Framing of Verbs for Turkish PropBank

Gozde Gul Sahin

Department of Computer Engineering
Istanbul Technical University
Istanbul, 34469, Turkey
isguderg@itu.edu.tr

Abstract. In this work, we present our method for framing the verbs of Turkish PropBank and discuss incorporation of crowd intelligence to increase the quality and coverage rate of annotated frames. First, we discuss the manual framing process by experts with the help of publicly available dictionaries, corpora and guiding morphosemantic features such as case markers. Then, we present a systematic way of framing for challenging cases such as light verbs, multiword expressions and derived verbs. Later, a verb sense disambiguation task where the verb senses correspond to annotated frames, is crowdsourced. Finally, the results of verb sense disambiguation task are used to increase the coverage rate and quality of created linguistic resource. In conclusion, a new lexicon of Turkish verbs with 759 annotated verbs and 1262 annotated senses is constructed.

Keywords: Turkish PropBank, Semantic Role Labeling, Semantic Frame, Light Verb, MWE

1 Introduction

In recent years considerable amount of research has been performed on extracting semantic information from sentences. Revealing such information is usually achieved by identifying the arguments of a predicate and assigning meaningful labels to them. Each label represents the argument's relation to its predicate and is referred to as a semantic role and this task is named as semantic role labeling (SRL). SRL aims to answer the question "Who did what to whom?", thus reveal the full meaning of a sentence. It has been employed in machine translation, information extraction and question answering tasks.

There exists different semantic role annotaion schemes, where the most commonly used ones are VerbNet [20], FrameNet [6] and PropBank [17]. **FrameNet (FN)** is a semantic network, built around the theory of **semantic frames**. All predicates in same semantic frame share one set of Frame Elements (FEs). In the example below, a sentence with predicate "buy", annotated with FrameNet, VerbNet and PropBank convention is given. The predicate "buy" belongs to "Commerce buy", frame of FrameNet which contains "Buyer", "Goods" as core frame elements and "Seller" as a non-core frame element. Moreover, FN provides connections between semantic frames like inheritance, hierarchy and causativity.

Contrary to FN, **VerbNet (VN)** is a hierarchical verb lexicon, that contains categories of verbs based on Levin Verb classification [20]. The predicate "buy" is contained in "get-13.5.1" class of VN, among with the verbs "pick", "reserve" and "book". Members of same verb class share same set of semantic roles, referred as **thematic roles**. In addition to thematic roles, verb classes are defined with all possible syntaxes for each class. One possible syntax is given below the examplary sentence. Unlike FrameNet and VerbNet, **PropBank (PB)** [17] does not make use of a reference ontology like semantic frames or verb classes. Instead semantic roles are numbered from Arg0 to Arg5 for the core arguments. Moreover, PropBank has an associated annotated corpus that help researchers to specify SRL as a task, furthermore are used as training and test data for supervised machine learning methods [11] [23].

[I]$_{\text{Buyer-Agent-Arg0}}$ bought [a coat]$_{\text{Goods-Theme-Arg1}}$ from [the flea market.][1]

Syntax: Agent V Theme {From} Source

In [18], the authors investigate the usability of FrameNet, VerbNet and PropBank conventions for modern Turkish and conclude that the PropBank convention with additional morphosemantic features would be the most appropriate semantic resource. Unfortunately, creating a qualified PropBank for a morphologically complex language with low-resources is a challenging task. Creation of such a corpus is generally considered as the combination of two subtasks: Framing of Verbs and Corpus Annotation with framed verbs. Framing process includes deciding on the verbs to annotate, examining different senses of the chosen verbs and deciding on the arguments for each verb sense. The languages with rich resources mostly perform corpus annotation in one step with large number of annotaters. Due to small number of expert annotaters, we choose to divide corpus annotation into two microtasks for crowdsourcing: Verb Sense Annotation and Argument Labeling. In the verb sense annotation task, people are asked to disambiguate the meaning of the verbs in the sentences from a morphologically and syntactically analysed corpus and in argument labeling task, annotaters are asked to label the arguments of the previously annotated verb senses.

Framing of Turkish verbs can be considered as the most important step for PropBank creation. The errors introduced in framing process may accumulate and may significantly reduce the accuracy and reliability of semantic role labeling task. Moreover, it can be considered as the most complicated task specially for languages with rich derivational morphology and with large number of light verbs and multi word expressions like Turkish. In this paper, we focus on this process due to its importance and difficulty, whereas we investigate the details of latter processes in other studies. In next sections, we present the details of our approach on choosing verbs and their arguments for annotation, framing light verbs/multiword expressions and incorporation of declension. Further on, we explain how

[1] In PropBank Arg0 is used for actor, agent, experiencer or cause of the event; Arg1 represents the patient, if the argument is affected by the action, and theme, if the argument is not structurally changed.

we interpreted the results of crowdsourced verb sense disambiguation microtask for fine-tuning verb frames. Finally, we conclude by describing the properties of created linguistic resource and results of the improvement process.

