Tracing Sentiments: Syntactic and Semantic Features in a Subjectivity Lexicon

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Abstract

In this paper we present a syntactic and semantic analysis of verbal entries in the Czech subjectivity lexicon Czech SubLex 1.0 concerning their semantic and valency properties with respect to the roots and degree of subjectivity and evaluativeness. We demonstrate that evaluative verbs share certain abstract syntactic patterns with valency positions encoding the position of the source and target of evaluative stance. These patterns then roughly correspond to semantic properties of the verbs. For example, verbs propagating sentiments to the Actor position usually describe events of destruction (negative sentiments), or progress (positive sentiments), or events of direct experiencing emotional states, whereas verbs propagating sentiments to the Addressee or Patient position usually describe events of taking and communicating a stance, stopping or eliminating, or praising. The analysis represents the first step towards enhancing the lexical database with syntactic and semantic features in order to suit the lexicon for the task of the detection of targets (and sources) within evaluative stances.
Keywords: subjectivity lexicon; valency; sentiment analysis

1 Introduction

Sentiment analysis is a subfield of natural language processing searching for, extracting and classifying opinionated segments of text. One of its main goals is the identification of a positive or negative polarity, or neutrality of a sentence (or, more broadly, a text). Usually, this takes place by means of detecting the polarity items, i.e. words or phrases inherently bearing a positive or negative value. The polarity items are usually collected in the so-called subjectivity lexicons. The implementation of polarity items from the subjectivity lexicon into the data is the first step towards sentiment analysis.

There are more ways to build a subjectivity lexicon. A popular method for languages with sparse resources is providing a small amount of manually selected seed words and using bootstrapping algorithms to grow the list of word candidates (Banea et al. 2008). Polarity items can also be found by training probabilistic models on manually annotated data. Other approaches use translations of existing subjectivity lexicons (Milhacea et al. 2007), sometimes enhanced with triangulation methods (Steinberger et al. 2012).

There is a number of papers dealing with the topic of building subjectivity lexicons for particular languages, see e.g. (Bakliwal et al. 2012), (De Smedt and Daelemans 2012), (Jijkoun and Hofmann 2009) or (Perez-Rosas et al. 2012). The ongoing research on sentiment analysis in Czech language (Habernal et al. 2013),

(Veselovská et al. 2012) manifested the need for compiling a subjectivity lexicon for Czech. In 2013, the Czech Sublex 1.0, a subjectivity lexicon for Czech, was made publicly available.[1]

The experiments with incorporating the subjectivity lexicon into sentiment classifiers (Veselovská et al. 2013) hint that unfortunately, plain lexical databases do not suffice. The performance of classifiers suffers from the lack of verb sense disambiguation stage. Moreover, it is suggested that sentiments should be approached in a compositional way (Neviarouskaya et al. 2009), combining lexical, semantic and syntactic information. Incorporating syntactic and semantic information into lexicons has already become an established lexicographic praxis, a variety of valency lexicons have been edited so far and semantic class annotation has become a popular method of enhancing lexicographic annotation of verbs. Since verbs are considered the core of the sentence, naming the events and linking the participants into a coherent situation, it is of importance to capture their properties, syntactic and semantic, in complexity.

In this paper we present a preliminary linguistic analysis of verb entries in a Czech subjectivity lexicon Czech SubLex 1.0 concerning their semantic and valency properties with respect to the roots and degree of subjectivity and evaluativeness. On the basis of the analysis, we suggest enhancing the lexicon data with pointers to a Czech valency lexicon and to a semantic class database.

2 Methodology and Data

The presented analysis is based on the entries from the Czech SubLex 1.0. The core of the Czech subjectivity lexicon has been gained by automatic translation of a freely available English subjectivity lexicon,[2] see (Milhacea et al. 2007), which is a part of the OpinionFinder system (Wilson et al. 2005) for automatic subjectivity detection in English. The clues in this lexicon were collected from a number of both manually and automatically identified sources (Riloff and Wiebe 2003). The lexicon data have been translated into Czech via the parallel corpus CzEng 1.0 (Bojar et al. 2012) containing 15 million parallel sentences (233 million English and 206 million Czech tokens) from seven different types of sources automatically annotated at surface and deep layers of syntactic representation.

