

Semantic Annotation of Metaphorical Verbs with VerbNet: A Case Study of ‘Climb’ and ‘Poison’

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Abstract

Metaphor is commonplace in language, regardless of genre, register or tone. As natural language processing moves beyond surface-level analyses into deeper semantic analysis, accurate identification and representation of metaphoric meaning becomes more important. In this paper, we look at several issues that arise when metaphorical language is semantically annotated, including the identification of appropriate thematic role labels and semantic representations. We look at the applicability of VerbNet’s classification for verbs that are commonly used both literally and metaphorically, using the verbs *climb* and *poison* as illustrations. We found that the full complexity of metaphor and other figurative language is not captured by annotation with VerbNet at this time, but that the current VerbNet structure provides accurate labelling of general thematic roles for metaphors and often accurate semantic representations as well.

1 Introduction

Metaphor is commonplace in language, regardless of genre, register or tone. As natural language processing moves beyond surface-level analyses into deeper semantic analysis, accurate identification and representation of metaphoric meaning becomes more important. In this paper, we look at several issues that arise when metaphorical language is semantically annotated, including the identification of appropriate thematic role labels and semantic representations.

We look at the applicability of VerbNet’s classification for verbs that are commonly used both literally and metaphorically, using the verbs *climb* and *poison* as illustrations.

VerbNet, inspired by Beth Levin’s (1993) classification of English verbs, is a verb lexicon that groups verbs into classes based on similarities in their syntactic and semantic behavior (Schuler, 2005). It was not created with a division between literal and metaphoric uses of language as an organizing principle. Therefore, this feature of language manifests itself in several different ways: (1) separate class assignments for literal and metaphoric uses of a verb; (2) one class encompassing both literal and metaphoric uses; or (3) only literal uses specifically accounted for in a class, with metaphoric uses unattributable to any class. These different outcomes result from various factors, such as how conventionalized a metaphoric usage is and the kinds of semantic restrictions that are specified by VerbNet for the arguments of a class.

The choice to focus on the verbs *climb* and *poison* stems from their representativeness in two different areas. First, both verbs are members of broad VerbNet classes that include many other verbs that are also used literally and metaphorically. We look more closely at this representativeness at the beginnings of section 2 and section 3. Second, taken together, these two verbs give examples of the various ways VerbNet deals with metaphor, as described above.

In discussing metaphor, we will refer to Lakoff and Johnson’s (1980) definition, in which

one conceptual domain (the source) maps to another domain (the target). Generally the source domain is a concrete, everyday domain that is used to elucidate a more abstract domain, the target.

2 *Climb*

This verb is currently a member of four VerbNet classes: *calibratable_cos-45.6*; *escape-51.1*; *run-51.3.2* and *meander-47.7*. These classes contain 257 verbs, many of which are used metaphorically in similar ways to *climb*. In fact, many of these verbs join *climb* in multiple classes, largely because of these metaphorical patterns. For example, *plunge* and *rise* are both members of the *calibratable_cos-45.6*; *escape-51.1*; and *meander-47.7* classes, and many other verbs belong to some combination of two or three of the classes that include *climb*.

These four classes belong to three broad categories of classes in VerbNet: Verbs of Change of State, Verbs of Existence, and Verbs of Motion. These encompass 24 VerbNet classes with hundreds of verbs. While *climb* seems representative of many verbs in the four classes, further study is needed to determine if its metaphorical patterns are representative of these broad categories of verbs.

The *calibratable_cos-45.6* class includes verbs that describe an entity's change along a scale, such as *increase*, *decrease*, and *multiply*. Most verbs in this class, however, fit it only when they are used metaphorically, such as *rise*, *fall*, *plunge*, and *climb*. The same is true of the *meander-47.7* class. The verbs in this class are primarily motion verbs that are being used metaphorically to describe the spatial configuration of something, such as "*The path climbs through the woods*".

Conversely, *climb*'s other two classes, *escape-51.1* and *run-51.3.2*, seem to accommodate both literal and metaphoric uses of their member verbs, at least when considering the alternations, general thematic roles and the semantic representations of the class. However, the semantic restrictions on the classes' thematic roles often result in excluding metaphoric extensions of the verb, as we show in sections 2.1 and 2.2.

2.1 *Escape-51.1*

Escape-51.1 includes verbs of motion along a path, such as *come*, *go*, *return*, and *climb*. The syntactic frames that characterize this class include

- NP V PP.initial_loc (*He came from France*)
- NP V PP.Destination (*He came to Chicago*)
- NP V PP.Trajectory (*He came through the door*)

One literal sense of *climb* fits all these alternations (e.g., "*He climbed from the bottom of the hill to the top*"). A corresponding metaphorical sense also fits all these alternations (e.g., "*He climbed from the gutter to the board room*").

