

# Predicting Semantics from Syntactic Cues – An Evaluation of Levin’s English Verb Classes and Alternations

Doug Jones

Institute for Advanced Computer Studies

A. V. Williams Building

University of Maryland

College Park, MD 20742

jones@umiacs.umd.edu \*

## Abstract

The relationship between the meaning of verbs and their syntactic patterns has recently been explored in the landmark study of (Levin, 1993). Although the central thesis of this book is that verb semantics and syntactic behavior are predictably related, the large scope of the work makes it difficult to verify. I show that it is possible to guess the semantic class of a verb based on syntactic cues automatically extracted from the example sentences in her book. In particular, it is possible to correctly guess 94.8% of Levin’s semantic classes if the parses contain prepositions, negative evidence is included, and word senses are disambiguated. This report includes the syntactic signatures of Levin’s 191 semantic classes, in addition to a detailed description of how the syntactic signatures behave according to the different parameters involving negative evidence, prepositions, and disambiguation.

## 1 Introduction

The central thesis of (Levin, 1993) is that the semantics of a verb and its syntactic behavior are predictably related. As a demonstration that such predictable relationships are not confined to an insignificant portion of the vocabulary, Levin surveys 4183 verbs, grouped into 191 semantic classes in Part Two of her book. The syntactic behavior of these classes is illustrated with 1525 example sentences, an average of 8 sentences per class. Given the scope of Levin’s work, it is not easy to verify the central thesis. To this end, I created a database of Levin’s verb classes and example sentences, and wrote a parser

---

\*The research reported herein was supported, in part, by Army Research Office contract DAAL03-91-C-0034 through Battelle Corporation, NSF NYI IRI-9357731, Alfred P. Sloan Research Fellow Award BR3336, and a General Research Board Semester Award.

to extract basic syntactic information from the sentences.<sup>1</sup>

The core idea of the experiment is to automatically extract syntactic patterns from the example sentences. The semantic classes are characterized by groups of syntactic patterns. Let us refer to these groups of patterns as *syntactic signatures*. The purpose of the experiment is to discover whether the syntactic signatures tell us anything about the meaning of the verbs.<sup>2</sup>

There are two ways to run the experiment, and each way has different results. The first way (the class-based experiment) is to try to link the syntactic signatures to semantic classes, abstracting away from the particular verbs in the classes. The second way (the verb-based experiment) is to compare the way the verbs are grouped semantically versus the way they are grouped syntactically, and to see whether these two groupings are related. The class-based experiment shows that as many as 94.8% of the 191 semantic classes have uniquely identifying syntactic signatures, depending upon what information is included in the parse. The verb-based experiment shows that 5.8% of the verbs are grouped identically by both the semantic classes and the syntactic signatures. As we will see, it is word-sense ambiguity that is responsible for the poor performance of the verb-based experiment. Let us turn to the details of each experiment.

## 2 Class-based Experiment

In the class-based experiment, we attempt to discover whether the syntactic behavior of a semantic

---

<sup>1</sup>Both the database and the parser are encoded in Quintus Prolog.

<sup>2</sup>The design of this experiment is inspired by work by Patrick Saint-Dizier. In particular, I depart from the alternation-based data in (Levin, 1993), which is primarily binary in that sentences are presented in pairs which constitute an alternation. Following Saint-Dizier’s work, I construct N-ary syntactic characterizations. The choice is of no empirical consequence, but it simplifies the experiment by eliminating the problem of naming the syntactic patterns.

Figure 1: Change of State – *break* subclass

**Verbs:** break, chip, crack, crash, crush, fracture, rip, shatter, smash, snap, splinter, split, tear

**Positive Example Sentences:**

Crystal vases break easily. The hammer broke the window. The window broke. Tony broke her arm. Tony broke his finger. Tony broke the crystal vase. Tony broke the cup against the wall. Tony broke the glass to pieces. Tony broke the piggy bank open. Tony broke the window with a hammer. Tony broke the window.

**Negative Examples:**

\* Tony broke at the window. \* Tony broke herself on the arm. \* Tony broke himself. \* Tony broke the wall with the cup.

class of verbs uniquely identifies that class. Consider class 45.1, the *break* subclass of the Change of State verbs, shown in Figure 1. The primary question is what syntactic information to extract. We cannot use complete parse trees, since these would include the terminal nodes and would therefore contribute no usable level of abstraction. Simply stripping the terminal nodes would be a start, but we immediately face a potential bias in the experiment: what aspects of a fine-grained syntactic analysis could end up providing accidental information that makes the syntactic signature spuriously unique? <sup>3</sup>

It turns out that a very simple strategy works very well, namely, flat parses that contains lists of the major categories in the sentence, the verb, and the handful of other elements shown below: <sup>4</sup>

```
np v pp adjective infinitive
s_comp poss expletive self w_comp
quotation vp appositive
```

Other syntactic elements are simply ignored by the parser. The “parse”, then, for the sentence **Tony broke the crystal vase** is simply the pattern `[np,v,np]`. For **Tony broke the vase to pieces** we get `[np,v,np,pp]`.

<sup>3</sup>For example, what if a sentence from one semantic class is just like a sentence from a different semantic class except that one of these has a noun phrase modified by an adjective whereas the other has an unmodified noun phrase? If the syntactic patterns extracted from these sentences reflects such a difference, the signatures will differ accidentally.

<sup>4</sup>Most of these elements are self-explanatory: `np` = noun phrase, `v` = verb, `pp` = prepositional phrase, `s_comp` = sentential complement, `poss` = possessive pronoun, `expletive` = expletive pronoun (*it*, *there*), `self` = reflexive pronoun, `w_comp` = *WH*-complement, `vp` = verb phrase complement, such as gerund complements.

Figure 2: Syntactic Signature for Change of State – *break* subclass

**Verbs:** break, chip, crack, crash, crush, fracture, rip, shatter, smash, snap, splinter, split, tear

**Example Sentences:**

Crystal vases break easily. The hammer broke the window. The window broke. Tony broke her arm. Tony broke his finger. Tony broke the crystal vase. Tony broke the cup against the wall. Tony broke the glass to pieces. Tony broke the piggy bank open. Tony broke the window with a hammer. Tony broke the window. \* Tony broke at the window. \* Tony broke herself on the arm. \* Tony broke himself. \* Tony broke the wall with the cup.

**Derived Syntactic Signature:**

```
1- [np,v] 1- [np,v,np]
1- [np,v,np,adjective] 1- [np,v,np,np]
1- [np,v,np,pp] 1- [np,v,poss,np]
0- [np,v,np,pp] 0- [np,v,pp]
0- [np,v,self] 0- [np,v,self,pp]
```

The outline for the class-based experiment is as follows:

1. Automatically extract syntactic information from the example sentences to yield the syntactic signature for the class.
2. Discover which semantic classes have uniquely-identifying syntactic signatures.

If we parse the 1525 example sentences (including the negative examples), these sentences reduce to 118 unique patterns. The 191 sets of sentences listed with each of the 191 semantic classes in turn reduces to 171 unique syntactic signatures. 153 of them uniquely identify a semantic class, meaning that 80.1% of the classes have uniquely identifying syntactic signatures.

To show a concrete example, let us return to semantic class 45.1, the *break* subclass of the Change of State verbs. The example sentences, both positive and negative, are parsed, yielding a set of syntactic patterns. This set of patterns constitutes the syntactic signature. Notice that duplicate patterns have been removed in forming the signature. Positive patterns are marked with 1- and negative patterns are marked with 0-. The signature is shown in Figure 2.

Not every one of the 171 signatures corresponds uniquely to a semantic class. For example, signature #127, composed of the patterns `0-[np,v,np,pp]` `1-[np,v,np]` `1-[np,v,np,pp]`, corresponds to three semantic classes: 25.3 (*Illustrate* Verbs), 25.4 (*Transcribe* Verbs), and 34 (Verbs of Assessment). This signature illustrates a shortcoming

of this parsing strategy: notice that the pattern `[np,v,np,pp]` is both a positive example and a negative example. The pattern is not capturing the distinction that differentiated the positive and negative example sentences. For example, in class 25.3 (*Illustrate Verbs*), these two sentences are listed: the positive example: **The jeweller decorated the ring with the name.** and the negative example: **\* The jeweller decorated the name on the ring.** On the one hand, the signature is in fact coherent, since what it means is that there is some sentence that matches this pattern that is grammatical, and another sentences that also matches this pattern that is ungrammatical. But the signature is not very informative. Furthermore, it is easy to enhance the parser: if we simply annotate the `pp` element with the actual preposition in the prepositional phrase, then the signatures will encode the information that minimally distinguishes the sentences. The pattern, then, for the positive sentence would be `1-[np,v,np,pp(with)]` and the pattern for the negative sentence would be `0-[np,v,np,pp(on)]`.<sup>5</sup>

## 2.1 The Best Signatures

Repeating the experiment outlined above, the 1525 example sentences now reduce to 272 patterns, where the `pp`'s of the parse patterns are marked with the head preposition. There are more patterns than before because the prepositions distinguished many of them. For the 191 sets of sentences that correspond to the 191 semantic classes, this time there are 186 unique syntactic signatures. Of these, 181 uniquely identify a semantic class. That means that 94.8% of the semantic classes have unique syntactic signatures with this parsing strategy. Ten of the semantic classes do not have a unique syntactic signature. As it turns out, these ten classes are underdetermined by syntactic information. Let us look at the details of these classes.

## 2.2 The Ten Underdetermined Semantic Classes

Ten of the 191 semantic classes do not have enough purely syntactic information to differentiate them. Coincidentally, there are five syntactic signatures for these ten semantic classes: each signature maps onto two semantic classes each, as shown in Figure 3.

Three of these confluations are because the syntactic descriptions for the semantic classes are genuinely the same. The other two confluations occur because the parser is only looking at sentential syntax, but if morphological information and nominal syntax is

<sup>5</sup>Similar improvements in the utility of syntactic signatures for semantic extraction were obtained in the research reported in (Dorr et al., 1995) in which the syntactic codes of the Longman's Dictionary of Contemporary English were enhanced by adding the head preposition to the code.

