

# Dictionary users in the digital revolution

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## Abstract

This contribution examines the digital revolution in lexicography from the perspective of the dictionary user. We begin with an observation that in the information age the status of the dictionary is changing, and so are patterns of user behaviour, with general internet search engines encroaching on the grounds traditionally reserved for lexicographic queries. Clearly, we need to know more about user behaviour in the digital environment, and for this we need to harness user research, to find out how the increasingly flexible and adaptive lexical reference tools of the future need to behave to best accommodate user needs. We summarize the existing findings and show in what ways digital dictionaries are already able to serve users better than their paper predecessors. The challenge to produce efficient and effective dictionaries is best seen in the context of dictionary users' reference skills, which now tend to overlap with digital literacy. We conclude with a possible vision of the future.

## I. Dictionaries and their users

For many centuries, dictionaries were viewed with authority, often admired and revered with awe, and the status of 'the dictionary' in some countries could be likened to that of the lay Bible. The high level of respect was no doubt due, at least in part, to the ties of lexicography with scholarship and education. Dictionaries were widely perceived as providing 'received' knowledge, and their authority was rarely questioned. This relationship was one which, apparently, both lexicographers and dictionary users seemed quite happy with.

In view of this, it is hardly surprising that compilers of dictionaries gave little thought to the cognitive abilities of their users: the task of deciphering the often cryptic lexicographic content was one that the user was burdened with, and few blamed the dictionaries if users could not quite cope with the idiosyncrasies of lexicographese. Rather, when dictionary users ran into obstacles while consulting dictionaries, they tended to blame themselves rather than the work.

Tradition reigned supreme and there was, in fact, not much point in asking the users what they wanted from their dictionaries, because this expectation was largely determined by their experience with lexicographic products up to that point. Centuries of lexicography saw a lot of repetition, including wholesale copying of dictionary content; change, if any, was slow and painful.

If there ever was a revolution in lexicography, then it was in these attitudes towards dictionaries, but the impetus seemed to come, not so much from within lexicography, but rather from the introduction of computers and, soon after, the internet into people's daily lives. As dictionaries moved from the bookshelves gradually onto floppy disks, optical disks, internet servers, and now mobile devices, they found themselves as it were in the same league as utility and productivity software, which in turn encouraged a more pragmatic and less ideological or dogmatic view of dictionaries. This trend was only strengthened as users themselves started getting involved in bottom-up dictionary-making. As a result of these developments, dictionaries — which have always been inherently practical — have now come to be recognized as even more practical. Meanwhile, parallels have arisen between searching for encyclopaedic information in general search engines, and searching for lexical information in digital dictionaries. However, there is also a clear tendency by internet users to search for lexical information in general search engines, as evidenced from dictionary websites recording an increasing proportion of search queries redirected from search engines (Lorentzen and Theilgaard 2012). This, of course, testifies to the advanced state of the algorithms underlying search engines, as they are in effect able to differentiate between general and lexical search queries. Internet users realize that the search engines are doing a good job, and learn to depend on them.

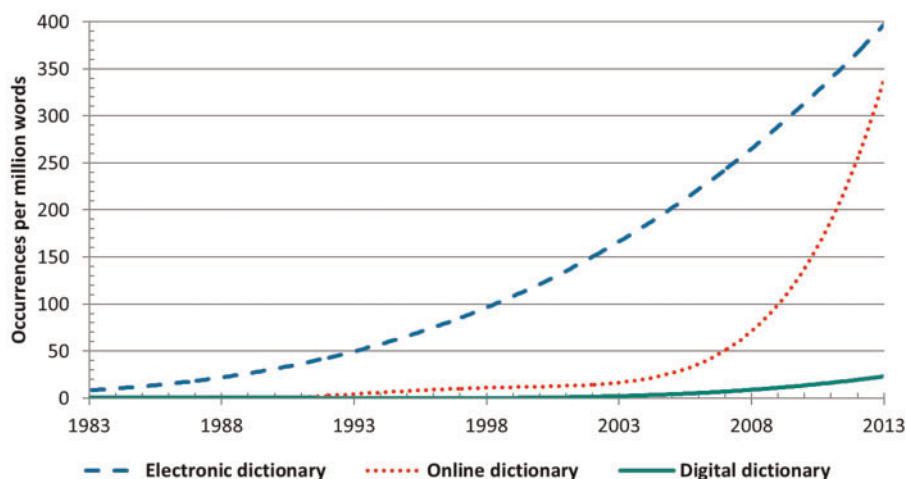
## 2. Questions of terminology: electronic or digital dictionaries?

