

# Beyond Syntactic Valence: FrameNet Markup of Example Sentences in a Slovenian-German Online Dictionary

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**Abstract.** This contribution focuses on the representation of syntactic and semantic valence in a bilingual electronic dictionary, *Online SLO-DE-SLO*. To overcome valence representation problems caused by cross-lingual divergences, FrameNet-style annotation is applied to usage examples. Results and possible future directions are discussed.

## 1 Introduction

Many factors must be considered when compiling electronic dictionaries (de Schryver 2003). This contribution focuses on the representation of syntactic and semantic valence in a bilingual dictionary, using examples drawn from an existing online dictionary. The *Online SLO-DE-SLO* dictionary is presented briefly in Section 2. Section 3 summarizes the FrameNet-approach to corpus-based semantic annotation. FrameNet-style annotation is applied to *Online SLO-DE-SLO* usage examples (Section 4), resolving valence representation problems caused by cross-lingual divergences (Dorr 1994). Section 5 discusses the results and indicates possible future directions.

## 2 A Slovenian-German online dictionary

*Online SLO-DE-SLO* is a Slovenian-German/German-Slovenian online dictionary; an interface in German and Slovenian is accessible via the Web.<sup>1</sup> Earlier stages of dictionary development and evaluation have been presented in Lönneker and Jakopin (2003), Jakopin and Lönneker (2004), and Lönneker and Rozman (2004). The motivation behind *Online SLO-DE-SLO* is to create a lexical resource useful to both human users and Natural Language Processing. Recent additions include a full-form morphological generator for Slovenian, and an improved dictionary structure: Translated example phrases and example sentences have been separated from the main component of the dictionary, which is now restricted to correspondences between single words and multi-words.

<sup>1</sup> <http://webapp.rrz.uni-hamburg.de/~slovenisch/> [July 30, 2007].

As of July 2007, the dictionary contains over 8,800 word and multi-word correspondences, as well as 2,150 bilingual usage examples. The dictionary records on average more than 80,000 requests per month. The subsequent subsections are devoted to two aspects of *Online SLO-DE-SLO* central to the focus of the paper: valence information (2.1) and example sentences (2.2).

### 2.1 Valence information in online SLO-DE-SLO

*Online SLO-DE-SLO* provides grammatical information for both languages, such as part of speech for each single word lemma or aspect information for Slovenian verbs. Syntactic valence patterns are also given; these apply to words which can function as syntactic governors (head words of phrases). Generally, syntactic valence information is available for verbs, but it can also appear with other parts of speech.

Example (1) contains *Online SLO-DE-SLO* grammatical information for the German and Slovenian verbs corresponding to English (*to*) *introduce* [*x to y*].

- (1) [Slov.] predstaviti (perf) V [+ DAT.] [+ AKK.]  
 [Ge.] vorstellen V [+ DAT.] [+ AKK.]

In the example, the first item in each line is the base form of the verb. Information on verb aspect is relevant for Slovenian only; (*perf*) indicates perfective aspect. This is followed by an abbreviation indicating part of speech; *V* stands for verb. Finally, arguments are represented by their grammatical case and delimited by square brackets. The order of the arguments corresponds to their canonical order in an unmarked declarative sentence. Only arguments typically following the verb are represented; the (unrepresented) subject is implicitly assumed to take nominative case. The verbs in (1) thus take two non-subject arguments, the first in the dative case (*[+ DAT.]*, corresponding to the indirect object in English) and the second in the accusative case (*[+ AKK.]*, corresponding to the English direct object).

Currently, each syntactic valence is a separate dictionary entry, whether or not it results in different cross-linguistic equivalents. To illustrate, the Slovenian verb *potresti* – ‘strew’ has several valence patterns, among them (2) and (3), which translate differently into German. – The display convention of dependent prepositional phrases is “preposition plus case”.