Figure 3: Semantic Classes with Non-Unique Syntactic Signatures

Sig.	Patterns	Semantic Classes
#44	1-[np,v,np] 1-[np,v,np,pp(from)] 0-[np,v] 0-[np,v,np,pp(of)]	10.7 Pit Verbs 10.8 Debone Verbs
#86	1-[np,v] 0-[np,v,np]	40.4 Snooze Verbs 45.5 Verbs of Entity-Specific Change of State
#60	1-[np,v,np] 0-[np,v]	27 Engender Verbs 55.2 Complete Verbs
#89	1-[np,v] 1-[np,v,pp(at),pp(of)] 1-[np,v,pp(from)] 0-[np,v,np]	40.6 Verbs of Body-Internal States of Existence 40.8.4 Verbs of Change of Bodily State
#143	1-[np,v,np] 0-[np,v,pp(from)]	51.2 Leave 52 Avoid Verbs

included, the remaining two confluations receive the necessary distinctions to differentiate them.

Signature #60 conflates classes 27 (*Engender Verbs*) and 55.2 (*Complete Verbs*). The sets of sentences for each class illustrate the same thing: the verbs must be transitive. Intransitive uses are not allowed. It is interesting, though, that these two semantic classes look like they may have something in common. Class 27 (*Engender Verbs*), which are **beget, cause, create, engender, generate, shape, spawn**, are described as follows: "These verbs describe a causal relationship between two arguments, which are typically both abstract NP's. One argument brings about the existence of the other." Class 55.2 (*Complete Verbs*, which are **complete, discontinue, initiate, quit**, are described as follows: "The members of this set of aspectual verbs again describe the initiation, continuation, or termination of an activity, but unlike the members of the other subset of aspectual verbs above, complete verbs are not used intransitively...". Both sets of verbs have a sense in which they bring something about, for class 27, in terms of causation, and for class 55.2, in terms of completion. These transitions of course are not synonymous. Nonetheless, there may be some overlap in their semantic descriptions. In any case, the syntactic information automatically extracted from the example sentences is not sufficient to yield uniquely identifying clues for the semantic classification. That is, the semantic distinction is underdetermined by the example sentences.

Signature #89 conflates sections 40.6 and 40.8.4. Class 40.6 is "Verbs of Body-Internal States of Existence": **convulse, cower, quake, quiver, shake, shiver, shudder,**

**tremble, writhe**. Class 40.8.4 is “Verbs of Change of Bodily State”: **blanch, faint, sicken, swoon**. The semantic distinction between these two classes is underdetermined by the four syntactic patterns extracted from the example sentences given.

Signature #143 conflates classes 51.2 (the *Leave* verbs) and 52 (the *Avoid* verbs). The semantic difference between the classes is underdetermined by two syntactic patterns corresponding to the example sentences.

The reason that class 10.7 (*Pit* Verbs) and class 10.8 (*Debone* Verbs) are conflated by their syntactic signatures is also that the sentence patterns for the two classes are identical. However, the two classes are distinguished on morphological grounds: all of the *Debone* verbs have the prefix *de-*.

The two classes 40.4 (*Snooze* Verbs) and 45.5 (Verbs of Entity-Specific Change of State) also have the same set of sentence patterns. The two classes are distinguished by differences in non-sentential syntax: most of the verbs in class 40.4 have zero-related nominals whereas some of the verbs in class 45.5 have adjectival perfect participles.

### 2.3 The Role of Prepositions

Recall that when prepositions were added to the syntactic patterns, the number of semantic classes with uniquely identifying syntactic signatures increased from 153 to 181, an increase from 80.1% to 94.8% of the 191 semantic classes. What would happen if we composed syntactic signatures based on prepositions alone? For the sentence **Nora sent books to the children.**, the original experiment had a sentence of pattern of `[np,v,np,pp]`. With the preposition-enhanced parse, the pattern is `[np,v,np,pp(to)]`. The pattern with *only* prepositions throws away everything that is not a `pp`. The pattern for this sentence is `[pp(to)]`. A sentence with no prepositions has a null pattern: `[]`. What is interesting is that in this case, we still get useful results. The 1525 sentences reduce to 102 patterns, which in turn compose the 149 syntactic signatures. 128 of the 191 semantic classes have uniquely identifying signatures. Thus 67.0% of the classes can be identified with prepositions alone.

### 2.4 The Role of Negative Evidence

There are 971 positive examples and 554 negative examples. Negative examples present plausible uses of the verb in contexts which are disallowed. Although this evidence is useful, it is not available in dictionaries, corpora, or other convenient resources that could be used to extend Levin’s classification. For these reasons, we would like to know how important the negative evidence is for building uniquely identifying syntactic signatures, since we will most likely have to do without it.

As we might expect, throwing out the negative evidence degrades the usefulness of the signatures

Figure 4: Unique Mappings between Semantic Classes and Syntactic Signatures

	With Negative Evidence	No Negative Evidence
With Prepositions <i>Percentage:</i> <i>Classes:</i>	94.8% (181 of 191)	83.2% (159 of 191)
No Prepositions <i>Percentage:</i> <i>Classes:</i>	80.1% (159 of 191)	37.7% (72 of 191)
Only Prepositions <i>Percentage:</i> <i>Classes:</i>	67.0% (128 of 191)	43.5% (83 of 191)

Figure 5: Number of Appearances of Verbs

Number of Appearances	Verbs with that number of appearances
1	2239
2	536
3	173
4	43
5	23
6	7
7	2
10	1

across the board, but if we keep the positive instances of prepositions in the pattern, the best result still gives 83.2% of the semantic classes uniquely identifying syntactic signatures. The results of the other conditions are more radically degraded, as shown in Figure 4.

## 3 The Verb-Based Experiment

In the class-based experiment, the goal was to find unique mappings between syntactic signatures and semantic classes. Although the semantic classes clearly play a meaningful role in the semantics of each particular verb, this experiment does not give us mappings between individual verbs and syntactic signatures. What the class-based experiment does is abstract away from word sense ambiguity. In fact, 46% appear more than once. One verb (*roll*) appears ten times. The distribution of number of appearances is shown in Figure 5.

In some cases, the verb appears to have related sense even though it appears in different classes. For example, the verb *roll* appears in two subclasses of Manner of Motion Verbs that are distinguished on the basis of whether the grammatical subject is animate or inanimate. In other cases, the verb may have (largely) unrelated senses. For example, the verb *move* is both a Manner of Motion verb and verb of Psychological State. What happens if we add the word sense ambiguity into the experiment?

### 3.1 The Role of Word Sense Ambiguity

The composition of a syntactic signature is different for this experiment. Here, we collect all of the syntactic patterns associated with every class a particular verb appears in, regardless of whether that verb is semantically related in the different classes. Now a syntactic signature is the union of the syntactic patterns extracted from every example sentence associated with each verb. The outline of the verb-based experiment is as follows:

1. Automatically extract syntactic information from the example sentences.
2. Group the verbs according to their syntactic signature.
3. See where the two ways of grouping verbs overlap:
  - (a) the semantic classification given by Levin.
  - (b) the syntactic classification based on the derived syntactic signatures.

To return to the familiar Change of State verbs from above, we now consider the syntactic signature of the verb *break*, rather than the signature of the semantic class as a unit. The verb *break* belongs not only to the Change of State class, but also four other classes:<sup>6</sup> Each of these classes is characterized syntactically with a set of sentences. The union of the syntactic patterns corresponding to these sentences forms the syntactic signature for the verb.

One way to view the difference in this experiment is the difference between the *intension* of a function versus its *extension*. In this case, we are interested in the functions that group the verbs syntactically and semantically. Intensionally speaking, the definition of the function that groups verbs semantically would have something to do with the actual meaning of the verbs.<sup>7</sup> Likewise, the intension of the function that groups verbs syntactically would be defined in terms of something strictly syntactic, such as subcategorization frames. But the intensions of these functions are matters of significant theoretical investigation, and although much has been accomplished in this area, the question of mapping syntax to semantics and vice versa is an open research topic. Therefore, we can turn to the *extensions* of the functions: the actual groupings of verbs, based on these two separate criteria. The semantic extensions are sets of verb tokens, and likewise, the syntactic extensions are sets of verb tokens. To the extent that these functions map between syntax and semantics

<sup>6</sup>The verb *break* belongs to these classes: 10.6 *Cheat Verbs*. 23.2 *Split Verbs*. 40.8.3 *Hurt Verbs*. 45.1 *Break Verbs*. 48.1.1 *Appear Verbs*.

<sup>7</sup>A very important example of an intensional characterization of the Levin classes is Bonnie Dorr’s definitions of Lexical Conceptual Structures which correspond to each of Levin’s semantic classes. See (Dorr, 1995).

Figure 6: Verb-based versus Class-based Syntactic Signatures

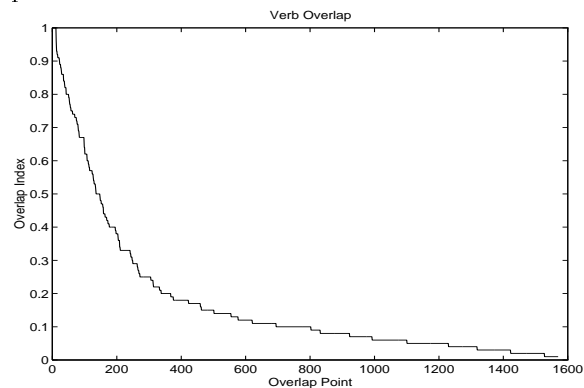
Class-based Signature for Class 45.1 (Change of State Verbs; <i>break</i> subclass)	Verb-based Signature for the verb <i>break</i> . Belongs to these classes 10.6 Cheat Verbs 23.2 Split Verbs 40.8.3 Hurt Verbs 45.1 Break Verbs 48.1.1 Appear Verbs
1- [np, v] 1- [np, v, np] 1- [np, v, np, adjective] 1- [np, v, np, pp] 1- [np, v, poss, np] 0- [np, v, np, pp] 0- [np, v, pp] 0- [np, v, self] 0- [np, v, self, pp]	1- [expletive, v, np, pp] 1- [np, v] 1- [np, v, np] 1- [np, v, np, adjective] 1- [np, v, np, pp] 1- [np, v, poss, np] 1- [np, v, pp] 1- [np, v, self] 1- [pp, v, np] 0- [np, v] 0- [np, v, np] 0- [np, v, np, pp] 0- [np, v, pp] 0- [np, v, self] 0- [np, v, self, pp] 0- [np, v, w_comp]

intensionally, they will pick out the same verbs extensionally.

