

Use of support verbs in FrameNet annotations

Kaarlo Voionmaa, Karin Friberg Heppin

Språkbanken, CLT, University of Gothenburg Address
 E-mail: kaarlo.voionmaa@svenska.gu.se, karin.friberg.heppin@svenska.gu.se,

Abstract

This article discusses the frame semantic annotations done in the Swedish FrameNet (SweFN) at the Centre for Language Technology (CLT) at the University of Gothenburg. The annotations are made manually, and result in full-coded frames. These are conceptual structures representing the description of types of situations, objects or events. We focus on annotations where verbs combine with nouns to produce predicates, e.g. *göra* 'make' in *göra uppehåll* 'make a pause.' These verbs are called *support verbs*, and the corresponding constructions *support verb constructions* (SVC). Not all verb-noun-combinations are SVCs, and adequate defining features are required to identify eligible SVCs. The focus of this paper is to scrutinize the criteria through which this aim can be achieved. Working at the CLT, we have access to a variety of computational research tools and a large Swedish text corpus. These resources buttress the annotation by showing, among other things, frequential properties of verb-noun combinations. We also discuss lexico-semantic features of the Swedish language as revealed through annotations.

Keywords: support verb constructions; frame semantics; annotation; Swedish

1. Introduction

Multiword expressions are a central and well-debated topic in linguistics and computational linguistics. Among the many kinds of multiword expressions there are constructions, where the finite verbs of sentences are semantically reduced and syntactically supportive of their nominal and, occasionally, adverbial complements. It concerns collocations such as *(He) gave a lecture*, where *lecture* is the base of the collocation and *gave* is the collocating verb. *Gave* has a non-free sense in this construction and does not have the sense of transferring possession that it has in constructions like *(He) gave ice cream to the children*. We call collocations like *give (a) lecture*, *support verb constructions* (SVCs), and the verb a *support verb*.¹

¹ For a discussion on the relevant terminology, see Langer (2004b). Constructions such as or similar to the one examined in this study have been termed as *complex predicates*, *operator verbs*, *light verbs* and others.

2. Aim of the paper

The paper deals with annotations of SVCs, which are performed manually with the help of various computational tools and resources.² The SVC annotations are discussed both from a theoretical and practical point of view drawing on the relevant criteria presented by Ruppenhofer et al. (2010), and from the perspective of the tests that Stefan Langer (2004a) put forward. The focus is on the criteria used to distinguish SVCs from verb-noun combinations that are not eligible as SVCs, which has proved to be a difficult matter in practical work on annotations. A well-informed understanding of the role SVCs play in language will benefit several different areas such as text generation, information extraction and text understanding.

SVCs can often be paraphrased by monomorphic verbs, and therefore their use also concerns areas such as psycholinguistics and its applications in second language acquisition. SVCs are also interesting from a typological point of view, since they occur in many languages, though there certainly are differences in how they are construed in them. For SVC-constructions in Japanese, see Miyamoto (1999); in Korean and Japanese, Karimi-Doostan (1997); in Farsi, Goldberg (2003); in Czech and Swedish, Cinková (2009); in German, Hanks & al. (2006); and in Urdu, Butt (2003).

In their study on collocations extracted from the FrameNet corpus, Alonso Ramons et al. (2008) state that support verbs are lexically idiosyncratic, and thus hard to predict.³ In this article we discuss ways to deal with these difficulties; and in particular, the criteria for identification of support verbs and SVCs. We also examine a sample of representative SVCs in order to show how the computational research tools can be used to buttress analytical work with verb-noun combinations.

3. The Swedish FrameNet project

The present study is part of the research work currently carried out in the Swedish FrameNet++ project (SweFN++) at the Centre for Language Technology in Gothenburg.⁴ The main goal of SweFN++ is the creation of a fully integrated lexical macro-resource for Swedish for use as a basic infrastructural component in Swedish language technology research and in development of natural language processing

² The corpus search interface Korp has a central role insofar as access to and use of the corpora. It contains 146 corpora, 104 712 701 sentences and more than 1.4 billion tokens (Oct. 2013). Apart from Korp, lexicon search interfaces available to the SweFN project also include *Karp*, which comprises 21 lexica and 673,932 entries. Integrated with Korp and Karp there is SALDO (Swedish Associative Thesaurus), which is an extensive electronic lexicon resource for the modern Swedish written language.

³ Their list of English support verbs is found at <http://www1.ccls.columbia.edu/~nlp/resources/support-verbs.txt>. For computationally oriented research on SVCs, see Salkoff (y.a.), Grefenstette & Teufel (1995), and Laport et al. (2008).