- (2) [Slov.] potresti (perf) V [+ AKK.] [s/z + INSTR.]  
 [Ge.] bestreuen V [+ AKK.] [mit + DAT.]  
 ‘strew [sth. with sth.]’
- (3) [Slov.] potresti (perf) V [+ AKK.] [po + LOK.]  
 [Ge.] streuen V [+ AKK.] [über + AKK.]  
 ‘strew [sth. over sth.]’

Dictionary data is stored in a relational database. There is a separate table for valence information, with a pointer to the relevant lemma and with a number indicating the order of the dependent phrases. For example, the two valence patterns of *potresti* shown in (2) and (3) are represented as in Table 1.

PhraseType	Lemma_sl_Ref	PhraseOrder
+ AKK.	2	1
s/z + INSTR.	2	2
+ AKK.	3	1
po + LOK.	3	2

**Table 1.** Slovenian valence information in dictionary database

## 2.2 Example sentences in online SLO-DE-SLO

Syntactic valence information as introduced in 2.1 is valuable to advanced learners with appropriate linguistic knowledge. It is also intended to be useful to automatic systems which might process the bilingual data. However, the occasional user lacking sufficient background in linguistics would benefit from (additional) examples illustrating the usage of the words. For instance, the entry for the Slovenian verb *telefonirati* – ‘(to) phone [so.], to call [so.]’ says that its first non-subject argument takes the dative case. The closest German translation equivalent is *anrufen*, which takes an accusative object, as in (4).

- (4) [Slov.] telefonirati (perf, impf) V [+ DAT.]  
 [Ge.] anrufen V [+ AKK.]

Example (5) illustrates this difference in context.

- (5) a. [Slov.] Če bom le mogla, **ti** bom telefonirala.  
 If will-I only can-PART, **you-DAT** will-I phone.  
 b. [Ge.] Wenn ich nur kann, werde ich **dich** anrufen.  
 If I only can, will I **you-ACC** call.  
 ‘If at all possible, I will call you.’

For *Online SLO-DE-SLO*, examples are considered particularly useful when valence patterns differ across languages. Example (5) illustrates a difference in grammatical case assigned to a particular argument, but cross-lingual divergences can be more complicated than that. *Thematic divergence* (Dorr 1994, pp. 607–609) is the repositioning of arguments with respect to a given verb or other lexical head. It can also be described as the realization of what is the subject in one language by a different grammatical function (e.g., direct object) in the other language. For instance, in its simplest valence pattern the Slovenian verb *zebsti* takes a zero subject and an accusative object, the object phrase indicating a living being that feels cold. With the corresponding German verb *frieren*, this living being is realized as subject, in the most common valence pattern. The dictionary represents this fact as in (6).

- (6) [Slov.] zebsti (perf) V [+ AKK.]  
 [Ge.] frieren V

Such cases present a problem in the current *Online SLO-DE-SLO* representation of syntactic valence, because it relies on formal and semantic cross-linguistic equivalence of the subject. Therefore, for further illustration the dictionary includes translation equivalent example sentences, as in (7).

- (7) a. [Slov.] Zebe me.  
Freezes me-ACC.  
b. [Ge.] Ich friere.  
I freeze.  
'I am cold.'

The correspondence between the Slovenian object and the German subject of sentences (7a) and (7b) is best captured in semantic terms. For English, information on syntactic and semantic valence has been collected in the lexical database of the FrameNet project (Fillmore *et al.* 2003, Ruppenhofer *et al.* 2006). After a brief overview of the main principles of FrameNet in Section 3, their possible applications in a bilingual dictionary such as *Online SLO-DE-SLO* will be shown in Section 4.