So for the verb-based experiment, we need a different methodology to establish relatedness between the syntactic signatures and the semantic classes, since the signatures are now mediated by the verbs themselves. A direct method is to compare the two orthogonal groupings of the inventory of verbs: the semantic classes defined by Levin and the sets of verbs that correspond to each of the derived syntactic signatures. When these two groupings overlap, we have discovered a mapping from the syntax of the verbs to their semantics. More specifically, let us define the overlap index as the number of overlapping verbs divided by the average of the number of verbs in the semantic class and the number of verbs in the syntactic signature. Thus an overlap index of 1.00 is a complete overlap and an overlap of 0 is completely disjoint. In this experiment, the sets of verbs with a high overlap index are of interest.

If we re-run the experiment that had the best results for the class-based syntactic signatures, where the *pp*’s of syntactic patterns are marked for the specific prepositions and negative evidence is used, the 1525 example sentences reduce to 272 syntactic patterns, just as before. But now there are 741 verb-based syntactic signatures, as compared with 186 class-based signatures from before. Since there are far more syntactic signatures than the 191 semantic classes, it is clear that the mapping between signatures and semantic classes is not direct. With 741 syntactic signatures and 191 semantic classes, there

Figure 7: The Best Overlap for the Verb-Based Experiment



are 141531 points of potential overlap. Since there are only 4183 verbs, we know that most of these points of potential overlap must be empty. In this experiment, 1674 of these points have non-zero overlaps. Only 11 of these are complete overlaps. That means 5.8% of the 191 semantic classes have a complete overlap with a syntactic signature. The median overlap is 0.10, and the mean is 0.17. The sorted overlap indices are shown in Figure 7.

An example of a full overlap is the overlap of Semantic Class 37.9 (Verbs of Communication; *advise* subclass) and Syntactic Signature #540, shown in Figure 8.

An example of a partial overlap is the overlap of Semantic Class 47.2 (Verbs of Entity-Specific Modes of Being) and Syntactic Signature #472, shown in Figure 9. In this case, the overlap index is 0.50. There are 42 verbs that belong to Semantic Class 47.2 and 14 verbs that are picked out by Syntactic Signature #472. There are 14 verbs in the overlap. The overlap index is the number of verbs in the overlap divided by the average size of the semantic class and the syntactic signature.

To get a better comparison between the verb-based experiment and the class-based experiment, let us try a third experiment in which the verbs listed in the semantic classes are annotated with arbitrary indices that disambiguate them.<sup>8</sup> In this experiment, we will still consider the overlap indices as the measure of the relationship between the syntactic signatures and the semantic classes. The percentages are the same, but their interpretation is

<sup>8</sup>To disambiguate the verbs in the study, they were given a unique index if they appeared in more than one semantic class. They were simply marked with the class number, for example, *break*:45.1 refers to the change of state reading of *break*. Verbs which appeared only once got a zero index. The content of the indices were not used directly by the system for the grouping the verbs – they served only to make different appearances of the verbs unique.

Figure 8: Example of Full Overlap

	Verbs belonging to this group:
<b>Semantic Class 37.9</b> (Verbs of Communication; <i>advise</i> subclass)	[admonish,advise, alert,caution,counsel instruct,warn]
<b>Syntactic Signature #540</b> 0-[np,v,pp] 0-[np,v,pp,infinitive] 1-[np,v,infinitive] 1-[np,v,np] 1-[np,v,np,infinitive] 1-[np,v,np,pp] 1-[np,v,np,quotation] 1-[np,v,np,s_comp] 1-[np,v,np,w_comp] 1-[np,v,pp] 1-[np,v,quotation] 1-[np,v,s_comp] 1-[np,v,w_comp] 1-[appositive([np,v])] 1-[appositive([np,v,np])]	[admonish,advise,alert, caution,counsel, instruct,warn]
<b>Overlap</b>	[admonish,advise,alert, caution,counsel instruct,warn]

Figure 9: Example of Partial Overlap

<b>Semantic Class 47.2</b> (Verbs of Entity-Specific Modes of Being)	[billow, bloom, blossom, blow, breathe, bristle, bulge, burn, cascade, corrode, decay, decompose, effervesce, erode, ferment, fester, fizz, flow, flower, foam, froth, germinate, grow, molt, propagate, rage, ripple, roil, rot, rust, seethe, smoke, smolder, spread, sprout, stagnate, stream, sweep, tarnish, trickle, wilt, wither]
<b>Syntactic Signature #472</b> 1-[np,v] 1-[np,v,pp] 1-[pp,expletive,v,np] 1-[pp,v,np] 0-[np,v,np] 0-[np,v,np,pp]	[bloom, blossom, decay, erode, ferment, flower, germinate, molt, rot, rust, stagnate, tarnish, wilt, wither]
<b>Overlap</b>	[bloom, blossom, decay, erode, ferment, flower, germinate, molt, rot, rust, stagnate, tarnish, wilt, wither]

different than before. In the class-based experiment, we counted the percentage of semantic classes that had uniquely identifying signatures. Here, we count the number of perfect overlaps (overlaps with an index of 1.00) between the verbs as grouped in the semantic classes and grouped by syntactic signature. There is also additional information in this experiment, namely, the partial overlaps. The experiments that perform best have mostly perfect overlaps, for example, the experiments that include information about prepositions. In even the poorest performing experiments, at least one third of the overlaps are perfect. This is interesting because the alternative would be that throwing away information would decrease the overlaps across the board. Instead of that, we see a significant proportion of very robust syntactic signatures that yield perfect overlaps, that is, they still uniquely identify semantic classes even though they have lost information. These results are shown in the appendix.

The overall results of the suite of experiments, illustrating the role of disambiguation, negative evidence, and prepositions, is shown in Figure 10. Here we see the percentage of perfect overlaps, as well as both the median and mean overlap ratios for each experiment. The two columns on the left have strikingly better results than the two columns on the right. These data show that the most important factor in the experiments is word-sense disambiguation. Having negative evidence and having prepositions in the syntactic patterns is also important. But if we have to do without negative evidence, if we at least have the positive instances of preposition patterns, 83.2% of the semantic classes can still be linked to unique syntactic patterns.

## 4 Summary

There were two ways of running the experiment: either constructing syntactic signatures for the verbs themselves, or else constructing signatures for the semantic classes as units. In the verb-based experiment, verbs that appeared in different classes collected the syntactic information from each class it appeared in. Therefore, the syntactic signature was composed from all of the example sentences from every class the verb appeared in. In some cases, the verbs were semantically unrelated and consequently the mapping from syntax to semantics was muddled. The class-based experiment, on the other hand, abstracted away from the verbs themselves and attempted to determine a relationship between a semantic class and the syntactic information associated with each class. Not surprisingly, but not insignificantly, this relationship was much clearer, since this experiment avoided the problem of word sense ambiguity.

The method for establishing a relationship between semantic classes and syntactic signatures was

Figure 10: Overall Results  
Disambiguated

	Overlap	With Negative Evidence	No Negative Evidence
With Prepositions	Median	1.00	1.00
	Mean	0.98	0.90
	Perfect	94.8%	83.2%
No Prepositions	Median	1.00	0.56
	Mean	0.92	0.56
	Perfect	80.1%	37.7%
Only Prepositions	Median	1.00	0.56
	Mean	0.82	0.57
	Perfect	67.0%	43.5%
Not Disambiguated			
With Prepositions	Median	0.10	0.09
	Mean	0.17	0.16
	Perfect	5.8%	4.2%
No Prepositions	Median	0.10	0.09
	Mean	0.17	0.15
	Perfect	5.2%	2.6%
Only Prepositions	Median	0.10	0.09
	Mean	0.17	0.15
	Perfect	3.7%	3.7%

different for each experiment. For the class-based experiment, we classified each semantic class in terms of the syntactic information extracted from the example sentences in that class. We composed the syntactic signature locally for the class. Then we saw how many of the syntactic signatures uniquely identified a semantic class. In some cases, the syntactic information extracted from different classes was the same, either because the parser was throwing away relevant information, or because the syntactic patterns really were the same for the two semantic classes. In either case, the method for establishing a relationship was to see how many syntactic signatures had a one-to-one mapping onto a semantic class. In the best result (which includes negative evidence and prepositions) 181 of the 191 semantic classes had syntactic signatures that identified them uniquely. That is, 94.8% of the semantic classes could be identified with syntactic information.

For the verb-based experiments, it was more complicated to establish a relationship between semantic classes and syntactic signatures. Here, there were two orthogonal ways of grouping the same inventory of verbs: by semantic class, as given by Levin, and by syntactic signature, as automatically extracted from the example sentences. We were interested in seeing the overlap between the two groupings. Clearly, when there was complete overlap, we identified a direct mapping. A complete overlap meant that the same verbs that belong to a particular semantic class had the same syntactic signature. That signature, in turn, picked out only those verbs that belong to that class, and that class contained no verbs with other signatures. As it turned out, there were very

few complete overlaps in this experiment. The best result (which included negative evidence and prepositions) had a median overlap of 0.10 and a mean overlap of 0.17, with 5.8% of the semantic classes receiving 100% overlaps. The relatively poor performance of this experiment was striking in contrast with the exceptional performance of the class-based experiment.<sup>9</sup>

## 5 Next Steps

We would like to use these results to help in constructing and augmenting online dictionaries for natural language processing, and in particular for machine translation. Bonnie Dorr has constructed lexical representations for Levin's semantic classes: these are encoded in LCS structures, which serve as the interlingua for her machine translation system. (See (Dorr, 1993), (Dorr, 1995), (Dorr et al., 1995) and the references listed there for relevant discussion.) We would like to use these syntactic signatures to categorize new verbs into Levin's classes, using online dictionaries such as Longman's Dictionary of Contemporary English and the COMLEX dictionary. We would also like to formulate correspondences between particular frames in the signatures and particular portions of the LCS representation of the verb semantics. This information would help us to construct classes beyond those categorized in Levin's book. We would also like to extend this analysis to other languages, along the lines that Saint-Dizier and his colleagues are pursuing for French (See (Saint-Dizier, 1995)) and explored in (Jones (editor), 1994).

## 6 Acknowledgements

I would like to express my gratitude to Bonnie Dorr for getting me started on this project and for her invaluable expertise and support. I would especially like to thank her for checking over all of the DCG parses for the 1525 example sentences which were used to composed the signatures: she found many errors which I was able to correct for this report. Thanks also to Amy Weinberg and Wade Shen for helpful feedback and discussion. I would also like to thank Robert C. Berwick for insightful comments about the verb-based experiment. Many thanks also to Beth Levin and Mari Olsen for very helpful suggestions and comments on the penultimate draft of this report. I would also like to thank Brian Ulicny's for permission to use the DCG parser he wrote for the sentences in Part One of Levin's book,

---

<sup>9</sup>To get better results with the verb-based experiment, it would probably be necessary either to employ a statistical analysis of the overlaps or to develop a way to disambiguate the verbs based on other information in the example sentences, but I will not explore these possibilities here.

from which I extracted applicable lexical entries and grammar rules for this project.