2 Method

We took a two-pass framing approach. In the first pass, we have performed regular framing explained in PropBank framing guidelines[5] based on available resources such as publicly available dictionary prepared by Turkish Language Association [21], a large corpus (Turkish National Corpus) [2] that can be queried for different usages of words, an open source annotation tool and CornerStone [8]. The senses of the verbs and case marking of their arguments are decided by manually investigating the sentences appear in search results of the TNC corpus. Then, the arguments of the predicates are labeled with VerbNet thematic roles and PropBank argument numbers, by checking the English equivalent of Turkish verb sense if possible. This process is repeated for all verb senses. However, low number of expert framers and limited amount of time occupied for framing cause incomplete, inaccurate and subjective frames. In order to reduce this phenomena, we have utilized crowd feedback from a verb sense disambiguation task and performed a second pass on framing of Turkish verbs.

3 First Pass: Creation of Verb Frames

PropBank framing guidelines [5] is an important resource of information that discusses how the verbs in English PropBank should be framed. Although we have followed that guideline, rich derivational morphology of Turkish and large number of light verbs (LV) and multi word expressions (MWE) introduce challenges for Turkish framers.

LV and MWE are still an active research area for linguists [22], and due to the complexity of this issue annotation of LV and MWE constructions in PropBank has been investigated separately in study [14]. Even though PropBanks have been constructed for morphologically rich languages such as Hindi/Urdu, Arabic and Finnish, modern Turkish language poses more challenges due to its extreme derivational morphology. According to Turkish Language Association (TDK)[2], there are 759 root verbs, 2380 verbs derived from nouns and 2944 verbs derived from verbs. However, these numbers only account for the first level of derivation, such as “sev-iş (to make love)”, reciprocal form of “sev (to love)”. In contemporary everyday Turkish, it is observed that words have about 3 to 4 morphemes including the stem [15] such as “sev-iş-tir-il (to be made to make love with someone)” which has 3 derivational morphemes: reciprocal, causative and passive accordingly.

[2] TDK is the official organization of Turkish language, founded on 1932. It is responsible for conducting linguistic research on Turkish and other Turkic languages, and publishing the official Turkish dictionary.(`www.tdk.gov.tr`)

Due to these challenging cases, our approach for each of them and the tools that are used are explained in each subsection in a guideline fashion.

3.1 Root Verbs

Turkish Language Association is a trustworthy source for lexical datasets and dictionaries. We have initiated our framing efforts with the list of Turkish root verbs provided by TDK. This list consists of 759 root verbs however it contains verbs that are rarely used or have fallen into disuse as the ones shown in Table 1. In order to detect those root verbs we have used TNC (Turkish National Corpus), which is a balanced and a representative corpus of contemporary Turkish with about 50 million words. Its query interface shown in Fig. 1 allows regular expressions which is essential for quering verbs that appear in different conjugated forms in unstructered text. We have performed queries on all root verbs and framed them if their frequency count is above 5 in a million words. Overall only 385 of the verbs were found to be above this threshold. Some examplary root verbs that were excluded from the framing process are given with their frequencies in Table 1.

Root Verb	Count[Verb]	Frequency[Verb]
eğir (to spin cotton for making thread)	105	2,24
semir (to batten, get fat)	80	1,68
yüksün (to regard someone, something as a burden)	52	1,09
çıv (to be deflected)	24	0,5
evele (to hum and haw)	16	0,34
göynü (to be grieved)	5	0,1
ılga (to run at a gallop - used only for horses without a rider)	5	0,1
çemre (to roll up one's sleeves, trouser legs, or skirts)	4	0,08
ipile (to give a very dim light)	1	0,02
fışılda (to make a swishing or rustling sound)	0	0

Table 1. Excluded root verbs and their frequencies in a million

3.2 Derivational Morphology of Verbs

Turkish is among languages with rich derivational morphology. According to TDK, there exists 10 morphemes that derives verbs from verbs and 2944 derived verbs. Of these, 6 are known as valency changing morphemes and are responsible from 98% of derived verbs. In Table 2, the count of derived verbs categorized according to their types are shown. In [18], it has been stated that Turkish valency changing morphemes always cause a predictable transformation, thus it is sufficient to have frames of the root verbs only. An examplary causative transformation for intransitive verb "laugh" and transitive verb "wear", is given in Fig. 2. When intranstive verbs are causitivized, the causee becomes the patient of the causation event. In other words, the central argument of the root verb, (Arg0 if exists, otherwise Arg1), is marked with ACC case and becomes