⁴ Funded by Vetenskapsrådet under contract 2010-6013 (Borin et al., 2010).

applications and annotated corpora for Swedish. A second goal is to make all resources and tools developed in the project freely available under open-content/open-source licenses. One specific objective of the SweFN++ project is to create a full-scale Swedish FrameNet fully integrated into the macro-resource.

The Swedish FrameNet (SweFN)⁵ is a full-scale lexical resource with a target size of at least 50,000 lexical units which is designed to support Swedish LT applications such as machine learning, text generation, text understanding and information extraction, in all domains. In September 2013, SweFN covered 905 frames comprising over 26,000 lexical units from the SALDO (Borin et al., 2010).

The project is based on the English Berkeley FrameNet (BFN) under construction by a research team at the International Computer Science Institute in Berkeley. BFN contains over 10,000 lexical units in more than 1,000 frames, together with more than 170,000 sentences. There is a fairly big difference between the number of lexical units in BFN and SweFN, a difference which is mainly due to the specific focus in the latter project on lexical units, while in BFN the focus has been on annotated example sentences.

4. FrameNet annotation procedure

Annotation, in SweFN as in BFN, entails labeling words and phrases of a given example sentence as *frame elements* (FEs), representing different semantic roles. These elements pertain to certain *frames*, frames being script-like structures describing different types of situations, objects or events. The annotation applies frame semantic principles, and in accordance with them, the FEs divide into core FEs and non-core FEs. The core FEs are part of the definition of the frames. The non-core FEs, such as Manner, Place and Time, are elements of more general kind and exist in many frames.

The annotation is partial in the sense that the labels of FEs are applied only to the relevant words or phrases of example sentences. Moreover, annotation concerns whole constituents rather than only the heads of the constituents.

In Table 1, a simplified frame annotation is shown.⁶ It concerns the frame SPEAK_ON_TOPIC, and there is an SVC in each of the example sentences. The support verb is tagged as SUPP. The tags of the frame elements are self-explanatory, whereas the digits after the LUs (e.g. lecture...1) are indexes of the entries or word senses in SALDO. In this manner, the lexical units in SweFN are systematically connected to other resources of SweFN.

⁵ SweFN is available as a free resource (CC-BY-SA 3.0, LGPL 3.0).

⁶ For more information on frame annotations, see <http://spraakbanken.gu.se/eng/research/swefn>

In Table 1, there are two example sentences, whose predicate verbs are, respectively, **ger** 'gives' and **hölls** 'was-held'. Both of them collocate with the noun **föreläsningar** 'lectures', with which they build a SVC. One may notice that in the group of lexical units, these verbs are not included. This is because they are supportive lexical elements and not full lexical units of the frame.

Frame	SPEAK_ON_TOPIC	English translation
Core FEs	Audience (A), Speaker (S), Topic (T)	
Non-core FEs	Explanation (E), Manner (M), Medium (ME), Occasion (O), Place (P), Time (TI)	
Examples	Ja, och så [SUPP ger] [S jag] [LU föreläsningar]. [TI Igår] [SUPP hölls] [LU föreläsningar] [T om livsstil och hälsa] [P i Nordstan].	Yeah, and then [SUPP give] [S I] [LU lectures]. [TI Yesterday] [SUPP were-held] [LU lectures] [T on lifestyle and health] [P in Nordstan]
Lexical units from SALDO	vb: föreläsa..1, predika..1 nn: föreläsande..1 föreläsning..1 predikande..1	vb: lecture..1, preach..1 nn: lecturing..1, lecture..1, preaching..1

Table 1. The frame SPEAK_ON_TOPIC with annotated example sentences.

The annotation of SVCs like the ones shown in table 1, is based on the study by Ruppenhofer et al. (2010), which has in practical terms been the manual of the SweFN project.

5. Support verb constructions

In the Berkeley FrameNet project, it was noticed that the SVCs brought with them “discrepancies between syntactic and semantic structure” (Fillmore et al., 2003). These discrepancies are due to the fact that in SVCs the support verb is the syntactic head, whereas the noun is the semantic head. Fillmore et al. (2003) call the support verbs “semantically neutral.” They characterize these verbs by saying that they “turn an event noun or a state noun into a verb phrase-like predicate [...]” (op. cit.).⁷

In SVCs, the verbs are typically selected by the nouns rather than the other way around. In English, for instance, the noun **prayer** opts for the verb **say**, (**say**

⁷ Apart from SVCs there are two more verb-noun constructions that are of importance for annotation, namely, the copula-noun (or copula-adjective) combination, and the construction having a controller verb such as *merit*, *offer*, *consider* and *find* as its syntactic head. See Ruppenhofer et al. (2010: 32–33 and, 40–41) for more specific information.

prayer), while the corresponding verb for *speech* is *give* (Fillmore et al., 2003: 244). Occasionally, the choice of verbs may concern fairly fine-grained nuances as for instance in Swedish, where there is a distinction between *ha samtal* 'have conversation, converse' vs. *hålla samtal* 'hold conversation(s), arrange discussion(s)'. In this case, *samtal* 'conversation, discussion' opts either for *ha* or *hålla*, depending on whether it concerns customary conversing or whether it is about arranging conversation(s).