Czech sentence	English translation	Syntactic pattern
Topolánek není důvěryhodný.	Topolánek is not trustworthy.	ACT_{TARGET} $PRED_{COPULA}$ PAT_{EVAL}
Považuji tento film za špatný.	I consider the film poor.	ACT_{SOURCE} $PRED_{PSYCH}$ PAT_{TARGET} EFF_{EVAL}
Zeman si se vyjádřil o Klausovi kriticky.	Zeman spoke critically of Klaus.	ACT_{SOURCE} $PRED_{COMM}$ PAT_{TARGET} EFF $MANN_{EVAL}$
Jiří Paroubek udělal chybu.	Jiří Paroubek has made a mistake.	ACT_{TARGET} $PRED_{EMPTY}$ $CPHR_{EVAL}$

Table 1: Examples of syntactic patterns for non-evaluative verbs in evaluative stances.

1 http://hdl.handle.net/11858/00-097C-0000-0022-FF60-B
2 Available at http://mpqa.cs.pitt.edu/lexicons/subj_lexicon

Czech sentence	English translation	Syntactic pattern
Líbí se mi to jméno.	I like the name	ACT_{SOURCE} $PRED_{EVAL}$ PAT_{TARGET}
Duchovní láska člověka obohacuje.	Spiritual love enriches the man.	ACT_{TARGET} $PRED_{EVAL}$ PAT EFF
Nový ministr zdravotnictví dráždí novináře.	The new health minister irritates journalists.	ACT_{TARGET} $PRED_{EVAL}$ PAT_{SOURCE}
Novináři kritizují nového ministra zdravotnictví.	Journalists criticize the new health minister.	ACT_{SOURCE} $PRED_{EVAL}$ PAT_{TARGET}

Table 2: Examples of syntactic patterns for evaluative verbs.

The output of the translation were 7228 items – evaluative expressions. These items have been further manually inspected for reliability. During the refinement process, items have been removed from the lexicon when considered errors or unreliable items. The reasons for excluding an item from the list were manifold, reaching from the "lost in translation" phenomenon, through predictable errors of the system (e.g. in translating negated items) to a significantly different degree of evaluativeness of the Czech word. The final set consists of 4625 evaluative expressions, of which 1549 are verbs. Within the analysis, each verbal item of the lexicon has been considered separately in order to decide which valency argument of the verb corresponds to the target of the sentiment propagated by the verbal evaluative semantics.

The current version of Czech Sublex 1.0 contains information about word lemma, part of speech, polarity orientation and source-language equivalent. Our intention to the future is to add information about valency and semantic class characteristics to relevant entries, possibly by means of pointers to existing resources, such as VALLEX 2.5[3] (Lopatková et al. 2007), FrameNet (Ruppenhofer et al. 2006), or VerbNet (Schuler 2005).

3 From Lexicon to Sentence: Preparing the Grounds for Compositional Approach

There are several reasons why enhancing a subjectivity lexicon with information about verbal valency is valuable. First, different valency frames serve as unique identifiers of verb senses. It is a common phenomenon that individual senses of a lemma differ with respect to the presence (or absence), degree and orientation of polarity. Disambiguating different senses of a verb lemma allows us to identify sentiments more precisely. For example, in case of the verb "abdicate", we are able to differentiate between the intransitive pattern "to leave a position" which does not constitute evaluative meaning directly, and the transitive pattern ("abdicate one's responsibilities"), meaning "to fail" and creating an evaluation stance with opinion target at the position of the Actor. There is a whole group of verbs in

3 http://hdl.handle.net/11858/00-097C-0000-0001-4908-9

the original English lexicon sharing the non-evaluative semantics of "action under a physical disorder", which in their second sense describe an evaluative stance ("hobble", "jolt", "stammer" etc.). By feeding them into the translation process without verb sense disambiguation we risk gaining a considerable number of inappropriate lexical units which may later spoil the polarity tracking results. In a larger perspective, such a disambiguation process represents a decision between real subjective sentiments and the so-called "good" or "bad news" (objectively presented positive and negative content), a task recognized as important e.g. in the sentiment analysis of the news. (Balahur et al. 2010).