1	OG24D1B-2300	bunun yanı sıra geometriyi demokrasiyle	**sevistiren**	"Bellavista-Bellevue" (Güzelyaşam/İyihayat ya da
2	SE36E1B-3352	tanıtım yazısındaki ihtiras ile melodramı	**sevistiren**	bir öykü gibimanasız manalandırmalar ve
3	KA16B4A-0121	bir araya getirdi. Hepsini de	**sevistirdi.**	sonunda da bu başörtünün hangi
4	OI22C1A-0532	Sıkı sıkı. Yüreklerimizi buluşturacağız, ruhlarımızı	**sevistireceğiz**	önce. Kıpırdamadan duracağız. Ne zama
5	KA16B4A-0121	bir çok delikanlısıyla birkaç kızını	**sevistirdi.**	Yalnız, esmer güzeli, yirmi yaşındaki
6	VI22F1D-4708	bayağı güzel geyiğini çevirmiştik. Protonları	**sevistirecekler**	diye duydum en son. *
7	SE36E1B-3352	ile hüznü, ihtiras ile melodramı	**sevistiren**	bir öykü. Kahramanlarının birbirine estetik
8	SE36E1B-3352	düzey bir tolerans kültürü de	**"sevistiren"**	bir çabayla çatışmasız, çelişkisiz bir
9	UD22C1A-0510	Çocukluğunda Barbie ile öpüşen, Barbieler'ini	**sevistiren,**	bu esnada ailesine yakalanan yetişkinlerin
10	LE41C2A-1360	ve aynı durumdaki insanlarla sahnede	**sevistiriliyormus."**	Çıkartmalardaki LSD Evet, içimiz yeteri
11	UA16B3A-1065	büyük arzusu Meltem ile Handan'ı	**sevistirmekti.**	İstediği de gerçekleşti. Kadınlar çılgınca

Fig. 1. TNC Query for "sev-iş-tir* (to make someone to make love with someone)"

Morpheme	Type	Count
-akla, -ekle, -ıkla, -ikle, -ukla, -ükle	Not Valency	8
-ala, -ele	Not Valency	22
-ımsa, -imse, -umsa, -ümse	Not Valency	5
-zir	Not Valency	1
Total		36
-ş, -aş, -eş, -ış, -iş, -uş, -üş	Reciprocal	258
-l, -al, -el, -ıl, -il, -ul, -ül	Passive	528
-n, -ın, -in, -un, -ün	Passive—Reflexive	720
-r, -ar, -er, -ır, -ir, -ur, -ür	Causative	29
-t, -at, -et, -ıt, -it, -ut, -üt	Causative	510
-tır, -tir, -tur, -tür, -dır, -dir, -dur, -dür	Causative	863
Total		2908

Table 2. Derivational Morphemes

an internal argument (usually Arg1) of the new causative verb. For transitive root verbs, the central argument, Arg0 of the root verb, receives the DAT case marker and serves as an indirect object (usually as Arg2), while Arg1 serves again as Arg1.[3]Moreover, there exists some verbs which are frequently used in their causative forms with some deviation in the meaning, such as "yaz-dır", causative form of the verb "yaz (to write)", which means *to register someone to school/course*. In order to have an accurate framing process, separate frames were created for such verbs. In addition to verb to verb derivational morphemes, there exists 2380 verbs that are derived from nominal words via 12 different morphemes as stated by TDK. We claim that creating a nominal bank and linking those derived verbs with the entries from the nominal bank would be more appropriate. Thus, only the most frequent ones are included in the current bank and the rest is kept as a subject of a further study.

[3] Causative morpheme introduces of a new argument called causer to the valence pattern. In Fig. 2, the causer is showed with A0, where in PropBank for Hindi/Urdu, it may be showed with A-A.

	[Kız]$_{A0}$ gül-üyor. girl laugh-PROG [The girl]$_{A0}$ is laughing.	[Kız]$_{A0}$ [mont-u-nu]$_{A1}$ giy-di. girl coat-POSS3S-ACC put+on-PAST [The girl]$_{A0}$ put on [her coat]$_{A1}$.
Causative	[Oğlan]$_{A0}$ [kız-ı]$_{A1}$ gül-**dür**-üyor. boy girl-ACC gül-CAUS-PROG [The boy]$_{A0}$ is making [her]$_{A1}$ laugh.	[Oğlan]$_{A0}$ [kız-a]$_{A2}$ [mont-u-nu]$_{A1}$ giy-**dir**-di. boy girl-DAT coat-POSS3S-ACC put+on-**CAUS**-PAST [The boy]$_{A0}$ had [the girl]$_{A2}$ put on [her coat]$_{A1}$.

