Mapping a Traditional Dialectal Dictionary with Linked Open Data

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Abstract

In this paper, we present an approach for turning a traditional dialectal dictionary into a modern digitized and online linked dictionary. We describe steps that have been taken for the transformation of a former paper-based dictionary into machine-readable (semantic) web representation languages. This move raises the possibility of cross-linking dictionary data not only with other types of language resources, but also with many (scientific) domain descriptions that are already available in the Linked Data framework.

Keywords: collaborative lexicography; linked open data; dialectology; Bavarian dialects

1. Introduction

In this paper, we discuss a proposal for turning major dialect-lexicographic enterprises (also known as *Territorialwörterbücher* 'territorial dictionaries' or *diatopische Gebietswörterbücher* 'diatopic area dictionaries') of the German language (c.f. Moulin 2010: 594), on which some teams have been working for centuries, into modern digitized and online linked dictionaries. We take the Dictionary of Bavarian dialects of Austria (*Wörterbuch der bairischen Mundarten in Österreich*, WBÖ) as an example for showing aspects for this process of transformation.

The WBÖ[1] is believed to be a good example, considering that the institutional infrastructure and conceptualization for the dictionary was set up in the early 20th century. Its systematic data collection continued until the late nineties. In 1998 a rationalization concept ("*Straffungskonzept*") was issued, with the goals of finalizing the systematic data collection, shortening the dictionary content, fastening the dictionary compilation, and targeting the linking of the dictionary with a (digital) data corpus. Results of the work are being made available in published volumes since 1963 (*A*- to *E*-, including *P*- and *T*- as well as compounds due to etymological

[1] See examples of entries of WBÖ in the appendix.

lemmatization rules). Digitization of the materials started in 1993 (*Datenbank der bairischen Mundarten in Österreich*, DBÖ, 1993–2007). The *Datenbank der bairischen Mundarten in Österreich electronically mapped* (dbo@ema; since 2007) includes geo-referenced linguistic data as well as lexicographic background data (such as biographies, bibliographies, location hierarchy) and interactive maps. This development enabled the publication of data on the internet immediately after editing in the data base, linked with the digital dictionary itself. With this development, interactive queries by users as well as user-friendly navigation on the basis of cartographic material, is supported (c.f. Wandl-Vogt, 2010; Wandl-Vogt & Nickel, 2011).

We recently launched the subsequent steps consisting of using standardized (semantic) web representation languages, in order to make the data machine-readable and processable. In doing so, the cross-linking of the WBÖ data is supported not only with other types of language resources, but also with many (scientific) domain descriptions that are already available in the linked data framework.[2] We also address the issue of collaborative approaches to the generation and use of shared dictionary data.[3]

This may be particularly urgent, considering that there are still projects working on endangered or minority languages with no or little support from modern (language) technologies and which therefore take a long time to produce results, and are extremely costly. Furthermore, this issue is also valid for minority language resources that were worked on before the advent of the Web, focusing here on associated possibilities to store and access collected and analyzed minority or endangered languages resources. At least, one should be able to see such results re-used profitably; i.e. quickly, reaching a larger audience or being integrated into new and different applications.

This way, minority and endangered languages gain the same digital dignity as mainstream languages, even if only a few people are using the language or if only a few documents or resources exist. If we adopt same methods of encoding linguistic descriptions as applied to mainstream languages, data quality can be the same for researchers as in the case of well-resourced languages, in spite of the missing quantity and variety of sources, which is very important for statistical studies and the detection and marking of variants.

To ensure interoperability of our data with other language data, their transformation into a description standard, such as ISO-LMF[4] or TEI,[5] is required. Further, it is

[2] See http://linkeddata.org/ for more details. Many National Libraries already publish their data within this framework.

[3] The most striking example of such a collaborative approach in the dictionary field is Wiktionary: http://www.wiktionary.org/

[4] LMF (Lexical Markup Framework) is a standard for encoding lexical resources, resulting

necessary to encode the language data in a semantic web standard, such as RDF,[6] SKOS[7] and SKOS-XL,[8] to make the data machine-readable and interoperable in web applications.

2. Harmonization of linguistic Information included in WBÖ

Before linking the language data provided by WBÖ – as well as its metadata – to other (linguistic) data, there is a need for a detailed analysis and harmonization of the given dictionary data, in order to ease their cross-linking and make use of the cross-linking potentials(Wandl-Vogt, 2005). The language data to which WBÖ is being linked can consist of entries in (dialect) dictionaries, multilingual semantic networks,[9] labels and comments in (multilingual) domain thesauri,[10] or language data available in online resources, such as knowledge resources available in the linked data infrastructure[11].