In their study, Ruppenhofer et al. (2010) provide criteria for identification of the SVCs. Before presenting the criteria, they briefly discuss semantic features of support verbs. They state that these verbs do not introduce significant semantics of their own but that this does not mean that these verbs are void of semantic features altogether. This state-of-affairs is illustrated in the following examples where the support verb is in bold face:⁸

Causative support verb: **orsaka** + förstörelse 'cause + destruction'

Aspectually inchoative support verb: **få** + insikt 'get + insight'

Support verb indicating point-of-view: **ta** + lån 'take loan'

Ruppenhofer et al. (2010) define the support verb constructions using four criteria that are listed and commented below:

1. **The support verbs govern the nouns syntactically.** This is the case for example, in the sentence **Han gav en föreläsning** 'He gave a lecture.', where *föreläsning* is the object complement of the verb *gav*.
2. **The noun denotes a state, event, or relation by itself.** This criterion excludes a number of other groups of nouns like sentient entities such as human beings and animals.
3. **The support verb does not have the same meaning in the SVC as it has without the construction.** This criterion specifies that verbs that are used as support verbs are polysemous. The polysemy of a verb can be examined with the help of the so-called Zeugma-test as explained below and in Langer (2004a).
4. **In an SVC, the support verb has very little meaning of its own.** The meaning of the construction relies almost entirely on the noun. This criterion must be applied with the reservation that support verbs may have semantic

⁸ In her study on light verbs (i.e. support verbs), Brugman (2001) comes to the conclusion that they not merely have function but meaning too. She suggests that light verbs are systematically related to their heavy counterparts in retaining their force-dynamic properties but drawing rather on a psychological domain than a physical domain as do their heavy counterparts.

properties of their own as shown above. Moreover, support verbs may assign semantic roles to given syntactic constituents. In the sentence **Hon genomgick en operation** 'She underwent an operation', the support verb **genomgick** 'underwent' assigns the semantic role Patient to **hon** 'she', the subject of the sentence, while in the sentence **Hon genomförde operationen** 'She performed the operation', the support verb **genomförde** assigns the role Agent to the subject noun **hon**.

In order to find a more unequivocal base to define the SVC, we may turn to the tests that Stefan Langer has presented. In his study (2004a), he puts forward a test battery to define SVCs and support verbs. In this battery, the Zeugma-test distinguishes whether a verb has more than one sense. An appropriate example is the sentence ***Hon gav en föreläsning och glass till barnen** 'She gave a lecture and ice cream to the children'. This sentence is semantically infelicitous, and as such it shows that when the verb **ge** 'give' combines with **föreläsning** 'lecture,' it has not the meaning of transfer of possession that it has in the sentence **Hon gav glass till barnen** 'She gave ice cream to the children.' In combination with the complement **föreläsning** 'lecture', the verb **ge** (and, respectively, **give**) is simply a support verb having "little meaning of its own" as required in criterion four of Ruppenhofer et al. (2010).

Another test that Stefan Langer (2004a) discusses, concerns the SVCs that can be paraphrased with a semantically equivalent monomorphic verb. For instance, the SVC **ge en föreläsning** 'give a lecture' can be paraphrased with a semantically equivalent monomorphic verb **föreläsa** 'to lecture'. By contrast, constructions consisting of non-support verbs combined with noun complements may not be paraphraseable as monomorphic verbs. See section 6.1 for further discussion on this issue.

6. SVCs in the Swedish FrameNet annotations

Below, a sample of SVCs is studied. The focus is on on three of the four SVC criteria. Criterion 1 is omitted, because all instances of SVCs examined in this paper are verb-noun combinations. The SVCs are presented in the form of verb-noun pairs. We take each of the three criteria and examine how they have been applied in the actual framenet codings. In the case of criteria 3 and 4, we shall make use of SALDO alongside Korp, the corpus search interface, and Karp, the lexical infrastructure and search tool (see footnote 2).

