Domain-Specific English-To-Spanish Translation of FrameNet

Mario Crespo Miguel*, Paul Buitelaar*

* Facultad de Filosofía y Letras
Universidad de Cádiz, Spain
mario.crespo@uca.es

* DFKI GmbH - Language Technology Lab
Saarbrücken, Germany
paulb@dfki.de

Abstract

This paper is motivated by the demand for more linguistic resources for the study of languages and the improvement of those already existing. The first step in our work is the selection of the most significant frames in the English FrameNet according to a representative medical corpus. These frames were subsequently attached to different EuroWordNet synsets and translated into Spanish. Results show how the translation was made with high accuracy (95.9 % of correct words). In addition to that, the original English lexical units were augmented with new units by 120%.

1. Introduction

Most lexical semantic resources have been created for English. This is mainly because most modern approaches to computational lexical semantics emerged in the United States. Some of these projects have been subsequently extended to other languages; however in all cases this requires a big human effort and time to create them. Transferring linguistic information automatically is therefore an attractive possibility to extend such resources to other languages.

FrameNet is a free on-line resource based on frame semantics and supported by corpus evidence (Ruppenhofer et al., 2006). It documents a range of different situations or frames and the list of lexical units that account for such frames in English. Frames are information packets about how to put across and understand information about a certain situation. Currently it covers 10195 different words in 795 different frames (approx. 14.14 per frame). The special conformation of FrameNet allows creating similar resources for other languages by maintaining the structural organization.

2. Approach

If the list of words of a certain language is limited, then the frames that are supported by them must be limited, too. However, the number of topics that human beings can talk about is unlimited; therefore frames combine with each other in our daily speech to convey information: medicine, politics, family, etc.

In addition to that, Frames can be described in terms of a variety of EuroWordNet concepts. EuroWordNet (Vossen, 1998) is a multilingual database like WordNet for several European languages (Dutch, Italian, Spanish, German, French, Czech and Estonian). Words are divided into nouns, verbs, adjectives and adverbs and sorted into groups representing concepts (called synsets). Each WordNet represents a unique language-internal system of lexicalizations linked on the Princeton WordNet used as Inter-Lingual index. This allows for the use of the database in multilingual information retrieval. Table 1 shows the synsets attached to unit cold.n of the FrameNet frame Medical_conditions:

| SYNSET ID | SYNSET IN ENGLISH | SYNSET IN SPANISH |
|-----------|------------------|------------------|
| 10174608n | cold.n            | resfriado        |
|           | common_cold.n    | resfriado_       |
|           | respiratory_desease | común        |
| 04422784n | cold.n            | frialdad          |
|           | coldness.n       | frío             |
| 03916773n | cold.n            | frio             |
|           | coldness.n       | temperatura_     |
|           | low_temperature.n | baja           |

Table 1: Lexical unit cold.n in EuroWordNet and synset equivalences in Spanish

From among them, 10174608n represents a concept depicted by the situation Medical_conditions. Assuming that every FrameNet trigger could be attached to a certain synset, equivalences could be used to obtain the triggers that support such a frame in a target language.

According to Yarowsky (1995), the meaning of words in a specific text is consistent and uniform, that is, polysemous word usually reflect only one sense in a certain document. Moreover, words semantically close to the general subject of the document have a significant distribution. Our approach takes advantage of this by selecting the frames and synsets that co-occur in a particular document and interconnecting them.

3. Data Set

The exploitation of a representative medical corpus allowed us to study the real use of language in this
domain. A corpus of around 7 million tokens and 90,000 different lemmas was obtained from several on-line resources:

- medlineplus.gov, a website on health information from the National Library of Medicine in the US, the world’s largest medical library
- familydoctor.org, a web site about health information that is operated by the American Academy of Family Physicians, a US-based medical organization representing family physicians and medical students
- www.unm.edu, the website of the University of Maryland Medical Center, including general information about diseases and treatments

All the XML and HTML tags were removed and the resulting text was analyzed with TreeTagger\(^1\). Once the corpus was annotated with part-of-speech, lemma frequencies were counted, which provided us with information on the distribution of lexical triggers for FrameNet frames in the medical corpus.

4. Processing

4.1. Frame Selection

The selection of medical-oriented frames was conducted over t-test. It was tested for each set of frame triggers if the distribution that they have in our medical corpus was compatible with the distribution they have in the British National Corpus (Burnard, 2007). Only triggers occurring in the medical corpus were computed and frames with only one element like Studying: study,v or Try_defendant: try.v were taken out. Every frame group was checked at 99.5 percent significance level and the ones statistically significant were chosen. A set of 35 different frames was selected.