It is important to have a clear picture of what linguistic information those language data contain: Does a (dialect) dictionary list as its entries lemmas, base forms or full forms? Do the entries contain synonyms, translations? Are the entries associated with morphological or syntactic information? Are the dictionary entries listing (different) meanings of the words? Metadata describing those fields are important, and we have started to port our dictionary component elements into the TEI standardized representation format for textual documents.

As shown in Table 1 of the Appendix, an entry in WBÖ typically consists of a lemma (*Puss*), morpho-syntactic information (*M., jedoch meist neutr.Dem.*), meanings (*Kuß, Gebäck, PflN*), location (*s-,mbair. m. SI, Egerl, Simmersdf. Igl.*), etymological information (*Schallw. ...*), and references to neighbouring German dialectal dictionaries (*Bayr.Wb. 1,295, Schwäb.Wb. 1,1558*).

If we now consider knowledge organization systems, such as thesauri, taxonomies or

from the cooperation between experts in dictionaries and computational lexicons. See: http://en.wikipedia.org/wiki/Lexical_Markup_Framework

[5] TEI stands for “Text Encoding Initiative”, see http://en.wikipedia.org/wiki/Text_Encoding_Initiative.See http://www.tei-c.org/index.xml

[6] See http://www.w3.org/RDF

[7] See http://www.w3.org/TR/skos-primer/

[8] See http://www.w3.org/TR/skos-reference/skos-xl.html

[9] The Multilingual extension of WordNet is such an example (http://www.globalwordnet.org/).

[10] A good example of a thesaurus available with labels in more than 30 languages is GEMET. (http://www.eionet.europa.eu/gemet/).

[11] A prominent source of such data in the Linked Data framework (http://linkeddata.org/) is DBpedia (http://dbpedia.org/About), with a lot of multilingual labels associated to both very generic and specific concepts.

ontologies, we can see that some of those systems contain labels, comments and/or definitions as annotation properties. Such annotation properties are making use of natural language expressions for naming and describing the elements of the knowledge organization system. Do such annotation properties contain precise terms? Do they include linguistic information? If not, they should be lexicalized by applying NLP tools, adding lemma, morphological and syntactic information to the annotation. The output of the lexicalization process should be compatible with lexical and linguistic information available in the (dialect) dictionaries. This way, lexicalization supports the disambiguated mapping of words used in a label or in a definition of a knowledge source to an entry of a (multilingual) semantic network or of a (dialect) dictionary.

The model we adopt for the representation of the results of lexicalized labels is the one described by *lemon*,[12] developed in the context of the Monnet project.[13] *Lemon* is also available as an ontology.[14]

A special focus in our work lies thus in achieving harmonization of all language data included in the various types of sources we are dealing with. We propose to use the ISO LMF standard for encoding all information about the organization of the lexicon or dictionary, whereas for detailed linguistic information, such as the morphology of dictionary entries, we point to the ISO data categories[15] for ensuring interoperability of linguistically relevant tag sets.

In doing so, we obtain a clear view of the commonality between the language data we are working with, so that they can be optimally used in the tasks combining (dialect) language resources with other language resources or with knowledge objects.

3. Transformation of WBÖ into a machine-readable Format

While encoding in LMF and the use of Data Categories are important for getting information about the content of dictionaries and other sources, this does not say anything about the formal representation of such data. LMF is represented as UML diagram, and the correspondingly marked language data can be serialized in XML or RDF. We need to know more about the adequate formal representation of language data if we want to achieve our goal, which is to publish the dictionaries in the Linked (Open) Data framework. We need to make our language data machine-readable and interoperable in a web context. And for this, there is a need to adopt a representation format that can model the interoperability between the information we can find in

[12] *lemon* stands for "Lexicon Model for Ontologies". See http://lemon-model.net/ and McCrae et al. (2012)

[13] See www.monnet-project.eu

[14] See http://www.monnet-project.eu/lemon

[15] See www.isocat.org for more details.

very different objects: lexicon entries, taxonomy labels, knowledge objects, etc.

This format should support easy publishing and access on the Web. Therefore we opt for a combination of RDF(s) and SKOS. A first experiment of porting entries of WBÖ to SKOS and *lemon* has been performed and examples of the actual state are presented below.