Valency is expected to be helpful in the task of the identification of the target of the evaluation as well. Traditionally, the subjectivity analyses distinguish three components of an evaluative private state[4] that need to be distinguished (Wiebe et al. 2004): the source, i. e. the entity expressing the private state, the target, i.e. the evaluated entity, and the evaluation, i.e. polar elements, words or phrases bearing positive or negative value.

Sublex verb	Czech sentence	English translation
abdikovat (abdicate)	Císař Vilém II. byl přinucen abdikovat.	The emperor Wilhelm II was forced to abdicate.
amputovat (amputate)	Lékaři mu museli amputovat chodidlo.	The doctors had to amputate his foot.
degenerovat (degenerate)	Schopnost naučit se mluvit u člověka degeneruje.	The ability of learning to speak degenerates in humans.
dovádět (frolic)	Tanečnice na parketu dovádí jako male děti.	The dancers frolicked on the dance floor like little children.
hladovět (starve)	Přiberu pět kilo, pak zase hladovím.	I put on five kilos, then I starve again.

Table 3: Examples of verbs not propagating sentiments to any of its arguments.

From the corpora of evaluative texts we are able to extract typical abstract syntactic (and semantic) patterns for expressing evaluative meaning.[5] Some verbs only serve as syntactic hints for evaluative words (evaluative nouns, adjectives, or adverbs), typically, this is the case of copular verbs, "psych" verbs (verbs describing mental action), communication eliciting verbs, or light verbs marking complex predication (phrasal verbs etc.), see table 1.

Other verbs function as bearers of the evaluation themselves, these are verbs which can be found in a subjectivity lexicon. In a typical verb-centered evaluative stance, evaluation as such is carried by the verb, while the source and the target of the evaluation occupy the positions of verb arguments. The

4 A subjective state, i.e. a state not open to objective observation or verification (see e.g. Ruppenhoffer et al. 2008).

5 The patterns presented in the tables are constructed in accordance with Functional Generative Description valency theory labelling standards, see (Sgall et al. 1986) based on the tectogrammatic layer of description. In this theoretical approach, the tectogrammatic layer represents deep syntactic relations between words, with certain extension into the area of semantic relations.

verbs in the lexicon then differ with respect to the question of sentiments propagation to individual arguments. Examples of syntactic patterns for evaluative verbs can be found in table 2.

A number of verbs which appear in the lexicon do not propagate sentiments to any of its arguments. These are most probably candidates for what we call "good/bad news" items. We describe good/bad news items as terms designating generally positive or negative situations or facts (like "war", "disaster" "luck" etc.). The good/bad news verbs (in their primary meaning) do not evoke a positive or negative attitude to an entity/situation/fact occupying any of the valency positions, rather they function at the same time both as the polar word and the target of the sentiment. Examples of such verbal items are listed in table 3.

Due to the fact that none of the good news/bad news verbs propagates the sentiment to any of its valency participants, it is necessary to mark them as a separate category in the lexicon. Still, it is beneficial to keep them in the lexicon because they provably, though indirectly, influence emotions of the reader.

Table 4 contains verbs propagating sentiments to the Actor position. They usually describe events of destruction (negative sentiments), or progress (positive sentiments), or events of direct experiencing emotional states.

The interesting thing with verbs propagating sentiments to the Actor position is that they are usually verbs allowing the Abstract Cause-Subject alternation (Levin 1993), i.e. an alternation of valency participants of the type "Mike distorted the wonderful moment with a scream" and "Mike's scream distorted the wonderful moment". Different aspects of the semantic shift between the two alternations are widely discussed (Alexiadou and Schäfer 2006) and the shift of the sentiment focus can be seen as significant in this respect.