4.2. Lexical Trigger Disambiguation

There were 35 different frames and 881 triggers to be disambiguated. 79 of these triggers (8.9%) were not present in EuroWordNet. The process of disambiguation was similar to the selection of frames. Firstly, each trigger was attached to all synsets in which it shows up and subsequently every synset was tested over a Statistical Hypothesis Testing. The most appropriate synset must be statistically significant (medical frames must be related with medical synsets). If the synset was composed of one term we used chi-square and if more than one, we used T-test, both at 99.5 percent significance level and by using the Statistical Hypothesis Testing over the term frequencies of each synset attached to each trigger in our selection of frames.

We detected that results can be affected by the fact that in a certain medical corpus different topics co-occur, and therefore, the system would select more synsets than the medical ones as significant. The corpus was then split into twelve different sub corpora to check if synsets were consistent in different medical texts. Table 2 shows the different experiments conducted.

Table 2: Experiments on disambiguation

| Trigger | Senses | hypernyms | Words used in T-test |
|---------|--------|-----------|---------------------|
| alleviate.v | 00361385v | aid.v help.v | ameliorate.v palliate.v amend.v |
| palliate.v | 00044854v | alleviate.v ease.v | 00361385v |

Figure 2: Illustration of how to include lexical relations

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\(^1\)http://www.ims.uni-stuttgart.de/projekte/corplex/TreecTagger

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triggers of our frame selection could be matched with a synset in WordNet.

5. Evaluation

Synsets attached to the frame were translated into Spanish and it was evaluated if these words represented the situation depicted by the frame. From the 1109 words obtained in Spanish, 95.9% of them were correct as shown in Table 3. Precision can be evaluated according to the number of lexical triggers correctly matched to WordNet synsets (95.9%) and recall according to the number of FrameNet triggers attached to WordNet (82%).

Table 3 describes the precision of the Spanish translation. The first column lists the 35 frames used. The second column shows the number of lexical units translated into Spanish for each frame. The third column displays how many of them were correct in Spanish according to the sense expressed by such a frame.

| FRAMES            | Selected | Correct |
|-------------------|----------|---------|
| Active_substance  | 16       | 15      |
| Being_named       | 26       | 26      |
| Being_obligated   | 7        | 7       |
| Biological_urge   | 65       | 65      |
| Body_mark         | 33       | 33      |
| Cause_change_consist | 15   | 15      |
| Communicate_categor | 19  | 19      |
| Cure              | 37       | 34      |
| Deny_permission   | 4        | 4       |
| Documents         | 56       | 51      |
| Duplication       | 10       | 10      |
| Duration          | 15       | 15      |
| Excreting         | 25       | 23      |
| Food              | 90       | 89      |
| Grinding          | 21       | 21      |
| Health_response   | 10       | 10      |
| Institutionalization | 6    | 4       |
| Intoxicants       | 79       | 63      |
| Kidnapping        | 7        | 7       |
| Likelihood        | 17       | 17      |
| Locale_by_use     | 61       | 61      |
| Medical_conditions| 84       | 84      |
| Medical_instruments| 18  | 18      |
| Medical_professionals | 54 | 54     |
| Medical_specialties| 24   | 24      |
| Observable_bodyparts | 108  | 102     |
| Ordinal_numbers   | 11       | 11      |
| People_by_age     | 24       | 19      |
| People_by_origin  | 3        | 3       |
| Perception_body   | 27       | 25      |
| Placing           | 108      | 106     |
| Redirecting       | 3        | 3       |
| Scarcity          | 12       | 12      |
| Toxic Substance   | 13       | 13      |
| Trust             | 11       | 11      |

Table 3. Spanish lexical triggers translated by use of EuroWordNet

We also translated the synsets selected in English to see how many of the original triggers were included, how many additional triggers can be found and the precision of such a translation into English. This is shown in Table 4 and Table 5. In our original selection there were 881 words, but the number was increased to 1942. 731 (87.2%) of the original triggers are represented in the current version (the upper bound was located at 91%). Most of the original triggers are included. FrameNet triggers were augmented by 120%.

