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The Dynamics of Digital Publications

An Exploration of Digital Lexicography

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Introduction or ‘Why Should Humanists Care about Digital Publications?’

“I have not established my name stamped on bricks as my destiny decreed” remarked Gilgamesch to Enkidu
(The Epic of Gilgamesh 72).

Since the earliest times, memory, learning, imagination and the technologies (in the sense of technê) that aid their recording, communication and study have been deeply interwoven. The roles played by technologies in reflecting, shaping and informing our interpretation of the world have been highly complex. Think of the technology of the book, for example, and the political, social and intellectual significance of the transition from the scroll to the codex both in and for the Christian tradition. Nevertheless, it is important to state that technologies are not the only or even driving force behind such changes and scholars, such as Winner (1999), have made clear the inherent limitations and myopic nature of the technological deterministic model. Indeed, De Smedt has brought out the complex interplay between human intellect, culture and technology in producing new knowledge:

The telescope was invented in 1608 and was initially thought useful in war. Galileo obtained one, improved it a little, and used it to challenge existing ideas about the Solar System. Although a magnificent new technology in itself, the telescope was hardly a scientific tool until Galileo used it to create new knowledge (De Smedt 2002, 99).

While the limitations of the theory of technological determinism are clear, the refrain that ‘the computer is just a tool’ is equally problematic, and for a number of reasons. Prominent among them is the implicit categorization of a tool as a neutral agent that is used to affect a more important end. In the Humanities, process is held to be as important as outcome, if not more so, and the aim is rarely to solve problems, once and for all, but rather to
rediscover and reinterpret them in order to ask new and better questions. Thus, such a statement implies that there can be no role for the computer in the intellectual work of the Humanities. It has deeper cultural resonances too:

Just because the separation between thinking and making is longstanding and well-entrenched doesn’t make it a good idea. At various times in the past, humanists have been deeply involved in making stuff: Archimedes, the Banu Musa brothers, da Vinci, Vaucanson, the Lunar Men, Bauhaus, W. Grey Walter, Gordon Mumma. The list could easily be multiplied into every time and place [...] (Turkel 2008, par. 5).

Perhaps most problematic about the statement is the way it can be used to proscribe the boundaries of our Wissensräume, i.e. knowledge spaces, whose description, transfer and even production are profoundly based on symbolic systems (Ash 2000, 239). Describing the computer as ‘just a tool’ implies that the spaces that it is conceived in, developed in and even operate in need not concern the Humanities. Indeed, it implies that the nature of a given tool is conceptually and philosophically independent from the society that develops it and uses it, as well as from the processes it is used in and the results it helps to create.

Early commentators on the effects of computing technology on the Humanities, and society more generally, often discussed such changes in highly emotive ways, whether it was the self-termed “neo-luddite” claims of Himmelfarb (1996), the profound elegy on the death of reading by Birkerts (2006) or Perelman (1993) who hailed computing technology to be the greatest invention since fire. Humanists in particular are able to draw on their understanding of history to contextualize such statements and know that all of these scenarios are highly unlikely to exist outside of the world of the page that they are captured in. Notwithstanding such hype, since the 1990s, in particular, which saw the arrival and exponential uptake of the World Wide Web and the making available of the Mosaic browser, the application of computing technologies to Humanities scholarship, and the primary and secondary sources that it concerns itself with, has been ushering in many changes.¹ Scholars from across the Humanities have open to them new ways to access, search, interconnect and visualize primary and secondary sources; to disseminate and access research findings, as well as to communicate and collaborate with one another. Many effects of such changes not only remain undiagnosed but, furthermore, are little understood. We find ourselves in the most nascent stages of identifying, analyzing, theorizing and responding to the profound changes that the application of computing
to our cultural heritage and learning is bringing about. For example, how are the ways we communicate, think, read and write altering? How are the information-gathering patterns of Humanities scholars changing? What of the issues of digital preservation and obsolescence? And this is to say nothing of the changes that are resulting from research that attempts to involve the computer as partner rather than slave. As McCarty (2010) observed in his inaugural lecture, “I celebrate computing as one of our most potent speculative instruments, for its enabling of competent hands to force us all to rethink what we trusted that we knew.” Despite the embryonic stage we are at we need have no doubts about the significance of such changes for the Humanities: “As with the renaissance sped forward by the printing revolution of the fifteenth century, digital technology is driving a radical shift in humanities scholarship and education. The depth and character of the change can be measured by one simple but profound fact: the entirety of our cultural inheritance will have to be reorganized and re-edited within a digital horizon” (McGann 2010, ‘Introduction’). In March 2010, a three day conference entitled Online Humanities Scholarship: The Shape of Things to Come took place at the University of Virginia. The conference was aimed at the Humanities in general and sought to explore how online Humanities research may be developed and sustained. In the introduction to the subsequent proceedings McGann wrote:

