Evaluating Complement-Modifier Distinctions in a Semantically Annotated Corpus

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1 Introduction

The distinction between complements and modifiers is important for parsing and language interpretation, since it impacts upon both syntactic and semantic decisions. On the syntactic level, it relates to questions such as *Is this sentence syntactically correct if a given complement is not realised?*; on the semantic level, the important issues are *Is this semantic representation complete?* (i.e. nothing has to be inferred from context), and *Does this preposition denote a predicate, or is it a contentless argument marker?*. For example, consider the following sentence:

(1) Overshadowed by Grigorovich, Kokonin nonetheless apparently eclipsed him in power in recent months.

Here, the prepositional phrase “in power” is a complement of “eclipse”, with “in” the only possible preposition in context. In contrast, in the prepositional phrase “in recent months”, the preposition “in” is a meaningful separate predicate. Moreover, “in power”, while optional, defines an argument specific to a particular class of verb, and its existence cannot be predicted from more general principles of grammar. Thus, these two prepositional phrases need to be treated differently in parsing and logical form construction.

However, the precise boundary between complements and modifiers is difficult to define. Existing lexical semantic resources (e.g. PropBank[4], FrameNet[3], VerbNet[5], OntoNotes[2]) do include information related to the complement-modifier distinction, but each applies slightly different criteria, depending on whether the emphasis is syntactic or semantic. A number of recent projects attempt to merge information from different resources [6, 1] and use them in parsing [8, 7]. For such applications it is important to be able to understand and evaluate to what extent the different approaches to making complement-modifier distinctions are compatible.

We investigate how well the semantic criteria used by the creators of the FrameNet corpus match up with the (primarily) syntactic criteria used in the VerbNet lexicon. We show that while there is a reasonably good correlation between the semantic ‘coreness’ of FrameNet verb dependents and the complements listed in VerbNet, in about 7% of cases these notions do not align, and discuss the implications for using FrameNet as a source of syntactic information for parsing.

2 Background

FrameNet[3] is a corpus of 140,000 English sentences (mainly drawn from the BNC) annotated with both syntactic and semantic information. Underlying the corpus is an ontology of 795 ‘frames’ (or semantic types), each of which is associated with a set of ‘frame elements’ (or semantic roles). For example, the target verb *eclipse* in (1) is tagged as an instance of the **Surpassing** frame, with four frame elements:

In the FrameNet ontology, the frame elements associated with a frame are partitioned into two main groups, Core and non-Core, a distinction which (according to the annotation guidelines) is meant to cover the ‘semantic spirit’ of the distinction between complements and modifiers. Thus, for example, obligatory complements are always Core, as are: (a) those which, when omitted, receive a definite interpretation; and (b) those whose semantics cannot be predicted from their form. In the Surpassing frame discussed above, the Item, Standard and Attribute frame elements are all classed as Core, whereas Time is marked as non-Core.

However, the fact that a number of constituents in the FrameNet corpus have been marked as direct objects, despite invoking non-Core frame elements suggests that the correlation between Core dependents and syntactic complements is not perfect. Take the following sentence:


The relevant frame here for the verb “rip” is Damaging, where the Subregion frame element is marked as being non-Core, based on examples like “John ripped his trousers [below the knee]”. In this particular case, the decision to retain all senses of the verb “rip” within the same frame has led to a situation where semantic and syntactic coreness have become dislocated.

To investigate how well syntactic and semantic criteria for complement-modifier distinctions correlate, we chose VerbNet as a source of syntactic information. VerbNet is a lexicon of around 5,000 English verb senses, partitioned into 237 top-level classes. Each verb class specifies, among other things, a set of associated subcategorisation frames listing the arguments (i.e. subjects and complements) that are appropriate for all the verbs in the class. Thus, the underlying assumption is that verbal dependents which are not listed in the subcategorisation frame of a verb are modifiers rather than complements. In general, this is a valid assumption; however, since VerbNet data is not strictly corpus-based, during the comparison we discovered a number of cases where entries appeared to be incomplete, as we discuss in Section 3.

3 Methodology

In previous work, we harvested a wide-coverage verb lexicon from the FrameNet corpus for use with a deep semantic parser, by reading off lexical entries from annotated sentences. One issue which we had to resolve in this process involved determining which frame elements annotated as dependents of a given verb were complements and hence should be included in verb subcategorisation frames. For dependents which had not been labelled as syntactic subjects or objects, we chose the simple expedient of keeping all Core dependents and eliminating all non-Core ones.

The aim of the project reported here was to evaluate the extent to which the distinction between Core and non-Core frame elements corresponds in practice to the distinction between syntactic complements and modifiers (using VerbNet as our gold standard), and whether our method was effective in appropriately differentiating between complements and modifiers for purpose of deep parsing and interpretation.

We took the verb lexicon we had harvested from FrameNet and extracted every entry (incorporating an orthographic base form, a semantic type, and a subcategorisation frame) which specifies at least one Core PP dependent. Along with the information about annotated dependents, each entry was also associated with the corpus sentence which it had been harvested from, representing the “canonical” frame (i.e. excluding passives, imperatives, questions and other cases where word order is derived by grammar/lexical rules).