In addition, a member of the *escape-51.1* class should work with the following thematic roles¹:

- **THEME [+CONCRETE]**
- **INITIAL_LOCATION [+CONCRETE]**
- **DESTINATION [+CONCRETE]**
- **TRAJECTORY [+CONCRETE]**

Figurative sentences using *climb* can fit the thematic roles and the syntactic patterns of this class without satisfying the semantic restrictions, such as "*John* [Theme [+concrete] *climbed from poverty* [Initial_Location [-concrete] *to wealth* [Destination [-concrete]]". "*Her feelings for him climbed from indifference to genuine love*" in which even the Theme is not concrete. For an application interested only in annotations of basic thematic roles, annotating these instances of *climb* as belonging to this class would not be a problem.

The issue of applying the semantic representation is a bit more complicated.

MOTION(DURING(E), THEME)
PATH(DURING(E), THEME, INITIAL_LOCATION,
?TRAJECTORY, DESTINATION)

The Theme is not actually in motion and does not change locations, but this is rather a metaphorical reference to changing circumstances. Without an indication that the instance is metaphoric, incorrect inferences would be drawn from the application of

¹ These roles and predicates represent a new treatment of motion in VerbNet which is still being developed, (Hwang et al., 2012)

this semantic representation. With an indication that the instance is metaphoric and a key to map the predicates from the source domain to the target domain, the semantic representation for this sentence could be appropriate. Annotation using this class for metaphoric as well as literal language would require an additional layer identifying metaphors and referring to mappings from the source domain to the target domain.

Although most metaphoric sentences would be excluded by strictly followed semantic restrictions, some will not be. “*John climbed from the slums of the South Side to the trading floor of the Chicago Stock Exchange*”, where the arguments, at least on the surface, satisfy the semantic restrictions. The semantic representation would not be incorrect: John probably was at one time at the location of the slums and moved to the literal location of the Chicago Stock Exchange. However, the representation misses the important implication that John’s circumstances in life have changed dramatically, from poverty to wealth. And his route was much more complex than traversing the physical distance between the two locations. A literal interpretation would lead to incorrect assumptions.

2.2 *Run-51.3.2*

The run class has a similar literal focus and requires agents and themes that are +animate and locations that are +concrete. The semantic representation for a sentence like “John climbed the hill” is

MOTION(DURING(E), THEME)
VIA(DURING(E), THEME, LOCATION)²

Figurative sentences like “*John is climbing the social ladder*” would fit this class’s syntactic alternations and would receive a semantic representation with similar accuracies and inaccuracies to the figurative sentences in the *escape-51.1* class.

2.3 *Calibratable_cos-45.6*

Certain figurative uses of climb would be annotated with the *calibratable_change_of_state-*

² As part of ongoing revisions to VN, the VIA predicate here may change to TRAJECTORY.

45.6 class, for example, “*The stock’s price climbed \$15 in one day of trading.*” This sense of *climb* is expressed in all the alternations of this class, which also captures the intended meaning of this conventionalized metaphor for *climb*. The roles of this class, Patient, Attribute and Extent, fit well with this usage, with the *stock* as the Patient that undergoes a change, the *price* as its Attribute and the *\$15* change as the Extent. The semantic representation fits as well, with no need to map from a source domain to a target domain:

CHANGE_VALUE(DURING(E), DIRECTION,
 ATTRIBUTE, PATIENT)
AMOUNT_CHANGED(DURING(E), ATTRIBUTE,
 PATIENT, EXTENT)

2.4 *Meander-47.7*

The final class that includes *climb* as a member is the *meander-47.7* class, which describes fictive motion verbs. Certain motion verbs can be used metaphorically to describe the stative configuration of a path (Ramscar, Boroditsky & Matlock 2010; Talmy 2000). A typical fictive motion use of *climb* would be: “*The trail climbs through the trees.*” The *meander-47.7* class uses the roles Theme [+elongated] and Location [+concrete]. These roles, excepting the semantic restriction on the Theme, are the same as those in the motion-oriented classes *run-51.3.2* and *escape-51.1*. The semantic representation is vastly different, however, and accurately describes the metaphoric meaning intended:

PREP(DURING(E), THEME, LOCATION)
EXIST(DURING(E), THEME)

Rather than an event describing the change of location of a Theme, the semantic representation describes a state (i.e., EXIST) of a Theme being in a particular Location.

3 *Poison*

The verb *poison* is a member of two VerbNet classes: *butter-9.9* and *poison-42.2*. The *butter-9.9* class comprises 140 verbs that express putting a Theme in a Destination, such as *cloak*, *glaze*, *salt*, and *poison*. It belongs to a larger category of 10

classes called Verbs of Putting. The *poison-42.2* class comprises 22 verbs, such as *shoot*, *stab* and *poison*, and belongs to the larger category of classes, Verbs of Killing. Although these classes include fewer verbs than the Verbs of Putting, they are more frequently used in conventional metaphors.