The most popular and broadly used term thus far for digital-media dictionaries has been electronic dictionaries, sometimes abbreviated as e-dictionaries. Etymologically speaking, *electronic* suggests the involvement of electronic circuitry. A factor working in favour of the term *e-dictionaries* was the spike of productivity of the *e-* prefix at the break of the century (McDonald 2005), with terms such as *e-mail*, *e-commerce*, *e-book*, *e-learning*, or *e-government* spreading through English vocabulary (and well beyond). Although a clipping of *electronic*, this prefix does seem to have a broader denotation than just a reference to electronic circuitry, as is apparent from the other *e-*terms, where it generally implies a digital version of a traditional concept.

Modern dictionaries in the form of apps or online services are probably better seen as collections of structured data and code, rather than hardware. For this reason, it may be questioned whether *electronic*, although somewhat established in this context, is really the best term. Instead, the adjective *digital*

(as in *digital humanities*), may be seen as better describing the concept. Perhaps it makes sense to adopt *digital dictionaries* as the cover term, and reserve *electronic dictionaries* for autonomous devices where the hardware only hosts lexicographic applications, as in the many handheld portable dictionaries particularly popular in East Asia.

Given that very few of today’s handheld devices are true stand-alone applications—think mobile phones with dictionary services, or smartphones and tablets with their dictionary apps—De Schryver’s (2003: 150) three-step access dictionary typology is in need of an update. Reassigning terms within the lexicographic community may not be easy, even though changes are already underway. This may be seen from Figure 1, which shows the occurrence frequencies for ‘electronic dictionary’, ‘digital dictionary’ as well as ‘online dictionary’ in a corpus of over 5,000 lexicographic articles and books, totalling about 30 million tokens in all. This lexicographic corpus is representative of the scholarly activity within our field of the past three decades, is balanced in terms of text genres (journal articles, monographs, edited collections, handbooks, festschriften, conference proceedings, etc.), in terms of metalexicographic theories (with ample coverage of the output from Heidelberg, Århus, etc.), as well as in terms of continents and languages covered (from English, German, French, etc., to Afrikaans, Chinese, Japanese and Korean). The three search terms thus actually sum the lemmatised frequencies in the various languages (e.g. for ‘electronic dictionary’, also ‘elektronisches Wörterbuch’, ‘dictionnaire électronique’, etc., ‘elektroniese woordeboek’, ‘电子词典’, ‘電子辞書’ and ‘전자 사전’).



**Figure 1:** Trendlines for ‘electronic / online / digital dictionary’ in a 30-million-word lexicographic corpus (for more on this corpus and the search terms, see addenda 1 and 2).

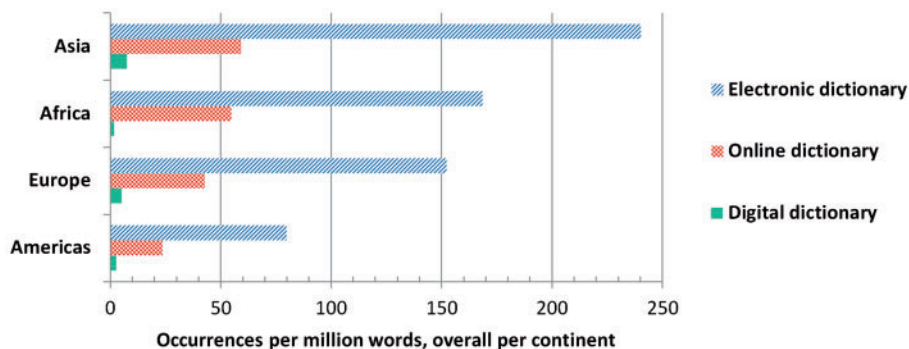
The term ‘electronic dictionary’ has clearly prevailed over ‘digital dictionary’, although the latter has not been entirely absent, and has actually begun to be used in earnest over the past two to three years. Perhaps even more revealing is the trendline for ‘online dictionary’, which at the current rate will overtake, in the scholarly lexicographic literature, the more general ‘electronic dictionary’ in just a few years’ time. It can indeed be predicted that it will soon be hard to find a digital dictionary that will not be in one way or another connected to servers in the cloud.

