of index stems, and the system will retrieve the items corresponding to the stem. Conversely, for full-text searching, the main goal of stemming is to expand the search to the cluster composed of all the variants of the morphological paradigm. The query clue word is substituted by all these variants and every one is used to search in the full-text database [Calzolari, Picchi & Zampolli 1987].

Since searching is an iterative process, when the result is not satisfactory the user can expand the query with closely related keywords which enhance the meaning, such as alternative forms, synonyms or cross-references. In addition to the user's own knowledge of expressing the same concept in alternative ways, a relational thesaurus brings related words together and thereby helps to stimulate his memory. Some systems provide an on-line thesaurus as a facility for the user in this regard. In order to help the user focus on the search, it is convenient that the system produces and manages the semantic paradigms transparently, without any intervention by the user [Calzolari, Picchi & Zampolli 1987]. In fact, this should be a goal of a user-friendly onomasiological search system.

Therefore, the success of an onomasiological dictionary relies on the accurate identification of the semantic paradigms. In this way, [Sierra/Mc Naught 2000] have built a prototype tool to construct the semantic paradigms by aligning definitions from two language dictionaries. The method relies on the assumption that two authors use different words to express a definition. The alignment matches the words of two definitions and shows the correspondence between words that can replace each other in the definition without producing any major change of the meaning. The difference in words used between two or more lexicographic definitions enables us to infer paradigms by merging the dictionary definitions into a single database and then using our own alignment technique.

## 5.2 Searching the words

The user process to access information in the database file through the formal statement of information needs is called searching. The use of natural language queries has been developed in information retrieval systems in order to give greater facilities to the user. Natural language

seems more "natural", since the user can input without syntax restrictions, sentences, paragraphs, phrases, a set of keywords, or a combination of the above. In fact, the goal for onomasiological searching is to let the user input natural language queries. A natural language system does not necessarily "understand" the user's input, since it may, for example, just extract those words which are not in a stop list and connect them by the usual Boolean operators.