But as we all know, online scholarship is still practised by only a tiny fraction of our humanities faculties. The absence of a broad professional involvement has been long-lamented and variously explained: steep learning curve, entrenched habits, lack of available time and resources, wariness at the volatile character of the new technologies. And all of those explanations are pertinent. But equally pertinent is the general failure of scholars who use digital media to give clear explanations of its critical research value (McGann 2010, ‘Introduction’).

In this paper, we will present two case studies of research that has been carried out on the digital remediation of German and Luxemburgish dialectal, regional and historical lexicography. In doing so, we will take some initial steps towards setting out what we hold the critical value of this research to be. The focus of the following reflections is not mere image digitization; rather, we aim to reflect on a host of new research findings that can be created via the scholarly evaluation, interpretation, semantic annotation and subsequent analysis of research material and data using computational methods. To close we will briefly address the “absence of broad profes-
ational involvement” noted by McGann. By exploring how the German and Luxemburgish lexicographical material described here might both benefit from and enrich a global information space, such as the emerging Semantic Web, we will argue that Humanists need to engage with such developments so that their unique knowledge and learning may inform them.

Creating and Identifying New Lexicographical Constellations: The Case of German and Luxemburgish

The European vernacular languages are characterized by a linguistic tradition in which dictionaries generally belong to the first forms of documentation and codification of a language. The dictionary corpus of a language (here, we shall begin by focusing on German) includes old lexicographical work in medieval manuscripts and old prints. From the nineteenth century onwards, dictionaries begin to document in a more modern sense standardized language forms, dialectal variants or historical stages of a language (Moulin 2010). Today, the manifold developments in the field of the Digital Humanities and e-philology have enabled new settings for the creation of lexicographical resources, ranging from the use of computer-based methods in the conception of dictionaries to the design of born digital lexicographical projects. Furthermore, the possibility of linking completed as well as ongoing lexicographical projects so as to form a complex and ‘intelligent’ multidimensional network of dictionaries becomes manifest. Though challenges are multiple, a project on German dictionaries at the University of Trier³ has been playing out this scenario by building up in the past ten years a network of different sorts of lexicographical data on the German language. One of the firsts steps in creating such a lexicographical network of the German language was built by the dictionaries of the (south) western German language area (Fournier 2003; Moulin 2010; Hildenbrandt and Moulin 2012). The dialect landscapes of the Rhineland, the Palatinate and the Euroregion of Saarland, Lorraine and Luxembourg are covered by completed broad-scale dictionaries, originally published in printed form and mainly based on the lexicographical tradition of dialect dictionaries as they have been developed since the middle of the nineteenth century.

The layout of these printed dictionaries varies from project to project. As the lemmatization and hierarchical order of the headwords have different realizations in the print dictionaries, the lexical matching of the different linguistic systems of these conjoining regions can only be examined and compared when using digital versions with appropriated encodings and
annotation standards. Such a system then enables complex enquiries, such as a full-text search through all the underlaying materials or specialized search for specific detailed information in the dictionaries enclosed in the system. Explicit links from the dictionaries themselves to other dictionaries and sources can be rendered as hyperlinks, and this is also true of the indirect cross references, which can only become apparent as a result of various statistical algorithmical and e-philological algorithms (Burch and Fournier 2004; Burch and Rapp 2007). Meanwhile, the digital edition of the monumental Grimm brothers’ ‘German Dictionary’ (www.dwb.uni-trier.de), the network of Middle High German dictionaries (www.mwv.uni-trier.de) and some others like the Goethe Dictionary (http://gwb.uni-trier.de/) have also been completed and can also be linked with the dialectal lexicographical material. In essence, a substantial lexicographical information system has been created (www.woerterbuchnetz.de) that allows cross-referencing and interlinking between the dictionaries. As a result, for example, dialect and historical vocabulary can be accessed and analyzed via standard language metaforms.