It is generally assumed that digital dictionaries are not only more frequently used in the East, but consequently also more frequently discussed in the Asian lexicographic literature. This assumption is confirmed in Figure 2, which somewhat surprisingly also indicates that the second most frequent region for the discussion of all lexicographic matters digital is Africa (and thus especially the journal *Lexikos*).

### 3. Relevance of user research for digital dictionaries

The aim of dictionary user research is to study how human users interact with dictionaries with the aim of making this interaction more effective (improving success), more efficient (faster), and more satisfying (pleasant to use). Of course, some of us are also simply interested to know how dictionaries are being used, without any further goals. While many findings from user studies are useful for dictionary design, user research has tended to concentrate on academic and educational contexts, but much less is known about the dictionary-related behaviour and preferences of dictionary users other than language learners (professional translators, journalists, lawyers, laypeople, etc.).

Dictionary user research is all the more relevant in digital dictionaries compared to traditional print products, as accommodating the findings of empirical research is normally easier, cheaper, and quicker than was the case



**Figure 2:** Continental distribution in the scholarly lexicographic literature of the terms ‘electronic / online / digital dictionary’.

for printed books. In print publications, any changes to lexicographic content or its presentation had to wait at least until the next edition was typeset and printed. Further, owners of paper copies would not usually be expected to purchase an updated edition every few years, so even if improvements had been made, users would still be stuck with the earlier version which they already had on their bookshelf. Likewise, dictionaries on optical media (CD-ROM, DVD-ROM, USB stick, etc.) or standalone handheld dictionaries are not that easily upgraded. Not so with modern digital publication. Online dictionaries as well as dictionary apps can be updated as often as needed, and all users can instantly benefit from the improved content or features right from the moment these become available.

Dictionary user research may for instance reveal those words users search for that are missing from the dictionary (De Schryver and Joffe 2004). In the print-dictionary age, one of the main motivations for updating dictionaries was to accommodate new vocabulary that had entered the language since the publication of the previous version. This usually involved painful decisions as to how to achieve this without the printed volumes overshooting their target size. Improved typographic design helped somewhat, but in the end the editors usually had to grapple with the dilemma of what to sacrifice in order to make space for the new items. The digital revolution has changed that, and now items are in fact very rarely removed when digital dictionaries are updated.

Dictionary user research can also help guide decisions related to the presentation of lexicographic data and dictionary interface design. However, it takes some time to design a study, collect, analyse, and interpret the data, before its findings can become a factor in updating a digital dictionary. In contrast, the concept of Simultaneous Feedback as proposed by De Schryver (1999, 2010) provides a shortcut through the process, by having user behaviour influence the presentation of lexicographic data through a direct feedback loop. Similar thinking is echoed in Varantola (2002: 31), who called for ‘a dictionary that will always adapt to my needs and always be ready to provide me with exactly the answer that I need and will also agree with.’ Varantola is furthermore also aware of the limitations of users expressing conscious choices when she adds that the dictionary should further be able ‘to give satisfactory answers to those questions that I forget to ask.’

It should be clear though that the potential of Simultaneous Feedback lies in complementing rather than entirely replacing user research. This is because any integrated feedback mechanism is restricted to those user choices that are made while using the actual dictionary, but in principle a much greater range of options can be tested than users can provide feedback on as part of live dictionary use. More importantly perhaps, not all conscious choices made by dictionary users are reasonable or work to their advantage. For example, in Lew and Doroszewska (2009) dictionary users frequently elected to view animations despite the fact that doing so had a significantly negative effect on the success of their consultation, of which they were completely unaware.

#### 4. What do users expect from digital dictionaries?

We do not have answers yet to this question for all types of digital dictionaries, but we are beginning to have an idea for online dictionaries. Declarations as to what users expect of online dictionaries were elicited in a large-scale online survey by Müller-Spitzer et al. (2012). Responses from nearly 700 German- and English-speaking participants gave the highest ratings to dictionary content being reliable and up to date, as well as to the clarity of presentation—all of the above being traditional lexicographic criteria. By contrast, features typical of digital dictionaries, specifically adaptability and multimedia, received the lowest ratings.

These findings can be explained in at least four ways. First, the conservative view of lexicography may still be going strong. Second, since the participants were recruited via channels related to academia, the respondents may have felt an urge to counterbalance in their ratings what they may have seen as uncritical adoption of novelty. Third, one cannot deny that shortcomings in reliable dictionary content can hardly be made up with an efficient interface. Conversely, it is easier to put up with a sub-optimal interface as long as the content is without fault. Fourth, low ratings of adaptability and multimedia may be the result of poor familiarity of the participants with modern features of digital dictionaries.