A total of 17,035 lexical entries were extracted in this way. The next step was to select a sample of these for manual checking, which proved to be more problematic than just picking a random subset. The FrameNet project’s approach to annotation, which has proceeded on a frame-by-frame basis rather than focusing on fully annotating running text, has led to some frames being associated with many more verbs and annotated sentences than others. We attempted to counteract this bias.
by limiting each frame to a maximum of two entries, and moreover limiting each verb in a frame to a maximum of one entry. We were thus left with 430 verb entries in our sample, involving a total of 432 subcategorised Core PP dependents and 53 non-Core PP dependents.

We then went through each PP dependent in turn and decided whether VerbNet classifies it as a complement or modifier of the target verb. We first of all determined whether the relevant sense of the target verb was included in VerbNet. If so, and if the relevant subcategorisation frame including the dependent as a complement was listed, then it was deemed to be a complement PP.

If such a subcategorisation frame was not listed, things became a little more complicated — because VerbNet is not corpus-based, it is an incomplete resource. Thus, in addition to certain verb senses not being defined in VerbNet at all, we also found a number of cases where a subcategorization frame appeared to be missing (e.g. label X as Y — note that as-PPs are complements in VerbNet for verbs like “characterise”). Thus, for all instances where a dependent was not listed in VerbNet, we determined to the best of our ability whether or not the PP dependent meets the criteria for complementhood which appear to underly VerbNet, generally with reference to listed verbs with similar meanings. We report the “strict” matches separately from the overall results.

4 Results

Of the 432 Core PP dependents in the sample, 281 (65%) have the appropriate verb sense listed in VerbNet. Of these, 199 (71%) have the dependent listed as a complement in the relevant subcategorisation frame, and of the remaining 82, we judged that 59 would be complements in a more complete version of VerbNet. In addition, of the 151 Core PP dependents in the sample which do not have the appropriate verb sense listen in VerbNet, we judged that 137 (91%) would be complements in a more complete VerbNet.

Thus, whereas the VerbNet lexicon itself agrees that 71% of the Core PP dependents in the FrameNet sample are complements, if we allow judgments to take into account related verb senses for missing entries, then the figure rises to 395/432 = 91%.

Turning to the 53 non-Core PP dependents in the sample, 30 (57%) have the appropriate verb sense listed in VerbNet. Of these, 7 (23%) have the dependent listed as a complement in the relevant subcategorisation frame, and of the remaining 23, we judged that 2 would be complements in a more complete version of VerbNet. In addition, of the 23 non-Core PP dependents in the sample which do not have the appropriate verb sense listen in VerbNet, we judged that 7 (30%) would be complements.

So, whereas the VerbNet lexicon itself thinks that 7/30 = 23% of the non-Core PP dependents in the FrameNet sample are actually complements, if we allow judgments to take into account related verb senses for missing entries, then the figure rises to 16/53 = 30%. Overall, if we take a combination of VerbNet and annotator judgements as a gold standard, this corresponds to 91% precision and 96% recall in correctly identifying verb PP complements, i.e. an F score of 0.934.

In order to come up with a better idea about how non-core PP modifiers may influence recall, we repeated the experiment with a similar sample of 460 entries containing at least one non-Core PP dependent, but ignoring Time and Place dependents (which are almost always modifiers) so that we were focusing on just the trickiest cases. We found that VerbNet assumes that 37% of the dependents we looked at are actually complements, suggesting that a better estimate as to recall in the current version of FrameNet is closer to 86% (given that Time and Place dependents account for 24% of non-core PP dependents, assuming that they are all modifiers).

We then manually examined a set of 38 cases from the first experiment where a FrameNet Core PP dependent was judged by VerbNet criteria not to be a complement of the relevant target verb can be divided into two groups. The first set (23 out of 38) involve straightforward cases where the Core PP dependent is a syntactic dependent of the target verb, but where its status is better understood as a modifier rather than a complement (e.g. the by-PP in “The Chancellor also caused further anxiety by strongly backing the VAT levy on domestic fuel and power”). The second group (15 out of 38) involves cases where there is a bracketing mismatch between semantics and syntax in some way — the Core PP dependent annotated in FrameNet
is not a syntactic dependent of the target verb. Take the following example:

(4) She looked away quickly, and unfastened [the waistband] CONTAINING OBJECT [of her uniform skirt] FASTENER. Here the target verb is “unfasten”. The FrameNet annotation recognises both “the waistband” and “of her uniform skirt” as distinct dependents of the verb. However, on the syntactic level it is the entire noun phrase “the waistband of her uniform skirt” which is a syntactic dependent of the verb (the direct object).

5 Conclusion

As can be seen from our analysis, while the syntactic and semantic criteria used to distinguish complements from modifiers distinctions are highly correlated, they do not align perfectly. This may be part of the reason why in general these distinctions may be so difficult to pin down. From the point of view of parsing, however, one possible solution may be to replace a single distinction with several finer-grained features, addressing the key issues raised in the introduction: Is some dependent syntactically required to complete the utterance? Is some (optional) clausal or adjectival phrase a possible dependent of a given verb? And does a particular preposition correspond to an independent predicate (regardless of whether the dependent can be classified as a complement)? In a resource like FrameNet, the answers to the first two questions can be induced automatically provided that a large enough set of sentences was annotated for a given verb. However, the answer to the third question is, to our knowledge, not coded in any existing resources. Adding it would provide essential information for building semantic representations, and therefore make such representations more usable in interpretation tasks.

References