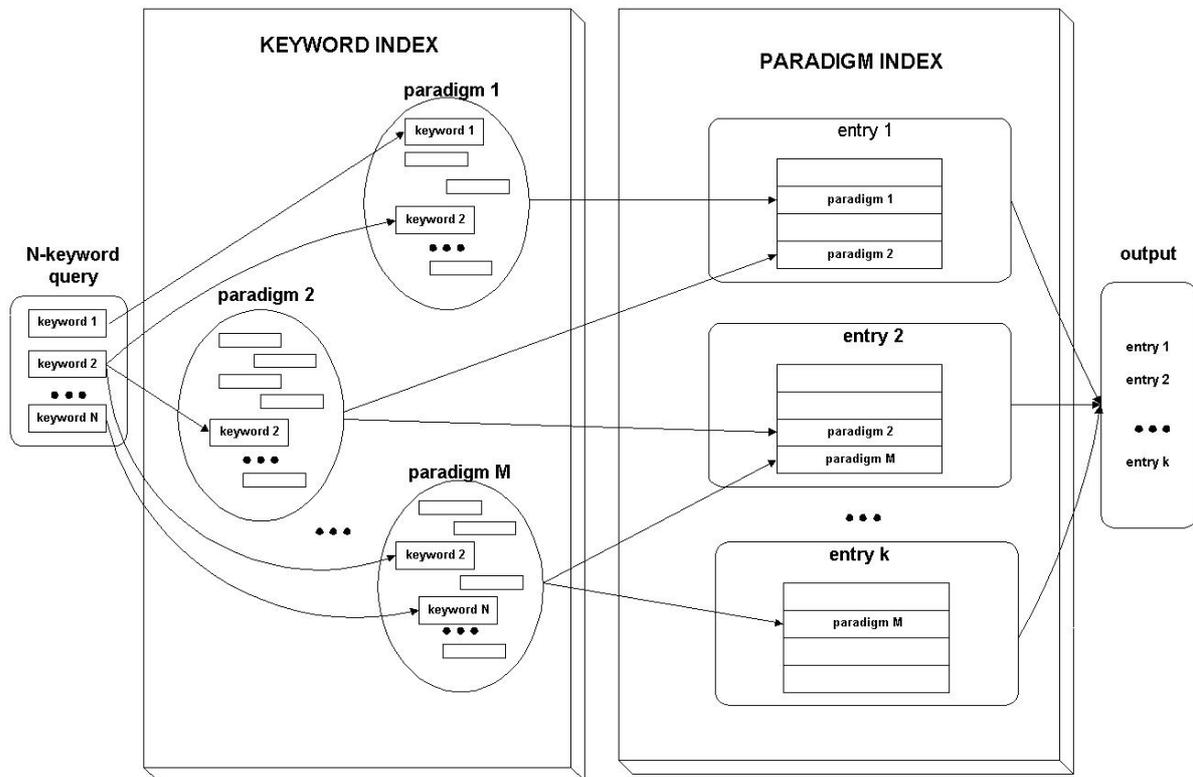


Figure 1: Inverted file for an onomasiological search

In an inverted file for an onomasiological search, each entry might be represented by a collection of index paradigms, and similarly the paradigms may be assigned to one or more keywords. When the user inputs the description of the concept, the system matches it in the database of indexed keywords in order to differentiate, among those entered by the user, relevant words from non-relevant function words. After the relevant words of the concept are identified as keywords, the system identifies the semantic paradigms that match with those keywords. Then the inverted file assigns each entry to one or more paradigms (Fig 1).

According to [Wilks et al 1996], an onomasiological search may be carried out on a dictionary, as a full-text database, through a Boolean combination of keywords. This assumption allows us to avoid the construction of an inverted file, which requires us to determine the keywords associated with each concept. Each clue word in the query is replaced by a cluster composed of all the members of the paradigm wherever the clue word appears. The members are used as keywords to search in the definitions. Because of the extension of the original query to a large set of keywords with the paradigms, a search is suggested in a similar way to the quorum

function [Cleverdon 1984]. Given a query associated with  $N$  paradigms, a word has a hit for each paradigm occurring in the entry and a score equal to the sum of the hits. Finally, the output ranks scores in decreasing order. The first level corresponds to the highest score, which could be less than or equal to  $N$ . The second level corresponds to the next lower score and in this way consecutively up to the lowest level which corresponds to a score of one.

### 5.3 Ranking the results

The onomasiological dictionary establishes the frequency of occurrence of the terms across the selected paradigms and displays or prints out a list of terms in order of frequency of occurrence. According to the search process, it is expected that the term with the highest score is the term the user was looking for. However, as it is difficult to specify exactly only one term in order to designate some keywords, which are commonly contained in several concepts, the display of less frequent terms may also be of interest to the user. Therefore, as a sequential display of terms according to their rank is preferable to an immediate and large list of terms, even when they present an order of relevance, we suggest a function 'more' to display the terms sequentially in rank order.

On the other hand, it is convenient to have a structured presentation of terms according to relationships in the context of onomasiological search. A user expresses a concept by a set of properties, but each one usually refers to other concepts and even that concept can designate a diverse and manifold set of terms. Thus, the presentation of conceptual relationships, instead of a single list of ranked terms by frequency of occurrence, becomes essential to allow the user to identify easily a term related to many others. Although we have shown the drawbacks to using WordNet as an onomasiological dictionary, there is the possibility of using the lexical relationships of WordNet for organising the terms retrieved by the system. Given a set of retrieved terms for a particular concept introduced by the user and the purpose to organise this set in associative chunks by using the relationships in WordNet, this set is considered a subset of the WordNet database. For two words  $A$  and  $B$  of the subset, word  $A$  is associated with word  $B$  if word  $A$  belongs to the synset of  $B$  in whatever category, either as synonym, hyponym, hypernym or coordinated term. Once the subset is divided in chunks, we can consider the head of each group as being any of the terms that has the highest score according to the search process.

## 6 Conclusion

The distinction made by linguistics between "active encoder" and "passive decoder" allows us to characterise the different types of dictionaries in order to focus on onomasiological type. We have surveyed common dictionaries intended to help writers and speakers to express an idea when a word is forgotten, as well as the few attempts to create new kinds of ODs.