The digital network of dictionaries ‘woerterbuchnetz.de’ was developed in several stages, starting from the available printed versions of extant dictionaries, enabling the continuous growth of the system also with digitally-borne material and ensuring the long-term, cross-platform availability of the data produced (Hildenbrandt and Moulin 2012). A machine-readable full-text version of each dictionary in the network was created. The geographical maps and diverse illustrations, charts and images contained in the material were also digitized and linked to their respective headwords. In the machine-readable version, the individual elements of each article were labelled in SGML/XML using TUSTEP scripts applied to complex layout information (e.g. headwords, grammatical information, phonetic transcriptions, semantic information, citations and quotes, geographical information concerning survey data, etc.). The markup is standardized and conforms to the internationally accepted guidelines of the Text Encoding Initiative (TEI). Dynamically generated and classified network information can be accessed in the online version: both the lemma on which the cross reference is based and the reference target are displayed. Interlinking the dictionaries, as in the transformation of existing cross references between the dictionaries to hyperlinks and the algorithmical generation of new semantic cross references at a virtual level, are of a high lexicographic potential, as they enable the idea of “rendering semasiological dictionaries onomasiologically useful” (Reichmann 1986: 176, our translation; in the original “semasiologische Wörterbücher onomasiologisch nutzbar zu machen”).
Such a dictionary network can only be set up with the aid of algorithmic methods drawn from the field of information retrieval and grid-technology. In comparison with traditional, printed monographical publications, the assets of the digital linkage of the lexicographical network lie in the fact that principally all existing lexicographic sources and materials (such as underlying sources, texts, geographical maps, images, etc.) can be included and also be augmented with further components, such as other dictionaries, primary texts including the belles lettres literature or new maps.

Moreover, the network of dictionaries demonstrates how such digital works can become the central pillars of additional tasks such as text analysis. In the case of the Virtual Research Environment TextGrid (www.textgrid.de), the network is reconceptualized as a WebService, thus enabling other software applications to act on the data contained in it. Via TextGridLab, which provides a single point of entry to the Virtual Research Environment itself, it is possible to implement an integrated search on all dictionaries, whether from the standalone Dictionary Search Tool or by double clicking on the required word from within the TextGrid XML Editor.

Such additional steps are, for example, undertaken in the LexicoLux project at the University of Luxembourg, which addresses the documentation of the Luxemburgish language, the youngest extant Germanic language. Its lexicographical tradition goes back to the nineteenth century and arises thus at almost the same time as Luxemburgish emerges as an independent language (Gilles and Moulin 2003). The first lexicographical source was published in 1847, the second in 1906. The most extensive lexicographic documentation to date was published in five volumes between 1950 and 1977 (LWB). In creating a dynamic and multi-directional network, the LexicoLux project not only documents the Luxemburgish language and its metalinguistic reflection from its beginnings in the nineteenth century, but the system also provides an extendable basis for further linguistic analysis and lexicographical documentation of the modern forms of the language itself. The headwords of different dictionaries can be browsed using a standardized meta-lemma list of Luxemburgish, which is necessary as the different dictionaries also use three distinct orthographic systems documenting different stages of orthographical reforms. Moreover, the linguistic components of the data are contextualized by the linking of the Luxemburgish lexicographical data with that of the neighbouring dialect varieties in the Grande Région; namely, by integrating the Luxemburgish data in the Trier network of regional dictionaries included in the woerterbuchnetz.de. A linking to similar digital dictionaries of the French language (e.g. www.atilf.fr) can also be considered, documenting
the roman elements of the Luxemburgish language. Political and national borders can thus be surpassed and common linguistic and lexicographical structures, phraseological parallels and cultural-historical features better analyzed. The principle of dynamical interoperability also extends to external digital resources (including audio and video). For example, the survey locations in the dictionaries can be linked in to the Digital Linguistic Atlas of Luxemburgish (www.luxsa.info) and its sources.

The fundamental conditions and necessary prerequisites for such complex information systems as the lexicographical networks presented here are the availability of open access data, the high quality in-depth annotation of this data using international standards in the digitization of text, maps, images and artefacts, and the interoperability of the systems created, plus a genuine willingness to engage in interdisciplinary collaboration within the academic community in the Digital Humanities.