### 3 FrameNet

FrameNet is an on-line lexical resource for English based on frame semantics (Fillmore 1978; Fillmore *et al.* 2003). It represents each word sense or “lexical unit (LU)” as a unique combination of semantico-conceptual and morpho-syntactic information. Morpho-syntactic information in FrameNet comprises part of speech, word forms and the order of units within multi-word terms. Semantico-conceptual information of a lexical unit is provided through membership in a particular *semantic frame*, the background for understanding the lexical unit in context (3.1). FrameNet annotates occurrences of LUs with respect to their frame-semantic and syntactic behavior in example sentences retrieved from electronic corpora (3.2). A set of analyses of annotated examples taken together then shows the valence of a LU (3.3).<sup>2</sup>

#### 3.1 The semantic frame

A frame is a conceptual structure that describes a particular type of situation, object, or event along with its participants and props, which are referred to as frame elements (FEs). Table 2 gives a very condensed overview of a frame and its elements.<sup>3</sup> Notably, each frame has a name (caption), a description in free text (top line of Table 2), and is associated with frame elements (subsequent lines of the table), which are given a name and a textual definition, usually referring back to the description of the frame as a whole.

<sup>2</sup> FrameNet is a very rich lexical resource and many of its features cannot be explained in this paper. More information on the FrameNet data model can be found in (Baker *et al.* 2003), (Ruppenhofer *et al.* 2006) and (Lönneker-Rodman 2007).

<sup>3</sup> For full definitions of the frames mentioned in this paper, please refer to the FrameNet website: <http://framenet.icsi.berkeley.edu/> [July 29, 2007].

This frame contains words describing physical experiences that can affect virtually any part of the body. The body part affected is almost always mentioned with these words.	
<b>Frame Element</b>	<b>Definition</b>
Body_part	This FE is the location on the body where the physical experience takes place [...].
Experiencer	The Experiencer is the being who has a physical experience on some part of his or her body, or internally.

**Table 2.** FrameNet Frame `Perception.body`

In spite of its conceptual nature, a frame cannot be defined without knowledge about the lexical units that *evoke* the frame. For example, in English, the verbs *ache* and *itch* (among others) evoke the `Perception.body` frame; the verbs are *members* of the frame.

### 3.2 Example sentences in FrameNet

Information provided by FrameNet would be very abstract if it were not supported by authentic example sentences where frame-evoking lexical units and frame elements are annotated. Color highlighting of each annotated constituent facilitates the recognition of its semantic role in the sentence. Frame-evoking words are displayed in white letters on black background. Highlighting of other constituents of the sentence makes reference to the colors defined for the respective frame elements of the frame. Examples (8) – (11) are taken from the FrameNet website and illustrate usages of the verb *itch*, evoking the `Perception.body` frame. Only the Experiencer frame element is realized in (8) with the noun phrase *he*; and only the Body\_part FE is realized in (9) with the noun phrase *they* (i.e. the ears).

- (8) Within hours, while **he** **itched** and writhed [...]  
 (9) The ears are thickened, [...] **they** **itch** and they hurt [...]

Most examples realize both of these frame elements, as in (10) and (11) below. Usually, syntactic constituents realizing different frame elements do not overlap. In the particular case of Examples (10) and (11), however, the frame element Experiencer is incorporated within the Body\_part constituent. To represent this, FrameNet uses second-layer annotation (Fillmore *et al.* 2003, p. 318; Ruppenhofer *et al.* 2006, p. 37), which allows an annotator to single out the relevant possessor phrase and annotate it twice, once for Body\_part (within the larger phrase) and then for Experiencer.

- (10) **Leith's right hand** started to **itch** again.  
**Leith's**
- (11) Is **your head** **itching** now?  
**your**

Besides the frame-evoking and frame element information provided by the semantic markup of sentence constituents, syntactic information about these constituents is given, including phrase type and grammatical function. More information on syntax in FrameNet can be found in (Fillmore *et al.* 2003) or (Ruppenhofer *et al.* 2006).

### 3.3 Valence information in FrameNet

In FrameNet, valence information is not stored statically as a feature of a lexical unit. Instead, it is derived dynamically from the annotation of sentences with respect to that lexical unit. The information characterizes both the semantic and syntactic combinatorial profile of the LU. The semantic profile is given in terms of number and specific combination of frame elements occurring with the LU, and the syntactic profile provides the phrase types and grammatical functions of the annotated constituents. Ideally, about 20 sentences are annotated for each LU, and the annotation summaries quantify each valence pattern in terms of its frequency within this set of annotations.