## References

- Bonnie Dorr 1993. *Machine Translation - A View from the Lexicon* MIT Press.
- Bonnie Dorr 1995. "Large Scale Dictionary Construction for Foreign Language Tutoring and Interlingual Machine Translation" Manuscript. University of Maryland.
- Bonnie Dorr, Joseph Garman, and Amy Weinberg 1995. "From Syntactic Encodings to Thematic Roles: Building Lexical Entries for Interlingual MT" *Machine Translation*:9:3, 71-100. Kluwer Academic Publishers, Boston.
- Danièle Dubois and Patrick Saint-Dizier. 1995. *Construction et représentation de classes sémantiques de verbes: une coopération entre syntaxe et cognition*. manuscript, IRIT-CNRS, Toulouse, France.
- Doug Jones (editor). 1994. *Working Papers and Projects on Verb Class Alternations in Bangla, German, English, and Korean* Manuscript, MIT AI Lab.
- Beth Levin. 1993. *English Verb Classes and Alternations* University of Chicago Press.
- Patrick Saint-Dizier. 1995. Colloquium Talk at University of Maryland, UMIACS. Contact: [stdizier@langnat.irit.fr](mailto:stdizier@langnat.irit.fr)

## 7 Appendix

### 7.1 Overlap Indices

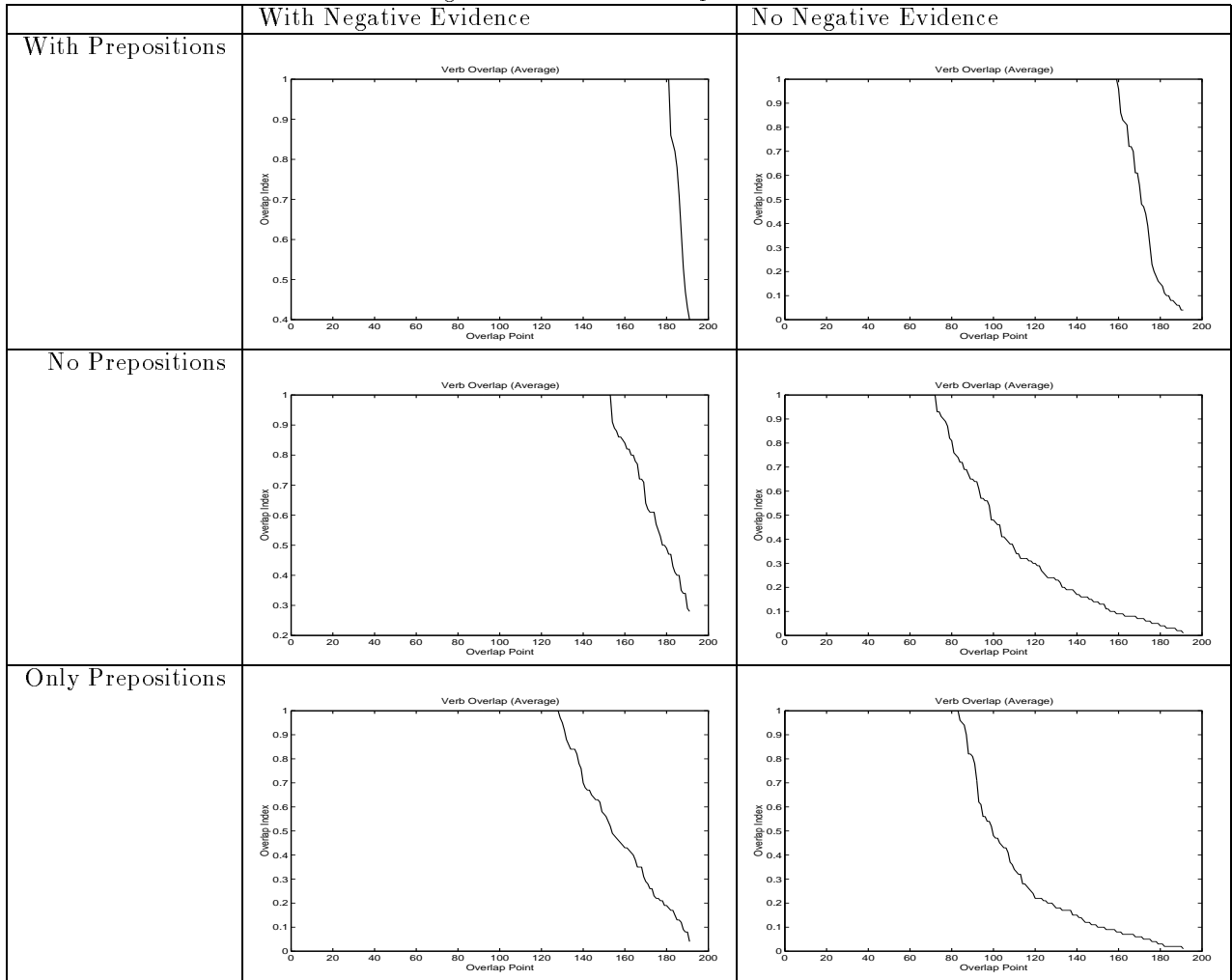
The distribution of sorted overlaps is shown in the graphs in Figure 11. Each graph shows the sorted distribution of overlap indices: when the overlap is 1.0, there is a perfect match in the verbs as grouped both by semantic class and by syntactic signature. The graphs in the left-hand column show experiments that used negative evidence. Each of these has higher a higher rate of overlap than its corresponding experiment that ignored negative evidence, shown in the right-hand column. The overlap ratios shown in Figure 11. correspond to the two columns of numbers on the left in 10.

### 7.2 Other Overlap Indices

Following a suggestion by Beth Levin, I have inspected the overlaps using different metrics than the one presented in the body of the paper. Recall that I defined the overlap index to be the number of verbs in the overlap divided by the average size of the semantic class and the syntactic signature. That definition abstracts away from the absolute sizes of the sets of verbs corresponding to the semantic classes



Figure 11: Sorted Overlap Indices



and to the syntactic signatures. It also abstracts away from the relative proportion of the size of the overlap to the size of the syntactic class and the semantic class separately. Since the number of verbs in the syntactic classes varies, as defined by the different sets of syntactic signatures, it may be informative to look at the overlaps related independently either to the size of the syntactic class or to the size of the semantic class. For the moment, I have simply summarized the relevant information in Figure 12 and Figure 13. In future work, we will consider this additional information systematically.

### 7.2.1 Key to Figure 12

The table in Figure 12 shows relevant information from each of the twelve experiments:

- **N Sent** – The number of example sentences used in the experiment (recall that some of the experiments only use the positive sentences),
- **N Syn Pat** – The number of syntactic patterns these reduce to,
- **N Syn Class** – The number of syntactic signatures composed of these syntactic patterns,
- **Mean N Verbs in Syn Class** – The average number of verbs associated with each syntactic signature,
- **Median N Verbs in Syn Class** – The median number of verbs associated with each syntactic signature,
- **N Sem Class** – The number of semantic classes
- **Mean N Verbs in Sem Class** – The average number of verbs in each semantic class.
- **Median N Verbs in Sem Class** – The median number of verbs in each semantic class.

### 7.2.2 Comments on Figure 12

The number of sentences varies according to whether negative evidence is used or not. For example, there are 1525 sentences in the experiments in which all sentences are used, and there are 971 sentences in the experiments which use only the positive example sentences. The less information used to construct the parses, the fewer syntactic patterns there are. Consequently there are fewer distinct syntactic signatures for these, which in turn leads to fewer syntactic classes. The number of semantic classes is constant (191). Therefore the mean and median number of verbs corresponding to each semantic class is constant. These values are shown for easy comparison with the syntactic classes.

In first experiment listed – the first disambiguated case, shown in the first row of the table – it is apparent that the syntactic classification is similar in proportion to the semantic classification. Notice that

the median number of verbs in both classifications is 13.00. For the other experiments, the more information that is ignored, the fewer classes there are, and the more verbs there are in each class.

The number of verbs per syntactic class drops dramatically in the experiments in which verb senses are not disambiguated. Notice that the mean number of verbs per syntactic class is 22.49 in the first experiment, whereas its equivalent in the undisambiguated case drops to 4.08. In the undisambiguated experiments, most of the syntactic classes only have one verb in them, as is apparent by looking at the value of the median number of verbs in the syntactic classes.

### 7.2.3 Key to Figure 13

The breakdown of the factors that are used to calculate the overlap index is shown. The proportion of verbs in the overlap as compared to the syntactic class and the semantic class is shown separately for each case. The table in Figure 13 shows information about the factors used to compose the overlap index. The two factors of the overlap index are shown directly: the column under **Syn** shows the number of verbs in the overlap divided by the number of verbs in the syntactic class. The **Sem** column is similar, only it is the number of verbs in the overlap divided by the number of verbs in the semantic class. The column under **Both** is the overlap index used in the experiments reported in the main text of this paper. It is the number of verbs in the overlap divided by the size of the syntactic class averaged with the size of the semantic class. Both the medians and the means of these values are shown. The absolute number of verbs in the overlaps are also shown. Both the mean and the median number of verbs have been calculated.

To give an example: the fifth column from the right, under the heading **Value of Overlap Index, Mean, and Syn**, which has the value of 0.97, is the mean value for the number of verbs in the overlap divided by the number of verbs in the syntactic class. The sixth column (1.00) shows the equivalent value but calculated using the size of the semantic class.

### 7.2.4 Comments on Figure 13

Notice that the number of nonzero overlaps is always 191 for the disambiguated experiments. This is because there is only one signature for each semantic class (the disambiguated experiments are equivalent to the class-based experiments). Recall that for each of these cases, there are fewer signatures than classes: from as many as 186 in the first disambiguated experiment listed to as few as 97 in the fifth one, as shown in Figure 12. Although the signatures do not necessarily uniquely identify a semantic class – each signature may correspond to more than one semantic class – no semantic class has more than one signature. Therefore, there are

only as many nonzero overlaps as there are semantic classes. Of course there is no equivalent restriction on the undisambiguated experiments, and in these cases there are as many as 1674 nonzero overlaps.