This last possibility was followed up in another study, also reported in Müller-Spitzer et al. (2012), in which some participants were presented with material explaining and illustrating these new features. Ratings of new features by those participants who received the instructional material indeed improved compared to those with no access to the material, although only to a modest degree (half a point on a seven-point Likert scale).

#### 5. The digital advantage

Quite a few studies have been undertaken to compare the effect of the dictionary medium on success in language comprehension, production, and vocabulary learning. These studies are somewhat difficult to operationalize, as it is not altogether clear how exactly the effect of medium should be rendered in an experimental setup. The problem is brought into focus in a series of studies comparing paper and digital dictionaries conducted by Dziemianko (2010, 2011, 2012, in preparation). Even though a similar research design was used and comparable groups of users were recruited as participants, findings vary quite markedly from one study to another. This may be due to several confounding factors. For example, pressures to save space are usually more pronounced in print dictionaries than in their digital versions (at least on the large-screen devices which were used by Dziemianko; small-screen devices present special problems). This often results in a less cluttered layout in digital

dictionaries compared to their paper counterparts, which rely more on traditional text compression and condensation.

An obvious exponent of this is the presentation of individual senses, which tend to be run-on in traditional print dictionaries, but often start on a new line in digital dictionaries. A question then arises in testing dictionaries on different media: is this aspect of presentation characteristic of digital versus print, or should it be normalized across the conditions? In several of her replications, Dziemianko explored both possibilities, in the most recent one (Dziemianko in preparation) using colour screen printouts from online dictionaries as the paper condition, in an attempt to better control for the effect of text formatting, which does not have to be determined by the dictionary medium. A less compressed presentation results in longer dictionary articles, and these lead designers of digital dictionaries to explore a number of navigational solutions, such as hyperlinks, lists, trees, menus, panels, or tabs. As most of these cannot be rendered on paper, their presence presents a further difficulty in testing fairly the effect of media on dictionary use.

Another complicating factor is the presence of extraneous material on web-pages. This includes all sorts of advertising (Dziemianko 2011), but also elements of a hosting service in which the dictionary may be embedded (Bank 2010: 50, 81).

What comparisons of paper and digital dictionaries show quite consistently is that the digital medium encourages more frequent consultation compared to traditional print dictionaries, and that such consultation is quicker. However, there is still uncertainty about whether digital dictionaries help immediate comprehension or promote vocabulary learning. Findings disagree on this point, and print dictionaries may hold an advantage over digital dictionaries as the former tend to be *more difficult* to consult. This somewhat paradoxical effect can be explained in terms of the Involvement Load Hypothesis (Laufer and Hulstijn 2001), which suggests that a task which requires greater effort is likely to produce a more lasting memory trace.

If our own experience as users of both paper and digital dictionaries may also be brought in, then the option to hear new words being pronounced, being able to copy over foreign scripts one would be hard pressed to type in, the interconnectivity with other resources (such as corpora), and the fact that one stays within the same (digital) medium, rather than having to move back and forth between the screen and a book on one's desk, should also be added to the digital advantages.

## 6. Digital presentation

Unlike a printed page, a digital display affords a number of options with respect to presentation, but at this point there is little other than speculation as to what works well in designing such dictionary interfaces, as hard evidence is

scarce and fragmentary. An approach which only recently entered dictionary use research is eye-tracking (Simonsen 2009, 2011; Kaneta 2011; Tono 2011; Lew et al. 2013; Müller-Spitzer et al. 2014). By recording the dictionary user's exact gaze position, the technique offers a unique view of the details of dictionary consultation otherwise impossible to observe, thus promising new useful findings which could inform digital dictionary design. In one of the first studies of this kind, Simonsen (2009) tested vertical versus horizontal organization of online dictionary material on five professional translators, and concluded that the vertical arrangement seems to be preferred for translation tasks, while horizontal may be better at gathering overall information from the entry.