Digital Lexicography in the Global Information Space

An indication of the huge amount of information that is available on the Web can be gained from Google’s announcement (Alpert and Nissan 2010) that in 2008 the number of unique URLs that it processed had reached 1 trillion (and this is to say nothing of the ‘Deep Web’ that remains inaccessible to most search engines). At present, keyword searches implemented via a search engine and its underlying algorithms are the most common way of retrieving information likely to be relevant to a query. However, as set out by Antoniou and Van Harmelen (2008), there are significant, commonly encountered problems associated with search engines. These include the case when a search engine may return pages relevant to the keywords given, but additionally include many thousands of pages of moderate to low relevance; where the requested pages are not found, for example because results are highly sensitive to vocabulary; or where results are spread over numerous pages and so a number of queries must be carried out (1-3). Furthermore, once a number of hits have been obtained, the steps involved in filtering such information by, for example, selecting documents of particular relevance, tracing recurring themes in documentation, or making links between documents, can be a laborious task. The result is that it is not currently possible to use a search engine to answer either a highly complex or highly precise question. To take a rather simple example, it is not possible to retrieve websites that refer to the German personal name Achim, rather than to the place name Achim without considerable
human intervention both in the selection and combination of keywords and subsequent filtering and evaluation of results. To move from there to a more complex query, such as 'all encyclopaedias printed in Paris during the eighteenth century (whether in French, German or English, etc.) that mention the place name Achim in the body of an article’ is practically impossible. Relevant to the problem too is the quasi-‘embarrassment of riches’ that we are currently facing. Ever increasing amounts of data are becoming available every day (through, for example, mass digitization initiatives, such as, inter alia, Europeana, Haithi Trust and the Internet Archive); however, much of it is not machine accessible. As a possible solution to such issues, in what is now regarded as a seminal paper, Tim Berners Lee et al. (2001) set out their vision for the Semantic Web.

Spearheaded by the World Wide Web Consortium (W3C), the Semantic Web research community has been working towards the realization of a Semantic Web that will not replace the current day web, but rather extend it. A central aspect of this research involves defining and making explicit the relationships that exist between data on the web. This can be done by describing such information in a formal way and with the complete consistency and explicitness that the computer requires. The most complex and fine-grained approach to expressing such definitions and relationships is the process of developing ontologies.

A term often used in philosophy, in the computational context referred to here, ontology is usually defined in line with Gruber (1993). The term is used to describe formal, explicit and re-usable conceptualizations of a specific domain, such as an ontology of linguistic terms. An ontology describes not only the concepts of a domain but their properties and relationships too. An important aspect of Semantic Web research, they have been developed by many disciplines across the Sciences for some time in order to enable the representation and interchange of the semantic knowledge on a large scale. In the area of linguistics and lexicography, perhaps the most well-known example is WordNet. An argument for the benefits of extending XML encoding with ontologies in order to model natural languages has been convincingly made by Canfield (2009) on the basis of the highly inflected Navajo language of North America. He concluded that this approach enables enhanced search of the lexicon, interoperability and, in turn, can be shared with the emerging Semantic Web. The research being carried out in the project ‘Wechselwirkungen zwischen linguistischen und bioinformatischen Verfahren, Methoden und Algorithmen,’ a collaborative project between the University of Trier, the Institut für Deutsche Sprache (Mannheim) and the Julius-Maximilians-Universität Würzburg, in which linguists, computer
scientists and bioinformatic scientists seek similarities between the human genome and language change, indicates the kind of highly innovative multidisciplinary work that such approaches can enable.\textsuperscript{5}

Since 2009, another research thread in the Semantic Web community has been gaining ground, that of Linked Data, which is a set of “best practices for publishing and connecting structured data on the web” (Bizer 2010 p. 1; for best practices see Tim Berners-Lee 2006). Linked data is about assigning a unique name (a URI) to a piece of data and making it accessible with HTTP, thus making dereferencable URIs in order to lay important prerequisites for making information recoverable, capable of being shared and re-purposed on demand. When a URI is dereferenced, useful information should be returned, in RDF/XML. RDF uses XML syntax and consists of resources, properties and statements. Each RDF file contains a number of RDF Triples, which specify a subject, predicate and object. For example, TextGrid (subject) is a collaborative project (predicate) of the University of Trier (object). Where HTML is used in the traditional web to create links between documents, linked data establishes typed links between things in the web of data. In turn, this information can be linked to from other datasets, so once data has been prepared and exposed according to linked data principles it can both draw on and be used by other disparate and distributed pieces of data or collections of data in the “global data space” (Bizer 2010 p.1) in a fully automated way. As more linked data becomes exposed the store dynamically becomes more comprehensive. This is one of the key benefits of linked data over other approaches to efforts to combine data from disparate sources such as Mashups, microformats, etc. “In summary, linked data is about using the Web to create typed links between data from different sources. The result, which we will refer to as the Web of Data, may be more accurately be described as a web of things in the world, described by data on the web” (Bizer 2010 p.2).