In the undisambiguated experiments, notice that the mean values of the syntactic portions of the overlap index is much higher than the semantic portion. For example, in the first undisambiguated experiment shown, the mean value of the syntactic overlap is 0.99, whereas the mean value of the semantic overlap is 0.11. Nevertheless, the combined value is 0.17. The reason for this is that there are many more syntactic classes than there are semantic classes, and there are a large number of overlaps to multiply this effect out. In this experiment, for example, there are 741 syntactic classes, and only 191 semantic classes. There are 1674 nonzero overlaps over which these values are multiplied. Since there are so many more syntactic classes, the average number of verbs per syntactic class is lower (only 4.08), whereas the average number of verbs per semantic class is 21.90. Therefore, the proportion of the overlap as compared with the size of the syntactic class is high. The median values show similar results.

### 7.3 Levin's Semantic Classes and Their Signatures

The actual signatures, as constructed from the parses including negative evidence and prepositions, are shown below. I inspected all of the parses of the example sentences, and corrected some errors in the parses such as incorrect PP-attachments and incorrect category assignments in cases of ambiguity. Bonnie Dorr inspected all of these, and found additional errors, which were corrected for this experiment. The signatures based on the uncorrected parses give roughly the same results as reported here.

Only fully grammatical parses are counted as positive. Deviant and mildly deviant parses, annotated as '??' and '?' in the example sentences, are encoded with the codes of 2- and 3- respectively. Patterns with these codes are not counted as positive in the entries below.

The entries also say whether the signature shown uniquely identifies that class. This means that the *full* signature, including non-positive frames, identifies the semantic class.

Furthermore, if the positive portion of the signature is a subset of a signature that is associated with some *other* semantic class, that fact is noted and the classes are listed.

Figure 12: Classification Survey

	N Sent	N Syn Pat	N Syn Class (Sig)	Mean N Verbs in Syn Class	Median N Verbs in Syn Class	N Sem Class	Mean N Verbs in Sem Class	Median N Verbs in Sem Class
Disambiguated With Negative With Prepositions	1525	272	186	22.49	13.00	191	21.90	13.00
Disambiguated With Negative No Prepositions	1525	118	171	24.46	15.00	191	21.90	13.00
Disambiguated With Negative Only Prepositions	1525	102	149	28.07	18.00	191	21.90	13.00
Disambiguated No Negative With Prepositions	971	156	168	24.90	14.50	191	21.90	13.00
Disambiguated No Negative No Prepositions	971	62	97	43.12	20.00	191	21.90	13.00
Disambiguated No Negative Only Prepositions	971	51	101	41.42	18.00	191	21.90	13.00
Undisambiguated With Negative With Prepositions	1525	272	741	4.08	1.00	191	21.90	13.00
Undisambiguated With Negative No Prepositions	1525	118	671	4.51	1.00	191	21.90	13.00
Undisambiguated With Negative Only Prepositions	1525	102	626	4.83	1.00	191	21.90	13.00
Undisambiguated No Negative With Prepositions	971	156	684	4.42	1.00	191	21.90	13.00
Undisambiguated No Negative No Prepositions	971	62	419	7.22	1.00	191	21.90	13.00
Undisambiguated No Negative Only Prepositions	971	51	427	7.08	1.00	191	21.90	13.00

Figure 13: Breakdown of Index Factors

	Mean Class		Value of Overlap Index						Number of		
	Size		Mean			Median			Nonzero	Verbs in Overlap	
	Syn	Sem	Both	Syn	Sem	Both	Syn	Sem	Overlaps	Mean	Median
Disambiguated With Negative With Prepositions	22.5	21.9	0.98	0.97	1.00	1.00	1.00	1.00	191	21.90	13.00
Disambiguated With Negative No Prepositions	24.5	21.9	0.92	0.90	1.00	1.00	1.00	1.00	191	21.90	13.00
Disambiguated With Negative Only Prepositions	28.1	21.9	0.82	0.78	1.00	1.00	1.00	1.00	191	21.90	13.00
Disambiguated No Negative With Prepositions	24.9	21.9	0.90	0.88	1.00	1.00	1.00	1.00	191	21.90	13.00
Disambiguated No Negative No Prepositions	43.1	21.9	0.56	0.51	1.00	0.56	0.39	1.00	191	21.90	13.00
Disambiguated No Negative Only Prepositions	41.4	21.9	0.57	0.53	1.00	0.56	0.39	1.00	191	21.90	13.00
Undisambiguated With Negative With Prepositions	4.1	21.9	0.17	0.99	0.11	0.10	1.00	0.05	1674	2.50	1.00
Undisambiguated With Negative No Prepositions	4.5	21.9	0.17	0.95	0.12	0.10	1.00	0.05	1604	2.61	1.00
Undisambiguated With Negative Only Prepositions	4.8	21.9	0.17	0.93	0.12	0.10	1.00	0.05	1563	2.68	1.00
Undisambiguated No Negative With Prepositions	4.4	21.9	0.16	0.96	0.12	0.09	1.00	0.05	1627	2.57	1.00
Undisambiguated No Negative No Prepositions	7.2	21.9	0.15	0.76	0.14	0.09	1.00	0.05	1379	3.03	1.00
Undisambiguated No Negative Only Prepositions	7.1	21.9	0.15	0.76	0.14	0.09	1.00	0.05	1377	3.04	1.00

**Semantic class 9.1 – Verbs of Putting: Put Verbs**

**13 Verbs**

arrange immerse install lodge mount place  
position put set situate sling stash stow

**Signature #55 (10 Patterns – 3 Positive)**  
uniquely identifies semantic class 9.1

0-[np,v,np]  
0-[np,v,np,pp(from)]  
0-[np,v,np,pp(to)]  
0-[np,v,np,pp(with)]  
0-[np,v,adv(easily),pp(on)]  
0-[np,v,pp(from),pp(to)]  
0-[np,v,pp(on)]  
1-[np,v,np,pp(near)]  
1-[np,v,np,pp(on)]  
1-[np,v,np,pp(under)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 9.3 – Verbs of Putting: Funnel Verbs**

**26 Verbs**

bang channel dip dump funnel hammer  
ladle pound push rake ram scoop scrape  
shake shovel siphon spoon squash squeeze  
squish sweep tuck wad wedge wipe wring

**Signature #7 (10 Patterns – 1 Positive)**  
uniquely identifies semantic class 9.3

0-[np,v]  
0-[np,v,np]  
0-[np,v,np,pp(from)]  
0-[np,v,np,pp(from),pp(to)]  
0-[np,v,np,pp(to)]  
0-[np,v,np,pp(with)]  
0-[np,v,adv(easily)]  
0-[np,v,pp(into)]  
1-[np,v,np,pp(into)]  
3-[np,v,np,pp(in)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 14 semantic classes:

17.1 19 22.1 22.3 25.4 26.1 26.2 26.5 26.6  
45.2 51.3.2 9.3 9.5 9.7

**Semantic class 9.2 – Verbs of Putting: Verbs of Putting in a Spatial Configuration**

**9 Verbs**

dangle hang lay lean perch rest sit stand  
suspend

**Signature #110 (9 Patterns – 3 Positive)**  
uniquely identifies semantic class 9.2

0-[np,v,np,pp(from)]  
0-[np,v,np,pp(to)]  
0-[np,v,np,pp(with)]  
0-[np,v,adv(easily),pp(on)]  
0-[np,v,pp(on)]  
1-[np,v,np,pp(on)]  
1-[np,v,np,pp([next,to])]  
1-[np,v,pp(on)]  
2-[np,v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 9.4 – Verbs of Putting: Verbs of Putting with a Specified Direction**

**5 Verbs**

drop hoist lift lower raise

**Signature #95 (12 Patterns – 6 Positive)**  
uniquely identifies semantic class 9.4

0-[np,v,np,np]  
0-[np,v,np,pp(on)]  
0-[np,v,np,pp(up)]  
0-[np,v,np,pp(with)]  
0-[np,v,adv(easily),pp(onto)]  
0-[np,v,pp(onto)]  
1-[np,v,np]  
1-[np,v,np,pp(onto)]  
1-[np,v,np,pp(to)]  
1-[np,v,np,pp([out,of])]  
1-[np,v,np,pp([up,to])]  
1-[np,v,pp(from),pp(to)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 9.5 – Verbs of Putting: Pour Verbs**  
8 Verbs

dribble drip pour slop slosh spew spill spurt

**Signature #135 (10 Patterns – 6 Positive)**  
uniquely identifies semantic class 9.5

0-[np,v,np,pp(with)]  
0-[np,v,adv(easily),pp(onto)]  
0-[np,v,pp(at),pp(into)]  
0-[np,v,pp(into)]  
1-[np,v,np,pp(from)]  
1-[np,v,np,pp(into)]  
1-[np,v,np,pp(onto)]  
1-[np,v,np,pp(over)]  
1-[np,v,np,pp([out,of])]  
1-[np,v,pp(onto)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 9.7 – Verbs of Putting: Spray/Load Verbs**  
49 Verbs

brush cram crowd cultivate dab daub drape  
drizzle dust hang heap inject jam load  
mound pack pile plant plaster prick pump  
rub scatter seed settle sew shower slather  
smear smudge ...

**Signature #106 (10 Patterns – 8 Positive)**  
uniquely identifies semantic class 9.7

0-[np,v,np,pp(at)]  
0-[np,v,pp(with)]  
1-[np,v,np,pp(at)]  
1-[np,v,np,pp(into)]  
1-[np,v,np,pp(on)]  
1-[np,v,np,pp(onto)]  
1-[np,v,np,pp(over)]  
1-[np,v,np,pp(under)]  
1-[np,v,np,pp(with)]  
1-[np,v,pp(on)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 9.6 – Verbs of Putting: Coil Verbs**  
9 Verbs

coil curl loop roll spin twirl twist whirl wind

**Signature #139 (5 Patterns – 3 Positive)**  
uniquely identifies semantic class 9.6

0-[np,v,np,pp(with)]  
0-[np,v,pp(at),pp(around)]  
1-[np,v,np,pp(around)]  
1-[np,v,adv(easily),pp(around)]  
1-[np,v,pp(around)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 9.8 – Verbs of Putting: Fill Verbs**  
95 Verbs

adorn anoint bandage bathe bestrew bind  
blanket block blot bombard carpet choke  
cloak clog clutter coat contaminate cover  
dam dapple deck decorate deluge dirty dot  
douse drench edge embellish emblazon ...