In another eye-tracking study, Kaneta (2011) compared two alternative interfaces on a PC screen, one mimicking traditional entries and the other a layered interface with illustrative example sentences initially folded away and accessed by clicking. Monolingual (English) as well as bilingual (English-Japanese) entries were tested. When using the layered interface, users tended to skip the illustrative examples (as this required action on their part) more than in the case of the non-layered interface, particularly in bilingual entries. This in itself was not necessarily a negative finding, as the simplicity of the decoding task employed may not have required reference to examples, particularly in bilingual entries. Indeed, task success rates turned out to be higher with the layered interface, again particularly in bilingual entries, though not significantly so (but there were only six participants).

As many as four alternative interface types were assessed by users in Müller-Spitzer et al. (2012). The focus of this assessment was how best to combine access to different entry components, in this case a set of four: grammar, paraphrase, typical contexts, and sense relations. The highest-rated interface was one employing tabs across the top of the screen, rather like those in a modern web browser. Second most preferred was a panel layout, with four different areas of the screen holding the four sections of an entry. In third place came the 'explorer view', rather like Kaneta's folded interface, with four expandable tree branches. Finally, the least liked option was the print view. Based on the comments provided, users most valued clarity and ease of navigation in an online dictionary interface. Overall, the tabbed view indeed seems a reasonable option for the moment, especially as it is likely to perform rather well on smaller screens. It also capitalizes on the familiarity of tabbed browsing. Having said that, these studies tell us little about how lexicographic data should be clustered in the first place. In Müller-Spitzer et al. (2012), the grouping was done along lexicographic microstructural lines, but this is not the only way: Verlinde (2010), for example, drawing on Tarp (e.g. Tarp 2008), describes a presentation organized around the primary activity in which the dictionary user happens to be engaging, such as translating, writing, understanding, or doing exercises. This was implemented in *Base lexicale du français*, which, however,



Bank (2010) found difficult, confusing, and prone to error. These negative findings prompted a fundamental redesign of the interface (Verlinde and Peeters 2012). It is not easy to assess to what extent the poor user experience with a function-based interface reflects the approach in general, its poor execution, or else its novelty and unfamiliarity to the average dictionary user.

## 7. How traditional user problems are addressed in digital dictionaries

The flexibility of the digital platform opens up opportunities to solve many of the problems that users of traditional print dictionaries have confronted for centuries.

### 7.1 *Issues of space*

Most digital dictionaries are either portable or can be accessed remotely. As a result, dictionary users are relieved of the burden of having to carry around the bulky medium on which dictionary contents (used to) reside. Gone are also the pressures to compress and condense dictionary content in an attempt to keep the total size manageable: these same pressures which have effectively given rise to the many lexicographic conventions related to textual condensation and compression, conventions which all too frequently leave dictionary users stumped. Although considerations of space are largely immaterial at the level of the cumulative dictionary content, problems remain when it comes to presenting the (often extensive) content to the dictionary user, and these problems become particularly acute on small-screen devices (cf. Lew in press). Several scholars now believe that an optimal digital dictionary should only present users with that which is relevant to them (inherent relevance), considering the task in which they are engaged and which prompted dictionary use (task relevance), and the particular text, if any, they are reading/hearing or writing/pronouncing (co-textual relevance).

For instance, and with regard to inherent relevance, in polysemous entries it is usually one sense that is relevant in a particular textual context. But how is the dictionary to ‘know’ which sense is relevant? What we are dealing with here is a variation on an issue that natural language processing has been grappling with for several decades under the term *automatic sense disambiguation*, but with only minor success despite many years of vigorous research (cf. Fellbaum in this issue). This also explains why a search engine is good at suggesting links to general or encyclopaedic information, but is rather less helpful when faced with lexical requests, at which point it redirects users to dictionary entries.

In terms of task relevance, content in a digital dictionary can be selected or filtered depending on the purpose of the consultation: users need more (and somewhat different) content when engaged in language production than when they use a dictionary as an aid in text comprehension. Whereas this was in

principle also true of paper dictionaries, practical considerations prevented most dictionary publishers from producing multiple printed dictionaries for particular uses (each to serve a different purpose), and instead the prevailing practice was to compile rather universal tools where only some of the entry elements were relevant in a given situation. And even if multiple versions were produced, few users would be expected to acquire separate dictionaries for different uses. But when a digital dictionary is structured as a lexical database with a presentation layer sitting on top of it (Atkins 1996; L'Homme in this issue), multiple dictionary versions can be rendered depending on a number of parameters.

The digital adaptation of the concept of Simultaneous Feedback, known as Fuzzy SF (De Schryver 2010, 2013), is one proposal for an adaptive and intelligent digital dictionary which also takes care of the co-textual relevance.