| FRAMES            | Original | Select | Overlap |
|-------------------|----------|--------|---------|
| Active_substance  | 14       | 23     | 11      |
| Being_named       | 36       | 50     | 21      |
| Being_obligated   | 18       | 16     | 9       |
| Biological_urge   | 43       | 136    | 37      |
| Body_mark         | 18       | 34     | 17      |
| Cause_change_consist | 11   | 21     | 11      |
| Communicate_categor | 14  | 40     | 14      |
| Cure              | 26       | 57     | 24      |
| Deny_permission   | 2        | 11     | 2       |
| Documents         | 31       | 55     | 27      |
| Duplication       | 12       | 27     | 12      |
| Duration          | 13       | 44     | 13      |
| Excreting         | 20       | 170    | 20      |
| Food              | 66       | 170    | 63      |
| Grinding          | 12       | 48     | 12      |
| Health_response   | 9        | 16     | 9       |
| Institutionalization | 10  | 20     | 6       |
| Intoxicants       | 36       | 111    | 32      |
| Kidnapping        | 12       | 23     | 11      |
| Likelihood        | 22       | 26     | 16      |
| Locale_by_use     | 30       | 101    | 29      |
| Medical_conditions| 72       | 145    | 66      |
| Medical_instruments| 19  | 21     | 15      |
| Medical_professionals | 37 | 62     | 30      |
| Medical_specialties| 29   | 44     | 26      |
| Observable_bodyparts | 88  | 196    | 82      |
| Ordinal_numbers   | 10       | 18     | 10      |
| People_by_age     | 13       | 39     | 13      |
| People_by_origin  | 13       | 4      | 1       |
| Perception_body   | 13       | 28     | 11      |
| Placing           | 68       | 135    | 61      |
| Redirecting       | 3        | 5      | 3       |
| Scarcity          | 5        | 12     | 5       |
| Toxic Substance   | 6        | 18     | 6       |
| Trust             | 7        | 16     | 6       |

Table 4. Triggers in the original FrameNet and after attaching new terms from EuroWordNet

Table 4 describes the overlap between original triggers and the ones from our translation. The table's first column lists our selection of frames. The second column shows the original number of triggers in FrameNet. The third column provides the number of triggers after translation. Finally, the overlap is displayed between the original FrameNet triggers and the ones translated by using EuroWordNet.
From the 1784 words obtained again in English, 91.7% of them were correct as shown in Table 5, which describes the precision of the English triggers that have been created by using EuroWordNet synset information. The table’s first column lists our selection of frames. The second column shows the number of triggers after disambiguation and the third column how many of them were correct in English according to the sense of the frame.

| FRAMES         | English Lexical Triggers | Selected | Correct |
|----------------|--------------------------|----------|---------|
| Active_substance | 23                       | 18       |
| Being_named     | 50                       | 50       |
| Being_obligated | 16                       | 16       |
| Biological_urge | 136                      | 130      |
| Body_mark       | 34                       | 31       |
| Cause_change_consist | 21                 | 20       |
| Communicate_categor | 40               | 37       |
| Cure            | 57                       | 51       |
| Deny_permission | 11                       | 11       |
| Documents       | 55                       | 50       |
| Duplication     | 27                       | 27       |
| Duration        | 44                       | 41       |
| Excreting       | 170                      | 152      |
| Food            | 170                      | 143      |
| Grinding        | 48                       | 45       |
| Health_response | 16                       | 16       |
| Institutionalization | 20              | 15       |
| Intoxicants     | 111                      | 99       |
| Kidnapping      | 23                       | 22       |
| Likelihood      | 26                       | 26       |
| Locale_by_use   | 101                      | 95       |
| Medical_conditions | 145                | 141      |
| Medical_instruments | 21                 | 21       |
| Medical_professionals | 62              | 62       |
| Medical_specialties | 44               | 44       |
| Observable_bodyparts | 196              | 176      |
| Ordinal_numbers | 18                       | 17       |
| People_by_age   | 39                       | 37       |
| People_by_origin | 4                    | 4        |
| Perception_body | 28                       | 26       |
| Placing         | 135                      | 116      |
| Redirecting     | 5                        | 5        |
| Scarcity        | 12                       | 12       |
| Toxic Substance | 18                       | 15       |
| Trust           | 16                       | 16       |

Tabla 5. Number of correctly back-translated lexical triggers in English

6. Conclusions and Future Work

EuroWordNet has been the key element in all of the tasks in our approach:

- In the frame selection by extending each frame group of triggers with new terms.
- In the matching of triggers with synsets by augmenting the range of concepts with new words.

7. Acknowledgements

This research has been supported in part by the THESEUS Program in the MEDICO Project, which is funded by the German Federal Ministry of Economics and Technology under the grant number 01MQ07016. The responsibility for this publication lies with the authors.

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