**Signature #120 (5 Patterns – 3 Positive)**  
uniquely identifies semantic class 9.8

0-[np,v,np,pp(in)]  
0-[np,v,pp(with)]  
1-[np,v,np]  
1-[np,v,np,pp(in)]  
1-[np,v,np,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

19 9.8

**Semantic class 9.9 – Verbs of Putting: Butter Verbs**  
**109 Verbs**

asphalt bait blanket blindfold board bread  
brick bridle bronze butter buttonhole cap  
carpet caulk chrome cloak cork crown di-  
aper drug feather fence flour forest frame  
fuel gag garland glove graffiti ...

**Signature #24 (8 Patterns – 2 Positive)**  
**uniquely identifies semantic class 9.9**

0-[np,v]  
0-[np,v,np,pp(on)]  
0-[np,v,pp(at)]  
0-[np,v,pp(at),pp(with)]  
0-[np,v,pp(with)]  
1-[np,v,np]  
1-[np,v,np,pp(with)]  
2-[np,v,np,pp(with)]

The positive portion of this signature identifies these 4 semantic classes in the positive signature suite:

17.2 25.3 44 9.9

Also, the positive portion of this signature is a subset of the signatures of these 23 semantic classes:

11.1 11.4 17.2 18.1 18.2 18.3 19 20 21.1 21.2  
22.2 24 25.1 25.3 31.1 39.1 42.1 44 45.1 45.2  
45.4 9.8 9.9

**Semantic class 9.10 – Verbs of Putting: Pocket Verbs**  
**53 Verbs**

archive bag bank beach bed bench berth  
billet bin bottle box cage can case cellar  
cloister coop corral crate dock drydock file  
fork garage ground hangar house jail jar jug  
...

**Signature #19 (5 Patterns – 1 Positive)**  
**uniquely identifies semantic class 9.10**

0-[np,v]  
0-[np,v,np,pp(in)]  
0-[np,v,np,pp(with)]  
1-[np,v,np]  
3-[np,v,np,pp(in)]

The positive portion of this signature identifies these 10 semantic classes in the positive signature suite:

27 39.4 41.1.2 41.3.1 51.2 52 54.1 54.2 55.2  
9.10

Also, the positive portion of this signature is a subset of the signatures of these 99 semantic classes:

10.3 10.4.1 10.4.2 10.7 10.8 10.9 11.1 11.2  
11.4 11.5 12 13.5.1 13.5.2 15.1 17.1 17.2 18.1  
18.2 18.3 19 20 21.1 21.2 22.2 22.3 23.3 24  
25.1 25.2 25.3 25.4 26.1 26.3 26.4 26.5 26.7  
27 29.7 30.1 30.2 31.1 31.2 32.1 33 34 35.1  
36.2 36.3 37.1 37.2 37.3 37.4 37.9 38 39.1  
39.2 39.3 39.4 39.7 40.1.2 40.2 40.7 40.8.1  
41.1.1 41.1.2 41.2.2 41.3.1 42.1 42.2 43.1  
43.2 43.4 44 45.1 45.2 45.3 45.4 47.3 47.5.2  
47.8 48.1.2 51.1 51.2 51.3.2 51.4.1 51.4.2  
51.5 51.6 51.7 52 54.1 54.2 54.3 54.4 55.2  
9.10 9.4 9.8 9.9



**Semantic class 10.1 – Verbs of Removing:  
Remove Verbs  
35 Verbs**

abstract cull delete discharge disengage dis-  
gorge dislodge dismiss draw eject eliminate  
eradicate evict excise excommunicate expel  
extirpate extract extrude lop omit ostracize  
oust partition pry reap remove separate  
sever shoo ...

**Signature #124 (9 Patterns – 3 Positive)  
uniquely identifies semantic class 10.1**

0-[np,v,np,pp(of)]  
0-[np,v,np,pp(to)]  
0-[np,v,np,pp([off,of])]  
0-[np,v,np,pp([out,of])]  
0-[np,v,pp(at),pp(from)]  
0-[np,v,pp(from)]  
1-[np,v,np,pp(from)]  
1-[np,v,np,pp([from,around])]  
1-[np,v,np,pp([from,under])]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

10.1 10.3

**Semantic class 10.2 – Verbs of Removing:  
Banish Verbs  
7 Verbs**

banish deport evacuate expel extradite recall  
remove

**Signature #126 (6 Patterns – 2 Positive)  
uniquely identifies semantic class 10.2**

0-[np,v,np,pp(of)]  
0-[np,v,pp(at),pp(from)]  
0-[np,v,pp(from)]  
0-[np,v,pp(from),pp(to)]  
1-[np,v,np,pp(from)]  
1-[np,v,np,pp(to)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 5 semantic classes:

10.2 11.1 11.3 11.4 11.5

**Semantic class 10.3 – Verbs of Removing:  
Clear Verbs  
4 Verbs**

clean clear drain empty

**Signature #86 (12 Patterns – 8 Positive)  
uniquely identifies semantic class 10.3**

0-[np,v,np,adjective]  
0-[np,v,pp(at)]  
0-[np,v,pp(at),pp(of)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,np,pp(from)]  
1-[np,v,np,pp(of)]  
1-[np,v,np,pp([from,around])]  
1-[np,v,np,pp([from,behind])]  
1-[np,v,np,pp([from,under])]  
1-[np,v,pp(from)]  
2-[np,v,pp(of)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 10.4.1 – Verbs of Removing:  
Wipe Verbs: Manner Subclass  
39 Verbs**

bail buff dab distill dust erase expunge flush  
leach lick pluck polish prune purge rinse  
rub scour scrape scratch scrub shave skim  
smooth soak squeeze strain strip suck suction  
swab ...

**Signature #21 (15 Patterns – 11 Positive)  
uniquely identifies semantic class 10.4.1**

0-[np,v]  
0-[np,v,np,pp(of)]  
0-[np,v,pp(at)]  
0-[np,v,pp(from)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,adjective,pp(of)]  
1-[np,v,np,pp(behind)]  
1-[np,v,np,pp(from)]  
1-[np,v,np,pp([from,inside])]  
1-[np,v,np,pp([from,outside])]  
1-[np,v,np,pp([from,under])]  
1-[np,v,pp(at)]  
1-[np,v,pp(behind)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 10.4.2 – Verbs of Removing:  
Wipe Verbs: Instrument Subclass**  
17 Verbs

brush comb file filter Hoover hose iron mop  
plow rake sandpaper shear shovel siphon  
sponge towel vacuum

**Signature #22 (14 Patterns – 10 Positive)**  
uniquely identifies semantic class 10.4.2

0-[np,v]  
0-[np,v,np,pp(of)]  
0-[np,v,pp(at)]  
0-[np,v,pp(from)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,adjective,pp(of)]  
1-[np,v,np,pp(from)]  
1-[np,v,np,pp(under)]  
1-[np,v,np,pp([from,among])]  
1-[np,v,np,pp([from,near])]  
1-[np,v,np,pp([from,under])]  
1-[np,v,np,pp(under)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 10.6 – Verbs of Removing:  
Verbs of Possessional Deprivation: Cheat  
Verbs**  
48 Verbs

absolve acquit balk bereave bilk bleed break  
burgle cheat cleanse con cull cure defraud  
denude deplete depopulate deprive despoil  
disabuse disarm disencumber dispossess di-  
vest drain ease exonerate fleece free gull ...

**Signature #111 (5 Patterns – 2 Positive)**  
uniquely identifies semantic class 10.6

0-[np,v,np,pp(from)]  
0-[np,v,np,pp([out,of])]  
0-[np,v,pp(of)]  
1-[np,v,np,pp(of)]  
1-[np,v,np,pp([out,of])]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 10.5 – Verbs of Removing:  
Verbs of Possessional Deprivation: Steal  
Verbs**  
45 Verbs

abduct cadge capture confiscate cop eman-  
cipate embezzle exorcise extort extract filch  
flog grab impound kidnap liberate lift nab  
pilfer pinch pirate plagiarize purloin re-  
claim recover redeem regain repossess res-  
cue retrieve ...

**Signature #94 (6 Patterns – 2 Positive)**  
uniquely identifies semantic class 10.5

0-[np,v,np,np]  
0-[np,v,np,pp(of)]  
0-[np,v,pp(at),pp(from)]  
0-[np,v,pp(from)]  
1-[np,v,np,pp(for)]  
1-[np,v,np,pp(from)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 4 semantic classes:

10.5 13.5.1 13.5.2 26.4

**Semantic class 10.7 – Verbs of Removing:  
Pit Verbs**  
41 Verbs

bark beard bone burl core gill gut head hull  
husk lint louse milk peel pinion pip pit pith  
pod poll pulp rind scale scalp seed shell  
shuck skin snail stalk ...

**Signature #23 (4 Patterns – 2 Positive)**  
identifies semantic classes: 10.7 10.8

0-[np,v]  
0-[np,v,np,pp(of)]  
1-[np,v,np]  
1-[np,v,np,pp(from)]

The positive portion of this signature identifies these 3 semantic classes in the positive signature suite:

10.7 10.8 10.9

Also, the positive portion of this signature is a subset of the signatures of these 13 semantic classes:

10.3 10.4.1 10.4.2 10.7 10.8 10.9 11.1 11.4  
11.5 13.5.1 13.5.2 23.3 26.4

**Semantic class 10.8 – Verbs of Removing:  
Debone Verbs  
50 Verbs**

deaccent debark debone debowel debug de-  
bur declaw defang defat defeather deflea  
deflesh defoam defog deforest defrost de-  
fuzz degas degerm deglaze degrease degrit  
degum degut dehair dehead dehorn dehull  
dehusk deice ...

**Signature #23 (4 Patterns – 2 Positive)  
identifies semantic classes: 10.7 10.8**

0-[np,v]  
0-[np,v,np,pp(of)]  
1-[np,v,np]  
1-[np,v,np,pp(from)]

The positive portion of this signature identifies  
these 3 semantic classes in the positive signature  
suite:

10.7 10.8 10.9

Also, the positive portion of this signature is a sub-  
set of the signatures of these 13 semantic classes:

10.3 10.4.1 10.4.2 10.7 10.8 10.9 11.1 11.4  
11.5 13.5.1 13.5.2 23.3 26.4

**Semantic class 11.1 – Verbs of Sending and  
Carrying: Send Verbs  
23 Verbs**

fed\_ex u\_p\_s airmail convey deliver dispatch  
express forward hand mail pass port post  
return send shift ship shunt slip smuggle  
sneak transfer transport

**Signature #136 (10 Patterns – 6 Positive)  
uniquely identifies semantic class 11.1**

0-[np,v,np,pp(with)]  
0-[np,v,adv(easily),pp(to)]  
0-[np,v,pp(at),pp(to)]  
0-[np,v,pp(to)]  
1-[np,v,np]  
1-[np,v,np,np]  
1-[np,v,np,pp(from)]  
1-[np,v,np,pp(to)]  
1-[np,v,np,pp(with)]  
1-[np,v,pp(from),pp(to)]

The positive portion of this signature uniquely identi-  
fies this semantic class in the positive signature suite.