As can be seen from table 5, verbs propagating sentiments to an Addressee or Patient position usually describe events of taking and communicating a stance (both polarities), stopping or eliminating (negative), or praising (positive).

Another pattern is evident from the data: the target of the evaluation is the centre of the evaluative stance. The way the source of evaluation is expressed is dependent on the verb's semantic choice of the target argument. If the target is expressed by a PAT argument, the source occupies the ACT position. If the target is selected at the ACT position, the source must be expressed external to the clausal structure (e.g. by means of "in my opinion" etc.).

The issue of propagating sentiments is more than complicated. There are of course more argument types than we have suggested so far to which sentiments can be propagated. The sentiments may be propagated to more than one argument in a structure. For example, in a sentence "John criticized Mary for her not coming," the negative sentiment affects not only "Mary" as the patient, but also "her not coming" as the cause of critique. The same may apply to verbs allowing the Abstract Cause-Subject alternation, where the sentiments may affect secondarily not only the Actor position, but also the position of the Abstract Cause if present overtly.

Sublex verb	Czech sentence	English translation	Syntactic pattern
bavit (amuse)	Hoteliérství mě baví ze všeho nejvíc.	I most enjoy being a hotel owner.	ACT_{TARGET} $PRED_{EVAL}$ PAT_{SOURCE}
děsit (freak)	Nekonečná samota tě děsí.	The neverending solitude freaks you out.	ACT_{TARGET} $PRED_{EVAL}$ PAT_{SOURCE}
kazit (spoil)	Nedovolím ti kazit mi život.	I won't allow you spoil my life.	ACT_{TARGET} $PRED_{EVAL}$ PAT
narušit (distort)	Nádhernou chvíli narušil výkřik.	The wonderful moment was distorted by a scream.	ACT_{TARGET} $PRED_{EVAL}$ PAT
naštvat (upset)	Rozhodčí naštval domácího borce.	The referee upset a guy from the home team.	ACT_{TARGET} $PRED_{EVAL}$ PAT_{SOURCE}
ohrozit (endanger)	Těžba ohrozí existence jejich domovů.	Mining will endanger the existence of their homes.	ACT_{TARGET} $PRED_{EVAL}$ PAT
zachránit (rescue)	Dobré jméno vlády zachránil ministr Bursík.	The Government's credit was saved by minister Bursík.	ACT_{TARGET} $PRED_{EVAL}$ PAT EFF
zlepšit se (improve)	Zlepšila se jí pleť a rozjasnily oči.	Her skin improved and her eyes brightened.	ACT_{TARGET} $PRED_{EVAL}$ ORIG PAT

Table 4: Example of verbs propagating sentiments to the Actor position.

Deciding the sentiment propagation direction also may be a nontrivial question – which of the two affected arguments receives the sentiment primarily and which acquires it on the basis of some semantic transfer. To make the issue even more fuzzy, there is more than one kind of sentiment. We must distinguish between the sentiments that affect the "source of evaluation" in the text and sentiments which affect the "perceptor" of the text. Thus for example, in the sentence "John ignored Mary without reason," Mary is the target of negative sentiments of John, but John may also be a target for negative sentiments held by the reader. Similar transfer of sentiments from the "inner" sentential structure (textual source of sentiments) to the "external" reader's perception appears with many verbs propagating sentiment to a non-actor position (cf. table 5). In a valid lexicon for opinion target extraction, we must keep the information about which of the two sentiments (reader-oriented or source-oriented) we want to trace.

Though the overall situation is quite complex, it can be seen from the analysis that verbs propagating sentiments to the same arguments usually belong to the same semantic classes, or at least share the same semantic components. The clusters of semantically similar verbs arising in the analysis are well traceable in common semantic class databases, like VerbNet of FrameNet. Thus, exploring the semantic affiliation of the verbs and recording it in the lexicon may be beneficial for further lexicon bootstrapping tasks.