An additional advantage of using RDF(s) and SKOS is the fact that it allows us to access details of the modelling of the language data, using for this the SKOS-XL extension and the *lemon* model for lexicons in ontologies. This also enables the representation of information about morphological composition, variants, collecting circumstances or methods, etc., which we can conclude from the LMF encoding of the lexical sources.

Our actual realization of WBÖ in SKOS and *lemon*[16] consist in creating a SKOS concept scheme in which each entry of WBÖ is encoded as a concept belonging to it:[17]

```
@prefix wboe: <http://www.oeaw.ac.at/wboe/#> .
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix skosxl: <http://www.w3.org/2008/05/skos-xl#> .
…
@base <http://www.oeaw.ac.at/wboe/> .

wboe: rdf:type owl:Ontology ;

owl:imports
<http://www.lemon-model.net/lemon> ,
<http://www.w3.org/2004/02/skos/core> ,
<http://www.w3.org/2008/05/skos-xl> .

wboe:ConceptScheme
      rdf:type skos:ConceptScheme .
wboe:Descriptor
      rdf:type owl:Class ;
      rdfs:isDefinedBy wboe:wboe_defs.rdf> ;
      rdfs:label "Descriptor "@en ;
      rdfs:subClassOf skos:Concept , owl:Thing ;
      skos:definition "Descriptors of the WBÖ dictionary"@en ;
      skos:inScheme wboe:ConceptScheme .
```

Above, the reader can see the declaration part of the knowledge organization system

[16] For modeling, we use the Protégé ontology editor, version 4.3. See http://protege.stanford.edu/ for more details. The examples we show in the following are in the turtle syntax (http://www.w3.org/TeamSubmission/turtle/), which is an export format supported by Protégé.

[17] Only the base URI http://www.oeaw.ac.at/wboe is for now accessible from outside the institute. Expansions of this URL given below are not yet accessible.

we created for representing the WBÖ in SKOS and RDF(s). Each entry of the original WBÖ is represented as a "concept" belonging to the "wboe" concept scheme, as can be seen in the following:

```
<http://www.oeaw.ac.at/wboe/concept/59600>
    rdf:type wboe:Descriptor ,
    owl:NamedIndividual ;
    rdfs:label „Pusselein“@bar ;
    skos:inScheme wboe:ConceptScheme .
```

The SKOS code above states that there is a concept called "59600", which is the ID of the entry in the online version of WBÖ, as well as the ID in the dbo@ema (see http://hw.oeaw.ac.at/wboe/59600.xml?frames=yes and http://wboe.oeaw.ac.at/dboe/lemma/59600). This concept in our SKOS scheme points to a "term" object:

```
<http://www.oeaw.ac.at/wboe/59600-bar>
       rdf:type wboe:Term ,
              owl:NamedIndividual ;
```

This term object represents the concrete entry in WBÖ, which is specified as being a "Bavarian" term (with the ISO code "bar"). It is this term object that carries the preferred label and the list of alternative labels. The preferred label is encoded this way:

```
skosxl:prefLabel
    <http://www.oeaw.ac.at/wboe/59600.1-bar> ;
```

It is important to note that the range of the "prefLabel" is an object in the knowledge system and not just to a string.

This object is encoded in the following way:

```
<http://www.oeaw.ac.at/wboe/59600.1-bar>
    rdf:type wboe:prefLabel,
           owl:NamedIndividual ;
        skosxl:literalForm "Pusselein"@bar ;
    skos:inScheme wboe:ConceptScheme .
```

With this we make it clear that the dictionary entry represented by the "prefLabel" is a complex entity, and not just a string, which is introduced in the SKOS modelling by the property "literalForm". The term object can also bear a list of related alternative labels, encoded as "altLabel":

```
 <http://www.oeaw.ac.at/wboe/term/59600.1-de>
      rdf:type wboe:altLabel ;
      skos:inScheme wboe:ConceptScheme ;
      skosxl:literalForm „Kuss“@de .
```