For example, a valence pattern table derived from only the four annotations of Examples (8) to (11) above is given in Table 3. The abbreviation *NP* stands for noun phrase and is a phrase type label; *Ext* stands for the grammatical function “external argument”, or subject.

Number Annotated	Patterns	
1 TOTAL	<b>Body_part</b>	
(1)	NP	
	Ext	
2 TOTAL	<b>Body_part</b>	<b>Experiencer</b>
(2)	NP	2nd layer
	Ext	–
1 TOTAL	<b>Experiencer</b>	
(1)	NP	
	Ext	

**Table 3.** FrameNet-style valence information for *itch.v*

As syntactic information is already – at least partly – covered in *Online SLO-DE-SLO*, the following discussion will concentrate on the possible contribution of FrameNet-annotation to the representation of semantic valence and cross-lingual correspondences thereof.

## 4 Putting the pieces together

This section discusses how FrameNet annotation could be integrated into the bilingual dictionary *Online SLO-DE-SLO*. The focus of the case studies (4.1 to 4.3) is the usefulness of such markup to human users, especially in difficult (i.e. divergent) cases. A discussion will follow in Section 5.

### 4.1 General concept

Given that *Online SLO-DE-SLO* already includes syntactic valence information, the purpose of the semantic annotation of example sentences is to supplement that with information on correspondences between frame evoking words and their frame elements. The idea that frame element assignments can be visualized by colored highlighting is taken from FrameNet. When applied to translation-equivalent examples in two languages, the colors identify cross-linguistically corresponding portions of the sentence. This can be seen in Table 4 illustrating the usage of Slovenian *telefonirati*; for glosses and translations, see Example (5) above. – Annotating bound morphemes such as the inflectional ending *-m* in the Slovenian auxiliary *bom* – ‘I will’ is not standard in FrameNet, but facilitates the display of cross-lingual equivalences.

Slovenian	German
Če bom le mogla,	Wenn ich nur kann,
ti bom telefonirala.	werde ich dich anrufen.

**Table 4.** Example sentence for Slovenian *telefonirati*, with FrameNet markup

The actual semantics of the color-highlighted annotations is given in an abbreviated description of the relevant FrameNet frame, to appear directly above or below the example(s). Table 5 displays the necessary information from the **Contacting** frame, of which Slovenian *telefonirati* and German *anrufen* would be members. Only the first part of the definition and the relevant subset of frame elements are displayed. The complete frame description could be connected via a hyperlink to the FrameNet website.

### 4.2 Illustrating thematic divergence

In the language pair Slovenian-German, thematic divergence (cf. 2.2 above) often involves a zero subject in Slovenian, or the expletive (semantically empty) sub-

A Communicator [...] directs a Communication to an Addressee [...]	
<b>Frame Element</b>	<b>Definition</b>
Addressee	The person that receives the message from the Communicator.
Communicator	The person who uses language in the written or spoken modality to convey a message to another person.

Table 5. FrameNet Frame *Contacting*

ject *es* ‘it’ in German. Some of the verbs with which this phenomenon occurs belong to the *Perception\_body* frame, a short description of which has been discussed in 3.1 above. By making reference to the frame, Example (7) discussed in 2.2, can be annotated in a straight-forward fashion, as in Table 6.

Slovenian	German
Zebe me .	Ich friere .

Table 6. Example sentence for Slovenian *zebsti*, with FrameNet markup

The Slovenian verb *srbeti* and its German counterpart *jucken* – ‘(to) itch’ also evoke the *Perception\_body* frame. Because of thematic divergences, three different valence patterns of German *jucken* have been defined as equivalents of one single syntactic valence in Slovenian, shown in (12).