6.1.1 Semantic properties of the SVC-noun base

Criterion 2 requires that the noun base of the construction denotes state, event, or relation by itself (see chapter 5). Whether this requirement is realized in the annotated SVCs may be difficult to establish. Ruppenhofer et al. (2010) do not give definitions or clear guidance, either, as to how the notions in question should be interpreted. In what follows, the semantic properties of noun bases of SVCs will be

examined from the point of view of paraphraseability.

Paraphrasing is suggested by Stefan Langer (2004a) as one of the tests of SVCs, because in paraphrases both the noun base and the verb collocate are involved. Paraphrasing also reveals what the noun bases of the constructions are semantically like. In Table 2, a sample of SVCs is presented, first in Swedish in the left column, then translated into English in the middle, and paraphrased with the corresponding monomorphemic Swedish and English verbs in the right column.

Support verb construction	English translation	Monomorphemic verb
driva + jordbruk	practise + farming	bruka (jord) / to farm
begå + våldsbrott	commit + crime of violence	? våldföra / ? to violate
ge + komplimang	give + compliment	komplimentera / to compliment
göra + distinction	make + distinction	urskilja / to distinguish
göra + försök	make + attempt	försöka / to attempt
hysa + aversion	show + aversion	ogilla / to avert
hålla + överläggning	hold + discussion	diskutera / to discuss
lägga + tonvikt	lay + emphasis	betona / to emphasize
ta + hämnd	take + revenge	hämnas / to revenge

Table 2. Sample of SVCs paraphrased as monomorphemic verbs

All verb-noun pairs in the table can be paraphrased in a fairly straightforward manner except for **begå våldsbrott** ‘commit crime’, which perhaps should be interpreted as an idiom rather than a SVC. (For idioms in modern Swedish, see Sköldberg 2004.)

In regard to semantics of the noun bases, a prominent feature appears, namely, the fact that all of them denote some kind of activity or check on activity, i.e. event, state or relation. Consequently, the verb-noun pairs in table 2 meet the second criterion of SVCs as posited by Ruppenhofer et al. (2010).

6.2 SVCs and polysemy of the verbs involved

According to the third SVC criterion, the support verb does not have the same meaning in the SVC as it has without the construction as a full verb. This means that,

in effect, the support verb should be polysemous. To illustrate this criterion, the semantic features of the verb **hålla** ‘hold’ can be studied. It is frequently used as a support verb in Swedish, and it also belongs to the most frequent full verbs of the language. In table 3, the full verb **hålla** has been differentiated into its senses derived from the SALDO (see footnote 2).

Sense-ID	English	Frame
hålla..1	grab	Manipulation
hålla..2	be operational	Being_operational
hålla..3	fulfill	Meet_specifications
hålla..4	do something with X	Intentionally_affect
hålla..5	side, support	Taking_sides
hålla..6	last, persist	Duration_relation
hålla..7	remain, stay	State_continue
hålla..8	keep X V-ing	Cause_to_continue

Table 3. Senses of **hålla** ‘hold’ in the SALDO lexicon.

Table 3 illustrates the polysemy of the verb **hålla** ‘hold.’ It can be noted that none of the senses listed in the table is applicable as a sense of **hålla** when it is used as a collocate verb of SVC. It seems, then, that **hålla** as a support verb and as a full verb are mutually exclusive in semantic terms. Insofar as the tools and resources are concerned, we may note that when analyzing the semantic properties of **hålla**, SALDO as a half-automatic implement is of great help. It buttresses the reliability and validity of the analysis.

6.2.1 SVCs and semantic lightness of the support verbs

The fourth criterion states that the support verb of the SVC should have very little meaning of its own and that the meaning of the construction relies almost entirely on the noun. As a collocate in a given SVC, the verb should not be semantically specific. So, for instance, a semantically specific verb like **heed** may not be used as a support verb whereas a polysemous verb such as **hålla** will do as a support verb (see above section 6.2).

Whether or not the criterion is realized in a verb-noun combination can be ascertained in several ways with the help of available lexical resources. To begin with, one may assume that if a given transitive verb, which is the most common type of verb in SVCs, has object complements that semantically differ greatly from one another, the verb may be semantically not specific but have little meaning of its own. Based on this, it may be eligible as a verb collocate of a SVC.

In order to examine the issue, we may extract so-called *word picture* from Korp. This picture shows the lexical context of the search term as based on frequency in the

large lexical corpora. In the present case, it concerns nouns that occur after **hålla** 'hold.', which is opted as the search term. Table 4 below shows the 14 most frequent object complements of the verb.