## 7.2 *Issues of access*

One other clear advantage of the digital format is easier access to the lexical resources held in a dictionary. In a traditional print dictionary, lexicographic data were arranged once and for all in a particular order, such as (most usually) in alphabetical order or grouped semantically (in onomasiological dictionaries). The move to the digital platform has freed dictionaries from the rigid constraints of fixed macrostructural organization, and given them the flexibility of multiple access routes.

The user of a digital dictionary is no longer constrained by either the formal (spelling or phonology) or semantic criteria as the organizing principle. It is now perfectly possible to combine formal and semantic relations, and utilize both types in navigating the lexical material. The did-you-mean function of modern digital dictionaries allows poor spellers to get to the information they need, even if they have slightly misspelled what they are hoping to find information on. And, advances in speech recognition now make voice search a viable option.

One problem besetting dictionary users for highly-inflected and agglutinative languages when consulting print dictionaries has been reducing the word form (as encountered in running text or heard spoken) to the citation form, so that the appropriate entry can be located. Well-designed digital dictionaries can offer an in-the-background lemmatization facility, whereby a call for a particular word form is automatically reduced to the lemma which can generate this word form. The benefits of such a functionality are particularly pronounced (1) for non-native speakers of the language, as they may not always recognize what particular citation form the word form represents, and (2) in heavily prefixing and agglutinative languages (as opposed to suffixing languages, where word forms tend to be alphabetically proximate and thus relatively easy to find even in traditional alphabetically-arranged dictionaries). Of course, once one has

built a parser to go from orthographic form to lemma, one should not stop there and merely show the traditional lemma to the dictionary user. Rather, the analysis itself can and should be shown, and the meaning should not just be given for the lemma, but for the full orthographic form in addition. A good example of exactly such a transducer is the Zulu-English dictionary available at <http://isizulu.net>.

Another thorny issue of paper dictionaries is access to multi-word units. Since print dictionaries are organized around orthographic word-long strings, they largely fail users in the area of units of meaning that are not coextensive with the orthographic word. John Sinclair's insights (e.g. Sinclair 1991: 109–111) have made many realize that this situation is the norm rather than the exception, but finding multi-word units has been notoriously tricky in paper dictionaries, where material is organized into entries around single words. Digital dictionaries today are close to solving this problem by allowing access to multi-words through querying more than one component of a multi-word, while making allowances for the variants (Lew 2012: 349–351).

All of these improvements bring a dictionary increasingly closer to a simulated language expert, as contrasted with the less intelligent and bulky wordlist of yesterday.

## 8. Online dictionary behaviour

How users interact with online dictionaries is investigated with log files, though only to a limited extent, due to the limitation of the data range in the web log file. De Schryver et al. (2006) observe that users of online dictionaries increasingly mimic habits from interaction with search engines, and will not infrequently enter longer strings into dictionary search engines. Sometimes these will even be words of another language than the one(s) treated in the dictionary at hand.

Search options for online dictionaries are covered in Pastor and Alcina (2010, 2013), although they do not describe the actual behaviour of users but rather the opportunities afforded by online dictionaries. Skilful use of these options is often taken for granted, but this appears overly optimistic: using online dictionaries efficiently requires skills, though they are, up to a point, a different set of skills than the ones required for successful print-dictionary use (Lew 2013).

## 9. A vision of the future

Although it has been slow in the making (cf. De Schryver 2003), the digital revolution in lexicography is finally starting to have an impact on its users—those users, just as the tools, are *digital* users. One of the ways in which future users will interact with digital dictionaries, promises to be quite a spectacle. At this stage it would be wise to take heed of Robert Amsler's advice,

however, posted to the lexicography mailing lists in November 2012 (<http://www.freelists.org/post/euralex/The-future-of-our-field-Part-1>), in response to Macmillan's announcement that this publisher was due to discontinue printing their dictionaries and was instead moving to the digital medium entirely:

Electronic dictionaries have only partially achieved their potential because they have only expanded their access capabilities in fairly minor ways despite an avalanche of new computational capabilities. Fundamentally, electronic dictionaries 'think' of themselves as print dictionaries being offered via electronic access. This is a very limiting vision.