From the perspective of the Humanities, it is not difficult to see the possible benefits of establishing connections between linked data sets and much finer-grained and complex domain-specific ontologies. To look again at our encyclopaedia example, it should be possible to use a search engine to retrieve a list of the dictionaries that were printed in Paris during the eighteenth century (whether in French, German or English, etc.) that mention Achim (the place name and not the personal name) in the body of an article. If ontological information were available that describes, for example, the domain vocabulary of geographical place names, it should furthermore be possible to use logic-based languages capable of ‘reasoning’ and automatically identifying new connections in the datasets at hand.
However, it is not clear that this is how the Semantic Web will develop. Most interestingly, Hausenblas (2009) has observed that linked data focuses mostly on RDF, linking and HTTP, rather than ontologies and inferencing and is thus a simplified approach to the Semantic Web. “This simplification – just as the Web simplified the established academic approaches of Hypertext systems – lowers the entry barrier for data provider, hence fosters a wide-spread adoption” ('Linked Data Principles').


But what of the role of dictionaries, whether as individual works or realized as the new lexicographical constellations (described above) in this emerging information space? As information retrieval and querying technologies – regardless of whether they are based on the approaches of the Semantic web or Linked Data communities described above, or other approaches such as data mining etc. – become more sophisticated, will the dictionary become obsolete? In short, might changing publication practices in the Humanities bring about the decline of the dictionary?

Dictionaries have existed for more than 4000 years; indeed, no literate society has existed that has not created lexicographical works (Hausmann 1989). At the most generic level, dictionaries are of immense and continuing importance to scholars of all disciplines and levels, as well as to lay people, as reference works. For the lay person they are a trusted repository of authoritative knowledge; for the scholar, dictionaries are a crucial resource, particularly in the Humanities, where scholars must often navigate multiple languages. Throughout history, dictionaries have allowed segments of cultural heritage to by identified and navigated; for example, by providing access or pointers to sources crucial to the word or idea under discussion. It is notable too that dictionaries have long been consulted, not only to locate information or references, but to reassemble information and hypothesize about it too (see, for example, Ó Corráin, Donnchadh (2001)). Dictionaries are also far more than simple word books or mere repositories of linguistic information. They are as much witnesses to and repositories of cultural and societal information as they are sources and objects of learning and also knowledge spaces (see, inter multa alia, A. Reddick 2010 and Hausmann op cit.). Dictionary research is increasingly identifying the many ways that dictionaries are implicitly and explicitly interlinked with one another and the languages and societies that they sought to reflect and sometimes influ-
ence. In this way, even dictionaries that are by today’s standards insufficient or, for example, reflect a questionable zeitgeist, can in and of themselves remain important historical witnesses (see, for example, Rapp 2011).

We hold that the changing publication cultures of the Humanities have the potential to reinforce and deepen this central role of the dictionary while also creating completely new roles for lexicographical information. In relation to this latter point, that dictionaries are a sine qua non of research infrastructures has been convincingly argued by McArthur. Drawing on Kronick’s theory of “information media” as consisting of two categories, primary (e.g. textbooks, periodicals, scholarly journals, etc.) and “secondary” (e.g. indexing systems, abstracting systems, etc.) he writes:

[...] it is clear from [Kronick’s] categorization that any comprehensive secondary system must also contain works of lexicographical and general reference. Indeed, dictionaries and encyclopaedias are classic examples of how we abstract information from primary sources of various kinds and marshal that information in terms of some kind of indexing and pointing system (McArthur 1988, p.7).