Fig. 2. Causative Transformations

3.3 Light Verbs and Multiword Expressions (MWE)

Light verbs are the verbs that cannot stand in the sentence on their own but can occur with another verb or a nominal[7].Light verb constructions in Turkish are the complex predicates formed by a nominal and one of the light verbs such as ol-, et-, gel-, ver-, dur-, kal-, düş-, bulun-, eyle- and buyur-[22]. Other than Turkish, light verb constructions can also be encountered in many languages such as Japanese, Korean, Persian, English, French and German.

Light verb itself may contribute comparatively light to the meaning or it has no contribution as in 'teşekkür et- (to thank) '. In such cases, where the meaning is mostly conveyed by the nominal, the phrase is treated as a new predicate as (teşekkür_et). In addition, Turkish light verbs are not necessarily light in all uses. Consider the function of the verb et- in the sentence "Üç artı iki beş eder (Three plus two makes five)". Framing process is handled similarly for such verbs as in other root verbs.

Most of the time, MWEs are confused with ligt verb constructions. In order to avoid discussions, we approach the problem practically, rather than categorizing verbs as LVC or MWE. We either treat such verbs as another sense of the root verb or as a complex predicate. The criterias followed during the decision process are:

- Deviation from the original meaning of the verb root,
- Nominal's contribution to the meaning of the complex predicate,
- The frequency of the complex predicate,
- Being a **fixed** phrase,

In Table 3. our framing approach for the verb "ver (to give)" is shown as an example. Second sense has the meaning of "to fix, to establish" as in to give/fix appointment, name or price. Similarly ver.03 is defined as to devote, allocate as in "öncelik vermek (to give priority)", "emek vermek (to give/devote effort)" and "zaman vermek (to give/allocate time)". These phrases are not fixed and the contribution of the nominal is not dominant. Hence they are framed with new senses for the root verb. On the contrary, the complex predicates, "söz ver (to promise)", "izin ver (to allow)", "kulak ver (to listen carefully)" and "hesap ver (to explain)" are fixed phrases and they have high frequency in TNC corpus. Hence they are determined as seperate predicates.

Predicate	Sense	Meaning	Example
ver	ver.01	To transfer	Hediye vermek (Give presents)
ver	ver.02	To fix	Randevu vermek (Give an appointment)
ver	ver.03	To devote, allocate	Öncelik vermek (Give priority)
söz ver	ver.09	To promise	Bana söz ver (Promise me)
kulak ver	ver.12	To listen carefully	Bana kulak ver (Listen to me)

Table 3. Framing of the verb "ver- (to give)"

3.4 Annotation Tool

For framing purposes, we have adjusted an already available open source software, cornerstone [8][4]. In study [18], the correlation between case marking information and semantic roles have been shown. That motivated us to include case markings in the framing process. To supply case marking information of the argument, a drop down menu containing six possible case markers in Turkish is added as shown in Fig 3.

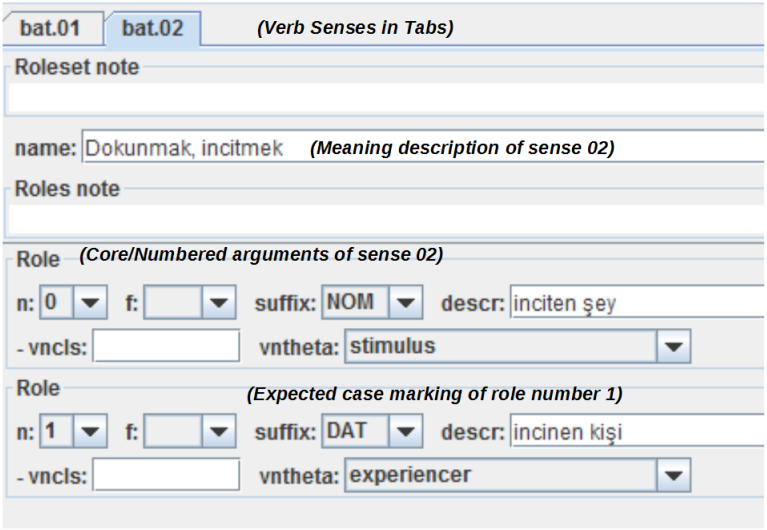

Fig. 3. Cornerstone Software Adjusted for Turkish

In this section, we have explained the process of framing Turkish verbs by expert annotaters with our systematic decision process for challenging cases introduced by LV, MWE and rich derivational morphology.