Amsler also points out that 'fundamentally, dictionaries as isolated islands of knowledge, are dying', and to the question of where the future of lexicography lies, he replies:

I believe it lies in the development of new lexical knowledge resources, new ways to display existing dictionary information and in connecting dictionary information to other knowledge. [...] It isn't quite a matter of whether it's a book, an online interface, or a wireless interface, it's what it displays that is useful. It's a matter of either having lexical knowledge that nobody else has or displaying lexical knowledge in ways that are so convenient that other means of access are less attractive.

Lexicographers remain the most qualified (more qualified than other people, and more qualified than machines) to provide the content, and as to attractive 'search and display' options, there is promise in gaze-contingent systems utilizing modern eye tracking (Bulling and Gellersen 2010). *The Economist* reported the following in December 2012, with reference to Text 2.0 (<http://text20.net>):

Text 2.0 [uses] eye tracking to analyse how a displayed text is being read. If the reader lingers on a foreign word, Text 2.0 can display its translation. Lingering on a word and then sweeping one's gaze to the right margin calls up a definition. If the reader starts to skim, the software dims common words. (The Eyes Have It 2012)

The step from eye-tracking to a system like Google Glass (<http://www.google.com/glass>) is a small one. One of the futures of lexicography, then, is in a pair of glasses.

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- Wells 1973 (*Dictionaries and the Authoritarian Tradition*)

#### Manuals

- Frawley et al. eds. 2002 (*Making Dictionaries: Preserving Indigenous Languages of the Americas*)
- Landau 1984 (*Dictionaries: The Art and Craft of Lexicography*)
- Landau 2001 (*Dictionaries: The Art and Craft of Lexicography, 2nd edition*)

#### Proceedings

- Householder & Saporta eds. 1962 (*Problems in Lexicography*)

### Asia (2.9m tokens)

#### Journals

- *Lexicon*: Vol. 25 (1995) → Vol. 43 (2013)
- *Kernerman Dictionary News*: Vol. 1 (1994) → Vol. 21 (2013) [full set]

#### Books

- Benson 2001 (*Ethnocentrism and the English Dictionary*)
- Miyoshi 2007 (*Johnson's and Webster's Verbal Examples, With Special Reference to Exemplifying Usage in Dictionary Entries*)
- Tono 2001 (*Research on Dictionary Use in the Context of Foreign Language Learning. Focus on Reading Comprehension*)
- Yong & Peng 2008 (*Chinese Lexicography: A History from 1046 BC to AD 1911*)

#### Proceedings

- ASIALEX 0 (1997) → ASIALEX 8 (2013) [full set]

### Europe (14.6m tokens)

#### Journals

- *International Journal of Lexicography*: Vol. 1.1 (1988) → Vol. 26.4 (2013) [full set]
- *Lexicographica*: Vol. 1 (1985) → Vol. 29 (2013) [full set]

#### Books

- Dziemianko 2006 (*User-friendliness of Verb Syntax in Pedagogical Dictionaries of English*)



- Fuertes-Olivera & Arribas-Bano 2008 (*Pedagogical Specialised Lexicography. The representation of meaning in English and Spanish business dictionaries*)
- Hartmann 2007 (*Interlingual Lexicography: Selected Essays on Translation Equivalence, Contrastive Linguistics and the Bilingual Dictionary*)
- Immken & Wolski eds. 1999 (*Herbert Ernst Wiegand: Semantics and Lexicography, Selected Studies (1976-1996)*)
- Nesi 2000 (*The Use and Abuse of EFL Dictionaries. How Learners of English as a Foreign Language Read and Interpret Dictionary Entries*)
- Piotrowski 1994 (*Problems in Bilingual Lexicography*)
- Spohr 2012 (*Towards a Multifunctional Lexical Resource. Design and Implementation of a Graph-based Lexicon Model*)
- Stark 2011 (*Bilingual Thematic Dictionaries*)
- Szczepaniak 2006 (*The Role of Dictionary Use in the Comprehension of Idiom Variants*)
- Tarp 2008 (*Lexicography in the Borderland between Knowledge and Non-Knowledge. General Lexicographical Theory with Particular Focus on Learner's Lexicography*)

#### Manuals

- Atkins & Rundell 2008 (*The Oxford Guide to Practical Lexicography*)
- Jackson 2002 (*Lexicography: An Introduction*)
- Svensén 1993 (*Practical Lexicography: Principles and Methods of Dictionary-Making*)
- Svensén 2009 (*A Handbook of Lexicography: The Theory and Practice of Dictionary-Making*)
- Zgusta 1971 (*Manual of Lexicography*)