**Semantic class 10.9 – Verbs of Removing:  
Mine Verbs  
2 Verbs**

mine quarry

**Signature #43 (3 Patterns – 2 Positive)  
uniquely identifies semantic class 10.9**

0-[np,v]  
1-[np,v,np]  
1-[np,v,np,pp(from)]

The positive portion of this signature identifies  
these 3 semantic classes in the positive signature  
suite:

10.7 10.8 10.9

Also, the positive portion of this signature is a sub-  
set of the signatures of these 13 semantic classes:

10.3 10.4.1 10.4.2 10.7 10.8 10.9 11.1 11.4  
11.5 13.5.1 13.5.2 23.3 26.4

**Semantic class 11.2 – Verbs of Sending and  
Carrying: Slide Verbs  
5 Verbs**

bounce float move roll slide

**Signature #138 (12 Patterns – 8 Positive)  
uniquely identifies semantic class 11.2**

0-[np,v,np,pp(with)]  
0-[np,v,pp(at)]  
0-[np,v,pp(at),pp(to)]  
1-[np,v,np]  
1-[np,v,np,np]  
1-[np,v,np,pp(across)]  
1-[np,v,np,pp(to)]  
1-[np,v,adv(easily),pp(across)]  
1-[np,v,pp(across)]  
1-[np,v,pp(at)]  
1-[np,v,pp(from),pp(to)]  
2-[np,v,np,pp([away,from])]

The positive portion of this signature uniquely identi-  
fies this semantic class in the positive signature suite.

**Semantic class 11.3 – Verbs of Sending and Carrying: Bring and Take**  
**2 Verbs**

bring take

**Signature #85 (8 Patterns – 4 Positive)**  
**uniquely identifies semantic class 11.3**

0-[np,v,np,adjective]  
0-[np,v,adv(easily),pp(to)]  
0-[np,v,pp(at),pp(to)]  
0-[np,v,pp(to)]  
1-[np,v,np,np]  
1-[np,v,np,pp(from)]  
1-[np,v,np,pp(to)]  
1-[np,v,np,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

11.1 11.3

**Semantic class 11.5 – Verbs of Sending and Carrying: Drive Verbs**  
**11 Verbs**

barge bus cart drive ferry fly row shuttle  
truck wheel wire

**Signature #26 (12 Patterns – 4 Positive)**  
**uniquely identifies semantic class 11.5**

0-[np,v]  
0-[np,v,np,pp(with)]  
0-[np,v,adv(easily)]  
0-[np,v,adv(easily),pp(to)]  
0-[np,v,pp(at)]  
0-[np,v,pp(at),pp(to)]  
0-[np,v,pp(to)]  
1-[np,v,np]  
1-[np,v,np,pp(from)]  
1-[np,v,np,pp(to)]  
1-[np,v,pp(from),pp(to)]  
2-[np,v,np,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 3 semantic classes:

11.1 11.4 11.5

**Semantic class 11.4 – Verbs of Sending and Carrying: Carry Verbs**  
**15 Verbs**

carry drag haul heave heft hoist kick lug  
pull push schlep shove tote tow tug

**Signature #31 (14 Patterns – 8 Positive)**  
**uniquely identifies semantic class 11.4**

0-[np,v]  
0-[np,v,adv(easily)]  
0-[np,v,adv(easily),pp(to)]  
0-[np,v,pp(at)]  
0-[np,v,pp(at),pp(to)]  
1-[np,v,np]  
1-[np,v,np,pp(from)]  
1-[np,v,np,pp(to)]  
1-[np,v,np,pp(with)]  
1-[np,v,pp(against)]  
1-[np,v,pp(at)]  
1-[np,v,pp(from),pp(to)]  
1-[np,v,pp(to),pp(with)]  
2-[np,v,np,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 12 – Verbs of Exerting Force: Push/Pull Verbs**  
**10 Verbs**

draw heave jerk press pull push shove  
thrust tug yank

**Signature #42 (10 Patterns – 9 Positive)**  
**uniquely identifies semantic class 12**

0-[np,v]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,pp(against)]  
1-[np,v,np,pp(through)]  
1-[np,v,np,pp([away,from])]  
1-[np,v,pp(against)]  
1-[np,v,pp(at)]  
1-[np,v,pp(on)]  
1-[np,v,pp(through)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 13.1 – Verbs of Change of Possession: Verbs of Change of Possession**  
**15 Verbs**

feed give lease lend loan pass pay peddle  
refund render rent repay sell serve trade

**Signature #17 (7 Patterns – 2 Positive)**  
**uniquely identifies semantic class 13.1**

0-[np,v]  
0-[np,v,np,pp(behind)]  
0-[np,v,np,pp(near)]  
0-[np,v,np,pp(with)]  
0-[np,v,pp(to)]  
1-[np,v,np,np]  
1-[np,v,np,pp(to)]

The positive portion of this signature identifies these 2 semantic classes in the positive signature suite:

13.1 13.3

Also, the positive portion of this signature is a subset of the signatures of these 11 semantic classes:

11.1 11.2 11.3 13.1 13.3 17.1 26.7 37.1 37.2  
37.4 39.7

**Semantic class 13.3 – Verbs of Change of Possession: Verbs of Future Having**  
**19 Verbs**

advance allocate allot assign award be-  
queath cede concede extend grant guaran-  
tee issue leave offer owe promise vote will  
yield

**Signature #18 (6 Patterns – 2 Positive)**  
**uniquely identifies semantic class 13.3**

0-[np,v]  
0-[np,v,np,pp(behind)]  
0-[np,v,np,pp(with)]  
0-[np,v,pp(to)]  
1-[np,v,np,np]  
1-[np,v,np,pp(to)]

The positive portion of this signature identifies these 2 semantic classes in the positive signature suite:

13.1 13.3

Also, the positive portion of this signature is a subset of the signatures of these 11 semantic classes:

11.1 11.2 11.3 13.1 13.3 17.1 26.7 37.1 37.2  
37.4 39.7

**Semantic class 13.2 – Verbs of Change of Possession: Contribute Verbs**  
**18 Verbs**

administer contribute disburse distribute  
donate extend forfeit proffer refer reimburse  
relinquish remit restore return sacrifice sub-  
mit surrender transfer

**Signature #15 (7 Patterns – 1 Positive)**  
**uniquely identifies semantic class 13.2**

0-[np,v]  
0-[np,v,np,np]  
0-[np,v,np,pp(on)]  
0-[np,v,np,pp(under)]  
0-[np,v,np,pp(with)]  
0-[np,v,pp(to)]  
1-[np,v,np,pp(to)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 27 semantic classes:

10.2 11.1 11.2 11.3 11.4 11.5 13.1 13.2 13.3  
13.4.1 17.1 18.3 21.1 22.4 26.7 31.1 37.1 37.2  
37.3 37.4 37.7 39.7 42.2 45.1 45.3 51.7 9.4

**Semantic class 13.4.1 – Verbs of Change of Possession: Verbs of Providing: Verbs of Fulfilling**  
**10 Verbs**

credit entrust furnish issue leave present  
provide serve supply trust

**Signature #104 (6 Patterns – 2 Positive)**  
**uniquely identifies semantic class 13.4.1**

0-[np,v,np,pp(at)]  
0-[np,v,np,pp(near)]  
0-[np,v,np,pp(onto)]  
0-[np,v,np,pp([next,to])]  
1-[np,v,np,pp(to)]  
1-[np,v,np,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 9 semantic classes:

11.1 11.3 11.4 13.4.1 18.3 21.1 22.4 31.1 45.1

**Semantic class 13.4.2 – Verbs of Change of Possession: Verbs of Providing: Equip Verbs**  
**10 Verbs**

arm burden charge compensate equip invest  
ply regale reward saddle

**Signature #90 (6 Patterns – 1 Positive)**  
**uniquely identifies semantic class 13.4.2**

0-[np,v,np,np]  
0-[np,v,np,pp(at)]  
0-[np,v,np,pp(near)]  
0-[np,v,np,pp(to)]  
0-[np,v,np,pp([next,to])]  
1-[np,v,np,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 29 semantic classes:

11.1 11.3 11.4 13.4.1 13.4.2 17.2 18.1 18.2  
18.3 19 20 21.1 21.2 22.1 22.2 22.4 24 25.1  
25.3 31.1 39.1 42.1 44 45.1 45.2 45.4 9.7 9.8  
9.9

**Semantic class 13.5.2 – Verbs of Change of Possession: Verbs of Obtaining: Obtain Verbs**  
**19 Verbs**

accept accumulate acquire appropriate borrow  
cadge collect exact grab inherit obtain  
purchase receive recover regain retrieve  
seize select snatch

**Signature #93 (7 Patterns – 4 Positive)**  
**uniquely identifies semantic class 13.5.2**

0-[np,v,np,np]  
0-[np,v,np,pp(of)]  
0-[np,v,np,pp(to)]  
1-[np,v,np]  
1-[np,v,np,pp(at)]  
1-[np,v,np,pp(for)]  
1-[np,v,np,pp(from)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

13.5.1 13.5.2

**Semantic class 13.5.1 – Verbs of Change of Possession: Verbs of Obtaining: Get Verbs**  
**33 Verbs**

book buy call cash catch charter choose  
earn fetch find gain gather get hire keep  
lease leave order phone pick pluck procure  
pull reach rent reserve save secure shoot  
slaughter ...