Indeed, over the past years we have seen dictionaries gain a new audience: machines, computational systems and networks. Just as humans rely on dictionaries to understand, access and navigate cultural heritage so, too, do machines. Presently, dictionaries play a crucial role in many kinds of computational systems; for example, multilingual data processing and interchange (see, inter alia, Dietrich 2010); machine translation (see, inter alia, Aljlayl et al. 2011); and information retrieval (see, inter alia, Gotscharek et al. 2009). While sophisticated search engines deliver an abundance of information, one of the greatest on-going challenges of modern day information technology is to make this abundance manageable. Accordingly, even the most sophisticated search engines will not, for the foreseeable future, offer viable or superior alternatives to authoritative scholarly dictionaries and thoroughly machine-readable dictionaries (such as those described above) play a multifaceted role in strategies developed to manage this abundance. A concrete example of the role of dictionaries in such systems is provided by Smith et al. (2001) in their discussion of the process they have used for the disambiguation of geographical names in the Perseus Digital Library. They note that:

Before either identification or disambiguation could proceed, we gathered the knowledge sources used to make the categorization and disambiguation decisions. Perseus uses some knowledge sources, such as the Getty
Thesaurus of Geographic Names or Cruchley’s gazetteer of London, that were purpose-built for geocoding. We captured other information, such as lists of authors or the entries in the Dictionary of National Biography, as a by-product of constructing the digital library as a whole. In total, the gazetteer used for name identification and disambiguation contains over one million place names (Smith and Crane, 2001).

So, it is clear that the changing publication cultures in the Humanities open new possibilities for how dictionaries may be used now and in the future by both humans and machines. However, this is, as yet, not fully realized. It is interesting to note that many of the problems that afflict hard-copy dictionaries can also be noticed in their digital surrogates. Since the early days of the World Wide Web, a critical mass of dictionaries of all kinds and formats has become available online, ranging from the scanned images of dictionaries made available by mass digitization initiatives, such as the Internet Archive (http://www.archive.org/), to the scholarly, retrodigitized and enhanced editions of historical dictionaries researched by Digital Humanities projects; for example, Das Wörterbuchnetz (www.woerterbuchnetz.de/). Yet, the varying use of standards, technologies and publishing strategies (e.g. server side transformation to HTML with underlying XML not being made public) used by these works mean that discovery, search, reuse and systematic research of individual digital dictionaries is often very difficult, and certainly impossible at the aggregate level. This is not the case with Das Wörterbuchnetz; however, such projects are still at the cutting edge of what has been realized in the domain of digital lexicography. As a result, much of the potential of digital dictionaries also remains fragmented and under-exploited by both humans and machines. We hold that dictionaries, viewed from their totality, rather than as individual work, represent a currently fragmented infrastructure and corpus. One possible outcome of the semantic and structural interweaving of successive dictionaries within a particular language will be the emergence of a dense matrix of cultural, linguistic and bibliographical information that is accessible to both Human and machine as never before.

Conclusion

In conclusion, we argue that new digital publication opportunities are not a substitute for the print publication of a book, but create wholly new publication forms that simultaneously transcend and replenish traditional book
publication. The formation of new publication cultures is a most dynamic and multi-layered process that requires a careful balance to be struck between innovations and traditional and calls for new kinds of methodological and theoretical skills to be brought into play, so that knowledge may be created, explored and interpreted in new ways, also involving the scope of new research infrastructures.⁶

Notes

1. Notwithstanding the impact of the internet, the application of computing to the Humanities is not a new or recent development. The field presently known as Digital Humanities aims to use “information technology to illuminate the human record, and [bring] an understanding of the human record to bear on the development and use of information technology” (Schreibman et al. 2004, xviii). Historiographically, it traces its most immediate origins to 1949, when Fr Roberta Busa began work on a digital index variorum of the complete work of St Thomas Aquinas in order to investigate the manifestation of ‘presence’ in his oeuvre (Busa 1980, 83).

2. We wish to express our gratitude to Andrea Rapp (Universität Trier) and James Cronin (University College Cork) for their helpful comments and suggestions about this paper. The paper reflects on the whole the situation as it was written for this book in 2010 and was updated punctually for the final publication in 2014.


4. The LexicoLux project aims to make the existing dictionaries of Luxemburgish available electronically and to link them with other materials; see http://infolux.uni.lu/lexicolux/.

5. See www.sprache-und-genome.de.

6. Space will not allow us to expand here on the issues of Research Infrastructures in any comprehensive sense; instead, we point the reader to the ESF Science Policy Briefing on Research Infrastructures in the Humanities (Moulin, Nyhan et al. 2011) and Ciula et al. (2013) where these issues are explored in much detail.

Bibliography