4 Conclusions and Future Work

We have described a newly emerged Czech subjectivity lexicon SubLex 1.0. The method of automatic translation from a source to a target language is on one hand quick and easy, on the other hand demands a further refinement processes, which may be costly, and brings certain challenging consequences: the target lexicon has different properties (part-of-speech distribution, degree of evaluativeness of individual words, possibly even polarity orientation of the individual words) than the source one.

Subjectivity lexicon capturing the information about prior polarities of words is a useful and needed resource for sentiment analysis of textual data. Nevertheless, it does not suffice for sentiment analysis tasks on its own. For a successful analysis of sentiment, syntactic and semantic patterns must be also employed, in order to prevent mistakes and handle the data appropriately.

We have offered here a brief analysis of the subjectivity lexicon data both in the contrastive perspective to the original items and in the mutual relations of the lexical items in the paradigm of valency and semantic class characteristics. This analysis is a first step towards a more thorough research into the linguistic properties of expressing evaluation and towards implementing the theoretical knowledge into sentiment analysis experiments.

The methodology described above is expected to ease the process of identification of the source and target of the evaluation, which would not be possible with a simple plain text with no semantic features annotated. In the near future, we would like to accomplish the extended annotation of the Czech SubLex with labels designating the typical deep syntactic pattern of the evaluative stance and verify our findings by a series of experiments. In the first step, we would like to map the verbs from SubLex also into the PDT-Vallex (Urešová 2009), a valency lexicon which is interlinked with the dependency treebank, and try to automatically extract the sources and targets of the evaluation on the syntactically annotated data of the PDT, where both syntactic and semantic roles are manually annotated.

verb	**Czech sentence**	**English translation**	**Syntactic pattern**
bát se (fear)	Bojím se, že přijdu o všechny své peníze.	I fear losing all my money.	ACT_{SOURCE} $PRED_{EVAL}$ PAT_{TARGET}
degradovat (degrade)	Tento přísup degraduje ženy na pouhé sexuální objekty.	This approach degrades women to mere sex objects.	ACT_{SOURCE} $PRED_{EVAL}$ PAT_{TARGET}
doporučit (recommend)	Studium lingvistiky bych doporučil každému studentovi.	I would recommend studying linguistics to any student.	ACT_{SOURCE} $PRED_{EVAL}$ ADDR PAT_{TARGET}
důvěřovat (trust)	Tvému úsudku plně důvěřuji.	I fully trust your opinion.	ACT_{SOURCE} $PRED_{EVAL}$ PAT_{TARGET}
eliminovat (eliminate)	Je potřeba eliminovat falešná doznání.	It is necessary to eliminate false confessions.	ACT_{SOURCE} $PRED_{EVAL}$ PAT_{TARGET}

verb	Czech sentence	English translation	Syntactic pattern
kárat (reproach)	Vedoucí káral nevkusně oděného účetního.	The manager reproached the tastelessly dressed accountant.	ACT_{SOURCE} $PRED_{EVAL}$ PAT_{TARGET}
odmítnout (reject)	Odmítnul nabídku členství v KSČ.	He rejected the offer of becoming a member of the communist party.	ACT_{SOURCE} $PRED_{EVAL}$ PAT_{TARGET}
oslavovat (praise)	Švýcaři oslavují nového šampióna ve sjezdovém lyžování.	The Swiss praise the new champion in alpine skiing.	ACT_{SOURCE} $PRED_{EVAL}$ PAT_{TARGET}
prosazovat (advocate)	Rychlé přijetí evropské měny prosazuje Jan Švejnar.	Jan Švejnar advocates prompt adoption of the euro.	ACT_{SOURCE} $PRED_{EVAL}$ PAT_{TARGET} EFF

Table 5: Example of verbs propagating evaluation to the position of Addressee or Patient.

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