#### Proceedings

- EURALEX 1 (1984) → EURALEX 15 (2012) [full set]

#### International collaboration (4.Im tokens)

##### Books

- Adams ed. 2010 (*"Cunning passages, contrived corridors": Unexpected Essays in the History of Lexicography*)
- Boas ed. 2009 (*Multilingual FrameNets in Computational Lexicography: Methods and Applications*)
- Cowie ed. 2008 (*The Oxford History of English Lexicography*)
- Fuertes-Olivera & Bergenholtz eds. 2011 (*e-Lxicography: The Internet, Digital Initiatives and Lexicography*)
- Fuertes-Olivera ed. 2010 (*Specialised Dictionaries for Learners*)

- Granger & Paquot eds. 2012 (*Electronic Lexicography*)
- Herbst & Popp eds. 1999 (*The Perfect Learners' Dictionary (?)*)
- Herbst, Faulhaber & Uhrig eds. 2011 (*The Phraseological View of Language: A Tribute to John Sinclair*)
- Kernerman & Bogaards eds. 2010 (*English Learners' Dictionaries at the DSNA 2009*)

#### Encyclopaedia

- *Dictionaries. An International Encyclopedia of Lexicography*: Vol. 1 (1989) → Vol. 3 (1991) [selections]
- *Dictionaries. An International Encyclopedia of Lexicography*: Supplement (2013) [full set]
- *Encyclopedia of Language and Linguistics, 2<sup>nd</sup> edition* (2006) [all chapters on lexicography]

#### Festschriften

- Corréard ed. 2002 (*Lexicography and Natural Language Processing: A Festschrift in Honour of B.T.S. Atkins*)
- De Schryver ed. 2010 (*A Way with Words: Recent Advances in Lexical Theory and Analysis. A Festschrift for Patrick Hanks*)
- Nielsen & Tarp eds. 2009 (*Lexicography in the 21st Century. In honour of Henning Bergenholtz*)

#### Proceedings

- COMPLEX 1 (1990) → COMPLEX 8 (2005) [full set]
- eLEX 1 (2009) → eLEX 3 (2013) [full set]

#### Addendum 2: Search terms used (for Fig. 1 & 2)

	<b>Singular</b>	<b>Plural</b>
English	electronic dictionary	electronic dictionaries
German	elektronisches Wörterbuch	elektronische Wörterbücher
Dutch	elektronisch woordenboek	elektronische woordenboeken
Afrikaans	elektroniese woordeboek	elektroniese woordeboeke
French	dictionnaire électronique	dictionnaires électroniques
Spanish	diccionario electrónico	diccionarios electrónicos
Italian	dizionario elettronico	dizionari elettronici
Chinese, Traditional	電子詞典 “diànzǐ cídiǎn”	
Chinese, Simplified	电子词典 “diànzǐ cídiǎn”	
Japanese	電子辞書 “denshi jisho”	
Korean	전자 사전 “jeonja sajeon”	

	<b>Singular</b>	<b>Plural</b>
English	online dictionary	online dictionaries
German	Online-Wörterbuch	Online-Wörterbüchern
Dutch	online woordenboek	online woordenboeken
Afrikaans	aanlyn woordeboek	aanlyn woordeboeke
French	dictionnaire en ligne	dictionnaires en ligne
Spanish	diccionario en línea	diccionarios en línea
Italian	dizionario online	dizionari online
Chinese, Traditional	在線詞典 “zàixiàn cídiǎn”	
Chinese, Simplified	在线词典 “zàixiàn cídiǎn”	
Japanese	オンライン辞書 “onrain jisho”, ウェブ辞書 “webu jisho”	
Korean	온라인 사전 “onlain sajeon”	
	<b>Singular</b>	<b>Plural</b>
English	digital dictionary	digital dictionaries
German	digitale Wörterbuch	digitalen Wörterbüchern
Dutch	digitale woordenboek	digitale woordenboeken
Afrikaans	digitale woordeboek	digitale woordeboeke
French	dictionnaire numérique	dictionnaires numériques
Spanish	diccionario digital	diccionarios digitales
Italian	dizionario digitale	dizionari digitali
Chinese, Traditional	數碼字典 “shùmǎ zìdiǎn”	
Chinese, Simplified	数码字典 “shùmǎ zìdiǎn”	
Japanese	デジタル辞書 “dejitaru jisho”	
Korean	디지털 사전 “dijiteol sajeon”	