- (12) a. [Slov.] *srbeti* V [+ AKK.]  
 b. [Ge.] *jucken* V  
 [Ge.] *jucken* V [+ AKK.]  
 [Ge.] *jucken* V [+ AKK.] [an + DAT.]

Given the *Perception\_body* frame, semantic valence patterns explain the cross-linguistic differences. Slovenian realizes the *Body\_part* FE as subject of *srbeti*, and *Experiencer* as direct (accusative) object, as in (13a). In German, information about the *Experiencer* can be incorporated as a possessive determiner in the constituent expressing *Body\_Part* (13b), precluding any other syntactic argument besides the subject. *Experiencer* information can also be expressed by a noun phrase in the accusative, similarly to Slovenian. In this case, the *Body\_part* FE might be realized by a prepositional phrase rather than as subject, as in (14b).<sup>4</sup>

<sup>4</sup> Both example sentences come from the German DWDS corpus (<http://www.dwds.de> [24 July, 2007]) and have been translated into Slovenian by the author.



- (13) a. [Slov.] Koža na glavi **ga** je srbela.  
The-skin on head **him-ACC** has itched.
- b. [Ge.] **Seine** Kopfhaut juckte.  
**His** scalp itched.  
‘His scalp was itching.’
- (14) a. [Slov.] Ko **ga** je srbela **noga**, ga je praskal eden izmed gospodov.  
When him-ACC has itched **the-leg**, him has scratched one of the-sirs.
- b. [Ge.] Als es ihn **am Bein** juckte, kratzte ihn einer der Herren.  
When it him-ACC **at-the leg** itched, scratched him one of-the sirs.  
‘When his leg was itching, one of the sirs scratched him.’

Table 7 shows how the semantic correspondences in these thematically divergent sentences can be made explicit by frame semantic annotation, by using second-layer annotation (cf. 3.2 above) in German.

Slovenian	German
Koža na glavi <b>ga</b> je srbela .	<b>Seine</b> Kopfhaut juckte . <b>Seine</b>
Ko <b>ga</b> je srbela <b>noga</b> , ga je praskal eden izmed gospodov.	Als es <b>ihn</b> <b>am Bein</b> juckte , kratzte ihn einer der Herren.

**Table 7.** Example sentences for German *jucken*, with FrameNet markup

### 4.3 Illustrating categorial divergence

In a bilingual dictionary, the canonical word equivalence is usually between lexical items of the same part of speech, as in (15) and (16). However, due to what Dorr (1994, pp. 615–616) calls *categorial divergence*, semantic correspondence might sometimes be established between words of cross-linguistically different parts of speech.

- (15) [Slov.] dolgčas N (m)  
[Ge.] Langeweile N (f)  
‘boredom’
- (16) [Slov.] dolgočasen ADJ  
[Ge.] langweilig ADJ  
‘boring’

FrameNet frames can host lexical units of different part of speech (e.g., both verbs and nouns). FrameNet-style annotation is thus suitable for illustrating categorial divergence because the translation equivalent sentences in which this phenomenon appears still evoke the same frame (also Padó 2007, p. 42). In a bilingual dictionary, frame semantic markup can illustrate cross-linguistic correspondences between frame-evoking words of any part of speech and between their frame elements, as illustrated in Table 8. It shows that specific translations of the German adjective *langweilig* into Slovenian do not always reflect the canonical equivalence given in the word table; instead of a form of the corresponding adjective (first line), a noun can appear in Slovenian. – Annotation refers to the `Subject_stimulus` frame, a summary of which is given in Table 9.

Slovenian	German
<i>Es</i> war furchtbar langweilig .	Bilo je obupno dolgočasno .
Mir ist langweilig .	Dolgčas mi je.
Das wäre langweilig !	To bi bil dolgčas !

**Table 8.** Example sentences for German *langweilig*, with FrameNet markup

In this frame either a Stimulus brings about a particular emotion or experience in the Experiencer or saliently fails to bring about a particular experience. [...]	
Frame Element	Definition
Stimulus	The Stimulus is the object or event which brings about the emotion in the Experiencer.
Experiencer	The Experiencer experiences the emotion brought about by the Stimulus.