Conventional, general language ODs, like language thesauri and synonym dictionaries not restricted to a domain, fulfil their purpose when speakers or writers need "to identify the most appropriate word already in our lexicon to express a particular idea" [Riggs 1985]. However, these dictionaries are not oriented towards finding the target word for a given concept. These dictionaries only allow writers to look for words in general, not for specific words, i.e., those which a writer may be said to have "on the tip of the tongue".

The organisation of human knowledge differs from author to author, so that it is impossible to arrive at a universal schema for ordering the words in the world. The arrangement of ODs is always controversial and users can choose one over others, and can even vary their preferences according to the topic or the kind of word they are looking for.

The ideal onomasiological search must allow writers to input the concept to be searched through the ideas they may have, using any words in any order. The system must be so constructed that it accepts a wide range of words which it then analyses in order to point the user to the word that most closely approaches the concept he had in mind when he started the search. An outline of an onomasiological dictionary was suggested and a research is currently underway at Universidad Nacional Autónoma de México (UNAM) to provide such a system, based on the observations and conclusions of the study reported on here.

## References

- [Baldinger 1980] Kurt Baldinger: *Semantic theory: towards a modern semantics*, (Oxford: Basil Blackwell) 1980.
- [Barnhart 1975] C.L. Barnhart: "Problems in editing commercial monolingual dictionaries". In F.W. Householder and S. Saporta (Eds.): *Problems in Lexicography*, (Bloomington: Indiana University) 1975.
- [Béjoint 1981] Henri Béjoint: "The foreign student's use of monolingual English dictionaries: A study of language needs and reference skills". *Applied Linguistics* 2 (3), 1981, 207-222.
- [Bernstein 1975] T.M. Bernstein: *Bernstein's reverse dictionary*, (London: Routledge & Kegan Paul) 1975.
- [Calzolari 1988] Nicoletta Calzolari: "The dictionary and the thesaurus can be combined". In M.W. Evens (Ed): *Relational models of the lexicon: representing knowledge in semantic networks*, (Cambridge: Cambridge University Press) 1988.
- [Calzolari, Picchi & Zampolli 1987] Nicoletta Calzolari, Eugenio Picchi & Antonio Zampolli: "The use of computers in lexicography and lexicology". In A. Cowie (Ed.): *Lexicographica: the dictionary and the language learner*, (Tübingen: Max Niemeyer Verlag) 1987.
- [Casares 1942] Julio Casares: *Diccionario ideológico de la lengua española*, (Barcelona) 1942.
- [Cleverdon 1984] C. Cleverdon: "Optimizing convenient online access to bibliographic databases". *Information Services and Use* 4(1-2), 1984, 37-47.
- [Cowie 1983] A.P. Cowie, "The pedagogical/learner's dictionary: I. English dictionaries for the foreign learner". In R.R.K. Hartmann (Ed.): *Lexicography: Principles and Practice*. (London: Academic Press) 1983.
- [Faber 1996] V. Faber: "Casey's snow day reverse dictionary (and Guru)", (Los Alamos National Laboratory) 1996, Web page <http://www.c3.lanl.gov:8064/>.
- [Fellbaum 1998] Christiane Fellbaum (Ed.): *WordNet: An Electronic Lexical Database*, (The MIT Press) 1998.
- [Fox 1988] Edward A. Fox: "Improved retrieval using a relational thesaurus for automatic expansion of extended Boolean logic queries". In M.W. Evens (Ed.): *Relational Models of the Lexicon*, (Cambridge: Cambridge University Press) 1988, 199-210.