Here the reader can see that the alternative label is directly associated with a (German) string. This is reflecting the fact that alternative labels do not point to entries in the WBÖ, and therefore not encoded as complex term objects, contrary to

the preferred labels. Below, we provide a simplified form of the list of alternative labels that can be derived from the WBÖ entry for the word "*Pusselein*":

```
skosxl:altLabel
    skosxl:literalForm „Busserl“@de-at ;
skosxl:altLabel
    skosxl:literalForm „Kuss“@de ;
skosxl:altLabel
    skosxl:literalForm „süßes Gebäck“@de ;
skosxl:altLabel
    skosxl:literalForm „Gewöhnliches Gänseblümchen“@de ;
skosxl:altLabel
    skosxl:literalForm „Kriech-Hahnenfuß“@de-at ;
skosxl:altLabel
    skosxl:literalForm „Gartenranunkel“@de-at ;
skosxl:altLabel
    skosxl:literalForm „Bellis perennis“@la ;
skosxl:altLabel
    skosxl:literalForm “Ranunculus repens”@la ;
skosxl:altLabel
    skosxl:literalForm “Ranunculus asiaticus”@la ;
…
```

The reader can observe that, for the time being, we associate, to the alternative label(s) of a concept, the modern German or Latin equivalent(s) of the preferred labels (reserved for the Bavarian entries of WBÖ).

In summary, in this simplified view of an entry in the SKOS representation of the WBÖ dictionary, the reader can see that each entry of the dictionary is encoded as a concept belonging to the whole concept scheme. The number associated with each concept is the ID given to the entries in WBÖ and DBÖ. The concept itself points to term objects that bear either preferred or alternative labels in various languages.

4. Mapping WBÖ to Open Linked Data

As they appeared in the example in section 3 above, alternative labels for the concepts (entries) of the "wboe" concept scheme have just strings as values. This is due to the fact that those words, modern German or Latin equivalents of the Bavarian entries, are themselves not part of the dictionary. One should expect this: WBÖ contains only Bavarian lexical material as entries. Due to this, and to the sophisticated lemmatization rules (in the example used: *Puss* with the variant *Pusselein* for the Austrian German word *Busserl*), it would be helpful for the user if some linguistic and semantic information about the words in other languages that are associated to the Bavarian entries were provided. For this purpose, we investigate the mapping of the content of the range of altLabel properties to existing lexical and linguistic information available on the Web, and more precisely in the Linked Open Data cloud.

A first experiment has been made with the actual DBpedia instantiation of Wiktionary (Wiktionary RDF extraction 2013).[18] Since in WBÖ we have the linking of

[18] There, *lemon* is also used for the description of certain lexical properties.

the Bavarian word "*Pusselein*" (see the example in section 3 above) to a number of German standard words, one can link the altLabel attribute for the Bavarian word directly to the entry in the DBpedia instantiation of Wiktionary. We discuss three cases here:

1. Corresponding with the value of altLabel `Kuss´, we have the entry of DBpedia/Wiktionary:
   http://wiktionary.dbpedia.org/page/Kuss-German-Noun-1de

   47 translations, e.g.
   en = ″kiss″, et = ″suudlus″

2. Corresponding with the value of altLabel ″Bellis perennis″ (Germ ″Gänseblümchen″):
   http://wiktionary.dbpedia.org/page/G%C3%A4nsebl%C3%BCmchen-German-Noun-1de

   39 translations, e.g. en = ″daisy″

3. Corresponding with the value of altLabel `süßes Gebäck´, we have two entries in DBpedia/Wiktionary:
   http://wiktionary.dbpedia.org/page/s%C3%BC%C3%9F-German-Adjective-1de

   21 translations, e.g. en = ″sweet″

   http://wiktionary.dbpedia.org/page/Geb%C3%A4ck-German-Noun-1de

   11 translations, e.g. en = ″pastry″

In these three examples, we notice a number of things. First, the links contain information about the language, the Part-of-Speech and a specific meaning (the integer number indicates one of the possible meanings). Within the page accessed by the link, this information is made explicit and can be linked to.

In the second example, the reader can see that for the Latin word "*Bellis perennis*", we refer to a German entry in DBpedia/Wiktionary. The fact is that this expression is used commonly in German. Since there is an entry for this compound term, we do not perform decomposition. But this can be performed additionally, and we could have a link to each of the Latin words "*bellus*" and "*perennis*",[19] similar to the third example discussed below.