**Table 9.** FrameNet Frame `Subject_stimulus`

## 5 Discussion and outlook

The case studies presented in Section 4 show that FrameNet-style markup of example sentences provides a semantic complement to the syntactic valence patterns already incorporated in *Online SLO-DE-SLO*. Many cross-linguistic divergences which are difficult to capture at the syntactic level alone can be adequately described by frame semantic annotation. Still, the incorporation of semantic annotation into the dictionary database remains a long-term goal rather than an immediate project. Some of the issues that first must be resolved are related to dictionary structure (5.1), others to the availability of resources (5.2).

### 5.1 Dictionary structure

If *Online SLO-DE-SLO* is to be enhanced with semantic annotations of examples, the question of storing annotation information must be addressed. A possible approach would be to integrate the annotation of example sentences into the example table; for instance, by augmenting the text with in-line XML markup. For several reasons, however, annotations should be represented separately and linked to the examples. First of all, it should be possible to turn off the display of semantic annotation. Second, each annotation is done with respect to one particular frame evoking word within the sentence. Now, the same sentence might be displayed as an illustration not only of this particular word, but also of all the other words it contains, when the user actually queries the dictionary. Automatic display of semantic markup targeting a word that does not correspond to the user query might be confusing. While a sentence may contain several frame-evoking words in respect to which annotation would be provided, the user will be interested in at most one of them at a time. This makes it necessary to index each annotation by the target word, which can then be accessed and evaluated by the display function, to ensure that only relevant annotations are shown.

Finally, each annotation must be provided with a reference to the evoked frame, and minimal information about this frame should be held in the dictionary database. This includes short frame definitions, information about the colors for presenting the markup, and the URL of the original FrameNet definition.

### 5.2 Multilingual FrameNets

To ensure internal consistency and consistency with existing FrameNet resources, the example annotations should ideally make reference to previously established monolingual FrameNets in German and Slovenian. In the case studies presented, the appropriate FrameNet frame for each illustrated word had first to be found before a sentence could be annotated. However, proceeding example by example does not make sure that a frame is interpreted consistently by an annotator, and does not facilitate verifying whether the frame is actually suitable for the language in all respects.

In fact, a frame might need language specific modifications even if some individual sentences seem to fit it (see e.g. Burchardt *et al.* 2006, Lönneker-Rodman 2007). The overall picture of the semantics of a given frame and its lexical units can only be achieved by investigating a large monolingual corpus, following the empirical approach adopted by FrameNet. For German, a substantial step in this direction has been made by the SALSA project (Burchardt *et al.* 2006). Their data, once released, should be regarded as a reference when adding semantic annotations to *Online SLO-DE-SLO*. For Slovenian, no such resource has been developed yet and it is unlikely that one will be available in the near future. Annotation within *Online SLO-DE-SLO* is a very first step. Still, its main merit will consist in pointing out methodological problems and possible solutions for this language as well as bilingual issues, rather than in substantial coverage.

The case studies have been presented against the background assumption that a FrameNet frame providing semantics for the selected sentences exists. This is not always the case. FrameNet itself does not yet cover the entire vocabulary of English. At the time of writing, it was impossible to find a frame for the Introducing situation corresponding to Example (1). Incomplete coverage of English FrameNet and possible work-arounds for FrameNet-style annotation in other languages have been pointed out previously by Burchardt *et al.* (2006, p. 971).

Finally, in spite of the high level of universality of FrameNet frames, not all frames based on English data are suitable for other languages. To illustrate, it is not clear whether the `Perception_body` frame is actually suitable for Slov. *zebsti* and Ge. *frieren* – ‘(to) be cold’ (see 4.2 above). The frame definition says that the body part affected is almost always mentioned with the words in the frame, which is not the case for the Slovenian and German verbs.

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