Object complement of <i>hålla</i>	English translation	Freq
koll	control	2206
möte	meeting	1514
utkik	outlook	1419
val	choice, election	1267
tumme	thumb	1244
tävling	competition	942
väder	weather	869
förhör	interrogation	610
rättegång	trial	589
trend	trend	580
tal	speech	512
folkomröstning	referendum	512
häktningförhandling	committal proceedings	301
konferens	conference	42

Table 4. Object complements of the verb **hålla**

The first impression of the word picture shown in table 4 is that the semantic spread of the object complements of the verb **hålla** is considerable. The following nouns (here, in English) stand for some kind of event: **meeting, competition, interrogation, trial, speech, referendum, committal proceedings** and **conference**. On the other hand, **control, outlook** and **weather** denote different sorts of state, whereas **trend** denotes a certain kind of relation. **Hålla tummarna**, lit. 'hold the thumb(s)', is a Swedish saying corresponding to the English turn of phrase **cross one's fingers**.

In the word picture, a number of different nouns collocate with **hålla**, the search term, which unequivocally shows that **hålla** is a semantically non-specific verb. As such, it meets the fourth criterion of SVCs and suits well to be used as a support verb..

6.2.2 Head verbs of a given object complement

The word pictures extracted through Korp make it easy to examine various aspects of verb-noun combinations. One may take a noun as the search term, and examine what verbs may have it as the object complement. This can be illustrated with the following example, where the search term is the noun **överläggning** 'discussion, consultation'.

The word picture in table 5 shows that the verb **ha** + **överläggning** 'have discussion' is the most frequent verb-noun combination followed by **hålla** + **överläggning** 'hold discussion.' Both of these verbs are very polysemous. The verbs **inleda**, **fortsätta**, **ta**, **ta upp**, **begära** and **kräva**, on the other hand, differ from **ha** and **hålla**, since they denote a situation where discussion is being started or requested to start. Therefore they can be described as semantically specific verbs. The verb **föra** 'conduct' is close to **ha** and **hålla** as it also denotes continued pursuing of activity. The verb **pågå** 'be going on' differs from these verbs, since it takes the activity itself as its subject, typically in sentences with a preposed adverbial, e.g. *I New York pågår överläggningarna*, lit. 'In New York the discussions are going on.' Consequently, **ha**, **hålla** and **föra** can be used as support verbs with the noun base **överläggning** in SVCs.

Verb before the noun överläggning	English translation	Freq
ha	have	520
hålla	hold	122
inleda	open	75
fortsätta	continue	56
ta	take	50
ta upp	take up	42
begära	want, request	34
föra	conduct, pursue	32
kräva	demand	31
pågå	be going	29

Table 5. Verbs used before **överläggning** in Swedish text corpora as extracted through Korp

In this section the word picture of the search term **överläggning** has been examined. It has been found out what the verbs are semantically like that appear as its heads in various verb phrases. The word picture has also distinguished a group of verbs that may construe a SVC together with **överläggning**. These verbs are **ha**, **hålla** and **föra**. Both the present word picture and the one discussed in section 6.3 have proved to be useful for the analysis, since they have helped investigate more closely Swedish SVCs and support verbs. We may conclude that research workers' knowledge of language and her/his linguistic intuitions are buttressed and, at times, contested by the evidence shown in these pictures.

7. Conclusions

This article can be summarized in three points:

(1) Support verbs in SVCs are non-specific and polysemous verbs, and they collocate with nouns that typically denote state, event or relation. A list of verbs eligible as collocates in SVCs might be a good idea to compose in combination with a list of eligible noun bases. With the help of such lists the frame semantic annotation of SVCs could be made more consequent and, hopefully, more automatic, and thereby less time consuming. One has to keep in mind, however, that the eligibility of both nouns and verbs for SVCs may be difficult to pin down, in which case tests such as the Zeugma-test and the paraphrasing test may be helpful.

(2) SVCs and monomorphic verbs are often paraphraseable with one another. This enhances expressive resources of the language. Occasionally, fairly fine-grained distinctions emerge between SVCs themselves such as **ha** vs. **hålla samtal** 'have vs. hold (or arrange) conversation(s)', in Swedish.

(3) Research workers' linguistic competence, language knowledge and their linguistic intuitions are essential for successful analysis and annotation of SVCs. However, computational tools and lexical resources such as Korp, Karp and SALDO, are very much needed to buttress this work. In regard to verb-noun combinations, the aim is to establish as unequivocally as possible, their status as constructions, that is, for instance, whether they are SVCs or not. This aim should be pursued effectively and consequently, because it contributes to the value of SweFN as a reliable, adequate and rich lexical resource for linguistic research.

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