3.1 *Butter-9.9*

The *butter-9.9* class has several selectional restrictions on its thematic roles:

- **AGENT** [+ANIMATE]
- **THEME** [+CONCRETE]
- **DESTINATION** [+LOCATION & -REGION]

The semantic representation for a sentence like “Lora poisoned the stew” seems likewise concrete:

MOTION(DURING(E), THEME)
NOT(**LOCATION**(START(E), THEME, DESTINATION))
LOCATION(END(E), THEME, DESTINATION)
CAUSE(AGENT, E)

Poison is not usually used figuratively with these roles, except with the phrase “poison the well”, as in “By the time I joined the board, John had already poisoned the well and no one would even listen to my plans.” As explained in the next section, the sentence, “He poisoned her mind with lies” fits better with the *poison-42.2* class, where “her mind” would be interpreted as the Patient that gets harmed by the poison rather than the destination of the poison.

3.2 *Poison-42.2*

The *poison-42.2* class accommodates both physical, concrete events of poisoning and at least some figurative events of poisoning. The class is characterized by only four syntactic frames:

- NP V NP (*The witch poisoned Mary*);
- NP V NP Adj (*The witch poisoned Mary dead*);
- NP V NP PP.Result (*The witch poisoned Mary to death*);
- NP V NP PP.Instrument (*The witch poisoned Mary with arsenic*).

The metaphoric uses of the verb *poison* also follow these frames, as we show below.

The thematic roles in the *poison-42.2* class are

- **AGENT** [+ANIMATE]
- **PATIENT** [+ANIMATE]
- **INSTRUMENT**
- **RESULT**

The semantic predicate for a sentence like “*The queen poisoned Snow White with the apple*” is

CAUSE(AGENT, E)
HARMED(DURING(E), PATIENT)

Clearly, physical events of poisoning fit perfectly well with the semantics of this class. Figurative poisoning seems to work as well. For example, the sentence “*John poisoned Mary with his lies*” has an animate Agent and an animate Patient and, because there are no selectional restrictions on the Instrument role, “lies” fits with that role. The semantic representation does not specify what kind of harm the patient undergoes, physical or otherwise, so it seems equally appropriate for this metaphorical sentence.

Although the class accommodates some metaphorical usages, it is not wholly free in its applicability. Sentences like “*John poisoned the process with his double-dealing*” and “*Max poisoned his Mercedes with low-grade gasoline*” would violate the restriction that the Patient should be animate. The consequences of ignoring this selectional restriction do not seem grave, as the semantic representation still seems perfectly adequate in describing these events.

4 Semlink annotation of metaphor

The SemLink project (Palmer, 2009) has implemented semantic annotation with VerbNet classes, labeling a portion of the Wall Street Journal corpus with VerbNet class labels on the verbs and thematic role labels from those classes on the arguments. A lenient approach to class assignments was used, often applying thematic role criteria without their semantic restrictions when determining a token’s class assignment (CLEAR, 2012). This approach resulted in many metaphoric verb tokens being annotated with classes that, under stricter criteria, would only apply to literal verb usages. These tokens would have otherwise

remained unannotated, as no class represented the purely metaphorical interpretation.

Annotation for the verb *climb* provides a good example of the variety of ways metaphoric tokens were annotated. Tokens of the type “*Share prices of many of these funds have climbed much more sharply than the foreign stocks they hold* [wsj_0034.mrg 2613],” where *climb* is used metaphorically to map from the source domain of motion and change of location to the target domain of change in value, were annotated with the *calibratable_cos* class. For these tokens, the thematic roles and semantic representation suit the target domain (the metaphoric meaning). Several other metaphoric tokens of the verb *climb* were assigned to the *escape-51.1* class, including “*Japan has climbed up from the ashes of World War II* [wsj_1120.mrg 0 2]” and “*It has always been the case that those outside the club want to climb in* [wsj_1986 49 14].” In these cases, the thematic roles and semantic representation follow the source domain (the literal meaning).

5 Conclusion

Although the full complexity of metaphor and other figurative language is not captured by annotation with VerbNet at this time, the current VerbNet structure provides a more accurate labelling of semantic features than one would first suppose from a resource not designed with literal-figurative distinctions in mind. Often conventionalized metaphoric uses of a verb are separated from literal uses and placed in classes where the metaphoric meaning is the primary one, such as the *calibratable_change_of_state* class. In those cases, the semantic representation captures the actual metaphoric meaning, rather than that of the source of the metaphor. VerbNet has many such classes, such as the “psychological” classes, where figurative uses of verbs like *cut*, *wound*, and *shake* are annotated with Experiencer and Stimulus roles and the semantic representation indicates a change in the Experiencer’s emotional state.

Where metaphoric uses have no appropriate separate class, VerbNet affords a very accurate shallow semantic annotation in the form of thematic roles. These are applicable to both literal and figurative uses of verb members of a class, especially when selection restrictions are

disregarded. The semantic representation is sometimes equally applicable, such as with the *poison-42.2* class. More often, though, the semantic representation would need some sort of indication that it is to be interpreted metaphorically to avoid inaccurate inferences from being drawn, such with the *run* and *escape* classes.

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