In the third example ("*süßes Gebäck*"), the advantage of providing a lexicalization of the labels is clear: we find no link in DBpedia/Wiktionary with the URL ending in "*süßes Gebäck.*" Lexicalization is helpful, since it informs us that we have two tokens in the label, and provides the lemmas of each token. We can thus point to the two URLs in DBpedia/Wiktionary. In our SKOS modelling we use for this purpose the

[19] Both entries are included in the English Wiktionary (http://en.wiktionary.org/wiki/bellus http://en.wiktionary.org/wiki/perennis)

lemon property “decomposition”:

```
<http://www.oeaw.ac.at/wboe/59600.2-de>
    rdf:type
        wboe:altLabel ,
        owl:NamedIndividual ;
    <http://www.lemon-model.net/lemon#decomposition>
        <http://wiktionary.dbpedia.org/page/s%C3%BC%C3%9F-German-Adjecti
        ve-1de> ,
        <http://wiktionary.dbpedia.org/page/Geb%C3%A4ck-German-Noun-1de>
         ;
    skos:inScheme wboe:ConceptScheme .
```

In this simplified view, the reader can see how the decomposition of the content of the label can be explicitly represented, and how each component can be linked to a lexical entry (with the corresponding meaning) in the Linked Open Data cloud (in this case, the DBpedia instantiation of Wiktionary).

For each of the cases above, we have been adding a number of available translations. In the DBpedia/Wiktionary entries, very often the property “hasTranslation” is added to an entry, with a varying number of translations for different entries. By transitivity, we can add to the Bavarian entries all those translations available for the German alternative labels.

We see an advantage for the lexicographers in using such an approach by the fact that they can concentrate on the lexical entries in one language and are not required to encode related information in their own dictionary or lexicon, but can link to existing resources.

5. Conclusion

In conclusion, we can assume that the discussed proposal can aid in complex lexicographic processes of encyclopedic dictionaries on the Web. The lexicographers can concentrate on the specific data on which they are working, and link to resources in the LOD for additional information. Linking to Wiktionary-like resources is not the only way to go. In a next step, we will link to language data available in domain descriptions available in the LOD, thus mapping indirectly to expert knowledge in fields other than lexicon and linguistics. We intend to test the approach in the field of botany.

We encourage lexicographers to work together to store their data in appropriate formats in order to allow cross-linking and merging of data. This can also contribute to maintaining the availability and accessibility of these precious sources for future generations.

6. References

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7. Appendix

In this appendix, we display some screen shots that display some relevant content of the WBÖ for our work. In Table 1 we display a WBÖ entry. The prefLabel in our SKOS model would be "Puss" ("Puss(e)lein" will be marked in the future as a related variant). Tables 2–4 display different meanings associated with the Bavarian entry.

Puss, Puss(e)lein
M. (jedoch meist neutr.Dem.), Kuß (,,Busserl"), Gebäck, PflN s-,mbair. m. SI, Egerl. nur als → (*Zwick*[*er*])-, Simmersdf. Igl.; Schallw., vgl. KLUGE[20] 114; frühnhd. *buß* M. Kuß GÖTZE Frühnhd.Gl. 44; s.a. KRANZMAYER Kennw. 10; entl. ins Magy. als *puszi* Kuß u. *puszedli* Gebäck KOBILAROV-GÖTZE 355f., ins Slow. als *pûšek* Kuß PLETERŠNIK 2,366 u. ins Kä.Slow. als *pushei* Kuß GUTSMANN Dt.-Wind.Wb. 261. — Bayer.Wb. 1,295, Schwäb. Wb. 1,1558.

Table 1: WBÖ 3,1515: Entry – Overview.

Bed.: 1. Kuß im gesamten Verbr.Geb. (meist als 1. od. 2. Dem.), Syn. → (*Fotz*)*pemperer*,

Table 2: WBÖ 3,1516: Meaning 1: "kiss"

2. Kl. süßes Gebäck m. flacher kreisförmiger Unterseite u. gewölbter Oberseite ugs. (meist 2., seltener 1. Dem.), s.a. EBNER[2] 51; rundes Nußgebäck auf Kirchtagen Gott.Wb. 1,91 (2.Dem.);

Table 3: WBÖ 3,1516: Meaning 2: "sweet pastry"

3. PflN:
a) f.d. Garten veredelte Art v. Gew. Gänseblümchen (→ Bellis perennis) BöW MARZELL PflN 1,555 (2.Dem.); *rote, weiße Busserl* dass. BöW SCHREIBER Bö.(1910) 134; — b) f.d. Garten veredelte Art v. Kriech-Hahnenfuß (→ Ranunculus repens): *gelbe Busserl* BöW SCHREIBER ebd. 156; s.a. MARZELL PflN 3,1278; — c) Gartenranunkel (→ Ranunculus asiaticus) OÖ (1893, 2.Dem.).

Table 4: WBÖ 3, 1516: Meaning 3: "plant", e.g. "daisy"