- [Frakes 1992] W.B. Frakes: "Stemming algorithms". In W.B. Frakes and R. Baeza-Yates (Eds): *Information Retrieval: Data Structures & Algorithms* (N. Jersey: Prentice Hall) 1992, 131-60.
- [Hartmann 1983] Reinhard R.K. Hartmann: "The bilingual learner's dictionary and its uses". *Multilingua* 2/4, 1983.
- [Hatherall 1984] Glyn Hatherall: "Studying dictionary use: some findings and proposals". *Lexicographica* 1, 1984, 183-189.
- [Hüllen 1986] Werner Hüllen: "The paradigm of John Wilkins's thesaurus". In R.R.K. Hartmann (ed): *The History of Lexicography* (John Benjamins Publishing Company) 1986, 115-23.
- [Kipfer 1986] Barbara Ann Kipfer: "Investigating an onomasiological approach to dictionary material". *Dictionaries: Journal of the Dictionary Society of North America* 8, 1986, 55-64.
- [Kipfer 1987] Barbara Ann Kipfer: "Dictionaries and the intermediate student: communicative needs and the development of user reference skills. *Lexicographica* 17, 1987, 44-54.
- [Malkiel 1975] Yakov Malkiel: "A typological classification of dictionaries on the basis of distinctive features". In F.W. Housholder and S. Saporta (Eds.): *Problems in Lexicography*, (Indiana University) 1975.
- [Mallinson 1979] G. Mallinson: "The dictionary and the lexicon: a happy medium?" In R.R.K. Hartmann (ed): *Dictionaries and their users*, (Exeter: University of Exeter) 1979.
- [McArthur 1986] Tom McArthur: "Thematic lexicography". In R.R.K. Hartmann (Ed.): *The history of lexicography*. (John Benjamins Publishing Company) 1986, 157-166.
- [Olsen 1997] M. Olsen: "ARTFL project: ROGET'S thesaurus, 1991 edition". (University of Chicago) 1991, Web page [http://humanities.uchicago.edu/forms\\_unrest/ROGET.html](http://humanities.uchicago.edu/forms_unrest/ROGET.html).
- [Peterson 1996] G. Peterson: "WordNet 1.5 vocabulary helper", (Kyoto: Notre Dame Women's College) 1996, Web page <http://www.notredame.ac.jp/cgi-bin/wn.cgi>.
- [Reader's] *Reader's Digest reverse dictionary*, (London: The Reader's Digest Association Limited) 1989.
- [Rey 1977] Alain Rey: *Le lexique images et modèles: du dictionnaire a la lexicologie*, (Paris: Librairie Armand Colins) 1977.
- [Riggs 1985] Fred W. Riggs: *Ethnicity, Intercocta glossary*, (Hawaii: University of Hawaii) 1985.
- [Riggs 1989] Fred W. Riggs: "Terminology and lexicography: their complementarity". *International Journal of Lexicography* 2/2, 1989.
- [Shcherba 1995] L.V. Shcherba: "Towards a general theory of lexicography". *International Journal of Lexicography* 8(4), 1995, 314-350.
- [Sierra 1995] Gerardo Sierra: "Outline of an onomasiological dictionary software in the disaster area". *J. of the International Institute for Terminology Research IITF* 6/2, 1995, 18-30.
- [Sierra 1996] Gerardo Sierra: *Bases para la búsqueda onomasiológica de términos*, Msc Thesis, (Mexico: UNAM) 1996.
- [Sierra 1997] Gerardo Sierra: "Estructura sema semántica del léxico en un diccionario onomasiológico práctico". *Estudios de Lingüística Aplicada* 23/24, 417-425.
- [Sierra/Mc Naught 2000] Gerardo Sierra & John McNaught: "Extraction of Semantic Clusters for Terminological Information Retrieval from MRDs. In *Proc. 2nd International Conference on Language Resources and Evaluation*, Athens, 2000.

[Summers 1993] Della Summers: *Longman Language Activator*, (Longman Group) 1993.

[Svensén 1993] Bo Svensén: *Practical lexicography: principles and methods of dictionary-making*, (Oxford: Oxford University Press) 1993.

[Whittaker 1966] K. Whittaker: *Dictionaries*, (London: Clive Bingley) 1966.

[Wilks et al 1996] Yorick A. Wilks, Brian M. Slator & Louise .M. Guthrie: *Electric words: dictionaries, computers and meanings*, (Cambridge: ACL-MIT Press) 1996.