[4] Cornerstone is also used for building English, Chinese and Hindi/Urdu PropBanks.

4 Second Pass: Interpreting Verb Sense Disambiguation Results

Overall aim of this study is to build a corpus with annotated semantic roles. For this purpose we have used the revised METU-Sabanci Turkish Dependency Treebank named IMST [15] [16] [19] and added an extra layer with predicate senses and their arguments. For annotation of verb senses, we have crowdsourced a verb sense disambiguation task, where people are asked to choose the appropriate frame or "Hiçbiri (None)" for all the verbs in the treebank. An examplary question from the original task is given in Fig. 4. At the end of the task, 5855 rows have been annotated at least by three annotaters, 265 rows have been annotated per hour and all annotation process took 68 hours. More than 100 taskers contributed from 39 different cities of Turkey and the overall annotater aggrement is calculated as 83.15%. The details of this work is presented in another paper. The consolidation of one or more contributor responses into a summarized

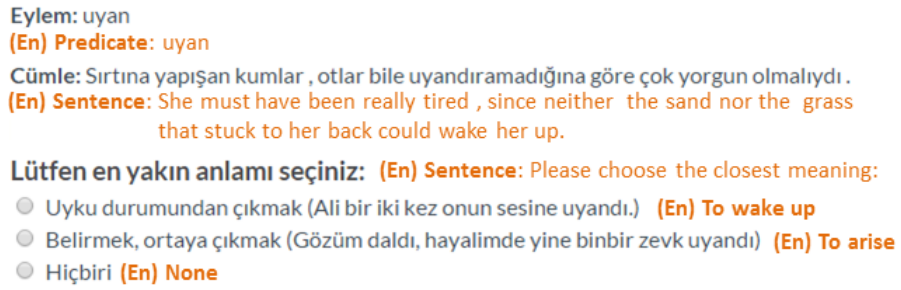

Fig. 4. A question from Verb Sense Disambiguation task. Corresponding English translations are shown near the original text starting with (En)

result is referred to as aggregation. We have analyzed the results which have a confidence level lower than 0.7 or an aggregated result as "None". 2174 rows had confidence lower than 0.7 and 738 rows were aggregated as "None" out of 6000 rows. We have manually performed a second pass annotation of experts for the rows with low confidence and eliminated 1200 out of 2174 of the rows since the aggregated results were already accurate. We have investigated the main reasons for annotaters to choose the option "None" as follows and taken the appropriate actions;

- Mistakes in morphological analysis of the predicate such as analyzing the verb as "sok" (to put) instead of "sokul" (to get near); "kal" (to stay) instead of "kaldır" (to lift): These erroneous analyses have been corrected and the appropriate sense is chosen by an expert.
- Missing meanings: They are added to PropBank.

– Confusion caused by metaphorical expression: Verb senses are coarse-grained, thus metaphorical expressions are treated the same way as non-metaphorical expressions as suggested in PropBank guidelines[5].

Similarly, we have detected the causes of low-confidence rows as follows;

– Fine-grained verb senses: When two senses of the predicate have close meanings, it leads to confusions: Such frames were detected and merged.
– Missing meanings: They are added to PropBank.
– Confusing the meaning of the complete sentence with the meaning of the verb in question: They are revised and annotated by an expert.

5 Conclusion

In conclusion, we have presented a new linguistic resource, the Turkish verb lexicon that consists of the verbs and their arguments with semantic role information. Total amount of 759 verb roots and 1262 verb senses are annotated.

We have explained our approach on framing light verbs and multiword expressions which can be inherited by other languages where light verb constructions are as common as in Turkish. We have presented a different approach to the framing problem with a two step solution to ensure the quality and quantity of the lexicon. In the first pass, framing guidelines that are explained in Section 3 is constructed and expert annotaters have framed 1135 verb senses. In the second pass, the results from a crowdsourced verb sense disambiguation task have been incorporated to improve the quality of verb lexicon as well as to increase the coverage rate. As a result, the number of annotated verb frame count increased from 675 to 759 and the total number of annotated senses increased from 1135 to 1262. As a future work, we plan to crowdsource argument annotation task where people will be asked to choose the most appropriate label for the verb sense given in the question.

This work explained in this paper, presented the first and the most important step to create necessary resources for Turkish to be included in the task of semantic role labeling. We believe that these resources will drive the NLP community for building semantic role labelers that will have wider coverage of language families and will enable the community work on a more challenging language.

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