**Signature #125 (7 Patterns – 5 Positive)**  
**uniquely identifies semantic class 13.5.1**

0-[np,v,np,pp(of)]  
0-[np,v,np,pp(to)]  
1-[np,v,np]  
1-[np,v,np,np]  
1-[np,v,np,pp(at)]  
1-[np,v,np,pp(for)]  
1-[np,v,np,pp(from)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 13.6 – Verbs of Change of Possession: Verbs of Exchange**  
**6 Verbs**

barter change exchange substitute swap  
trade

**Signature #96 (3 Patterns – 1 Positive)**  
**uniquely identifies semantic class 13.6**

0-[np,v,np,np]  
0-[np,v,np,pp(to)]  
1-[np,v,np,pp(for)]

The positive portion of this signature identifies these 2 semantic classes in the positive signature suite:

13.6 35.4

Also, the positive portion of this signature is a subset of the signatures of these 17 semantic classes:

10.5 13.5.1 13.5.2 13.6 26.1 26.3 26.4 26.7  
31.2 32.1 33 34 35.1 35.2 35.3 35.4 54.5

**Semantic class 13.7 – Verbs of Change of Possession: Berry Verbs**  
**26 Verbs**

antique berry birdnest blackberry clam  
crab fish fowl grouse hay log mushroom nest  
nut oyster pearl prawn rabbit seal shark  
shrimp snail snipe sponge whale whelk

**Signature #185 (1 Patterns – 1 Positive)**  
**uniquely identifies semantic class 13.7**

1-[np,v,pp(in)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 14 semantic classes:

13.7 35.1 40.2 40.3.1 43.2 45.6 46 47.1 47.2  
47.4 47.5.1 47.5.2 50 53.1

**Semantic class 14 – Learn Verbs**  
**7 Verbs**

acquire cram glean learn memorize read  
study

**Signature #178 (2 Patterns – 2 Positive)**  
**uniquely identifies semantic class 14**

1-[np,v,np,pp(from)]  
1-[np,v,pp(from)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 4 semantic classes:

10.3 14 23.1 26.2

**Semantic class 15.1 – Hold and Keep Verbs: Hold Verbs**  
**7 Verbs**

clasp clutch grasp grip handle hold wield

**Signature #112 (6 Patterns – 3 Positive)**  
**uniquely identifies semantic class 15.1**

0-[np,v,np,pp(from)]  
0-[np,v,adv(easily)]  
0-[np,v,pp(at)]  
1-[np,v,np]  
1-[np,v,np,pp(by)]  
1-[np,v,poss,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 15.2 – Hold and Keep Verbs: Keep Verbs**  
**4 Verbs**

hoard keep leave store

**Signature #142 (5 Patterns – 4 Positive)**  
**uniquely identifies semantic class 15.2**

0-[np,v,np,pp(with)]  
1-[np,v,np,pp(behind)]  
1-[np,v,np,pp(in)]  
1-[np,v,np,pp(over)]  
1-[np,v,np,pp(under)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 16 – Verbs of Concealment**  
**11 Verbs**

block cloister conceal curtain hide isolate  
quarantine screen seclude sequester shelter

**Signature #128 (4 Patterns – 3 Positive)**  
**uniquely identifies semantic class 16**

0-[np,v,np,pp(of)]  
1-[np,v,np,pp(behind)]  
1-[np,v,np,pp(from)]  
1-[np,v,np,pp(in)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 17.1 – Verbs of Throwing: Throw Verbs**  
**30 Verbs**

bash bat bunt cast catapult chuck fire flick  
fling flip hit hurl kick knock lob loft nudge  
pass pitch punt shoot shove slam slap sling  
smash tap throw tip toss ...

**Signature #27 (12 Patterns – 8 Positive)**  
**uniquely identifies semantic class 17.1**

0-[np,v]  
0-[np,v,np,pp(with)]  
0-[np,v,adv(easily)]  
0-[np,v,pp(at)]  
1-[np,v,np]  
1-[np,v,np,np]  
1-[np,v,np,pp(against)]  
1-[np,v,np,pp(at)]  
1-[np,v,np,pp(into)]  
1-[np,v,np,pp(over)]  
1-[np,v,np,pp(to)]  
1-[np,v,pp(from),pp(to)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 17.2 – Verbs of Throwing:  
Pelt Verbs**  
5 Verbs

bombard buffet pelt shower stone

**Signature #88 (10 Patterns – 2 Positive)**  
uniquely identifies semantic class 17.2

0-[np,v,np,np]  
0-[np,v,np,pp(against)]  
0-[np,v,np,pp(at)]  
0-[np,v,np,pp(over)]  
0-[np,v,np,pp(to)]  
0-[np,v,adv(easily),pp(with)]  
0-[np,v,pp(at)]  
0-[np,v,pp(at),pp(with)]  
1-[np,v,np]  
1-[np,v,np,pp(with)]

The positive portion of this signature identifies these 4 semantic classes in the positive signature suite:

17.2 25.3 44 9.9

Also, the positive portion of this signature is a subset of the signatures of these 23 semantic classes:

11.1 11.4 17.2 18.1 18.2 18.3 19 20 21.1 21.2  
22.2 24 25.1 25.3 31.1 39.1 42.1 44 45.1 45.2  
45.4 9.8 9.9

**Semantic class 18.2 – Verbs of Contact by  
Impact: Swat Verbs**  
11 Verbs

bite claw paw peck punch scratch shoot slug  
stab swat swipe

**Signature #4 (12 Patterns – 5 Positive)**  
uniquely identifies semantic class 18.2

0-[np,v]  
0-[np,v,np]  
0-[np,v,np,pp(against)]  
0-[np,v,np,pp(into)]  
0-[np,v,np,pp(on)]  
0-[np,v,np,pp(through)]  
0-[np,v,adv(easily)]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,pp(on)]  
1-[np,v,np,pp(with)]  
1-[np,v,pp(at)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

18.1 18.2

**Semantic class 18.1 – Verbs of Contact by  
Impact: Hit Verbs**  
24 Verbs

bang bash batter beat bump butt dash  
drum hammer hit kick knock lash pound  
rap slap smack smash strike tamp tap  
thump thwack whack

**Signature #8 (15 Patterns – 9 Positive)**  
uniquely identifies semantic class 18.1

0-[np,v]  
0-[np,v,np]  
0-[np,v,np,pp(into)]  
0-[np,v,np,pp(through)]  
0-[np,v,adv(easily)]  
0-[np,v,pp(with)]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,adv(together)]  
1-[np,v,np,pp(against)]  
1-[np,v,np,pp(on)]  
1-[np,v,np,pp(with)]  
1-[np,v,self,pp(on)]  
1-[np,v,pp(at)]  
1-[np,v,pp(at),pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 18.3 – Verbs of Contact by  
Impact: Spank Verbs**  
25 Verbs

belt birch bludgeon bonk brain cane clobber  
club conk cosh cudgel cuff flog knife  
paddle paddywhack pummel sock spank  
strap thrash truncheon wallop whip whisk

**Signature #5 (11 Patterns – 4 Positive)**  
uniquely identifies semantic class 18.3

0-[np,v]  
0-[np,v,np]  
0-[np,v,np,pp(against)]  
0-[np,v,np,pp(into)]  
0-[np,v,np,pp(through)]  
0-[np,v,adv(easily)]  
0-[np,v,pp(at)]  
1-[np,v,np]  
1-[np,v,np,pp(on)]  
1-[np,v,np,pp(to)]  
1-[np,v,np,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.



**Semantic class 18.4 – Verbs of Contact by Impact: Non-Agentive Verbs of Impact by Contact**  
**10 Verbs**

bang brush bump crash hit knock ram slam  
smash thud

**Signature #156 (4 Patterns – 2 Positive)**  
**uniquely identifies semantic class 18.4**

0-[np,v,pp(with)]  
0-[np(and),v]  
1-[np,v,pp(against)]  
1-[np(and),v,adv(together)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 20 – Verbs of Contact: Touch Verbs**  
**13 Verbs**

caress graze kiss lick nudge pat peck pinch  
prod sting stroke tickle touch

**Signature #1 (13 Patterns – 5 Positive)**  
**uniquely identifies semantic class 20**

0-[np,v]  
0-[np,v,np]  
0-[np,v,np,adjective]  
0-[np,v,np,pp(against)]  
0-[np,v,np,pp(into)]  
0-[np,v,np,pp(through)]  
0-[np,v,adv(easily)]  
0-[np,v,pp(at)]  
1-[np,v,np]  
1-[np,v,np,pp(on)]  
1-[np,v,np,pp(with)]  
1-[np,v,poss,np]  
1-[np,v,self]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 19 – Poke Verbs**  
**6 Verbs**

dig jab pierce poke prick stick

**Signature #16 (11 Patterns – 6 Positive)**  
**uniquely identifies semantic class 19**

0-[np,v]  
0-[np,v,np,pp(against)]  
0-[np,v,adv(easily)]  
0-[np,v,adv(easily),pp(through)]  
0-[np,v,pp(through)]  
1-[np,v,np]  
1-[np,v,np,pp(in)]  
1-[np,v,np,pp(into)]  
1-[np,v,np,pp(through)]  
1-[np,v,np,pp(with)]  
1-[np,v,pp(at)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 21.1 – Verbs of Cutting: Cut Verbs**  
**10 Verbs**

chip clip cut hack hew saw scrape scratch  
slash snip

**Signature #38 (11 Patterns – 10 Positive)**  
**uniquely identifies semantic class 21.1**

0-[np,v]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,pp(to)]  
1-[np,v,np,pp(with)]  
1-[np,v,poss,np]  
1-[np,v,self,pp(on)]  
1-[np,v,adv(easily)]  
1-[np,v,pp(at)]  
1-[np,v,pp(from),pp(to)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 21.2 – Verbs of Cutting:  
Carve Verbs  
33 Verbs**

bore bruise carve chip chop crop crush cube  
dent dice drill file fillet gash gouge grate  
grind mangle mash mince mow nick notch  
perforate prune pulverize punch shred slice  
slit ...

**Signature #25 (6 Patterns – 3 Positive)  
uniquely identifies semantic class 21.2**

0-[np,v]  
0-[np,v,np,pp(on)]  
0-[np,v,pp(at)]  
1-[np,v,np]  
1-[np,v,np,pp(with)]  
1-[np,v,adv(easily)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 7 semantic classes:

21.1 21.2 22.2 31.1 45.1 45.2 45.4

**Semantic class 22.2 – Verbs of Combining  
and Attaching: Amalgamate Verbs  
42 Verbs**

affiliate alternate amalgamate associate co-  
alesce coincide compare confederate con-  
fuse conjoin consolidate contrast correlate  
criss\_cross engage entangle entwine harmo-  
nize incorporate integrate interchange in-  
terconnect interlace interlink interlock in-  
termingle interrelate intersperse intertwine  
interweave ...

**Signature #148 (9 Patterns – 7 Positive)  
uniquely identifies semantic class 22.2**

0-[np,v,np(and),adv(together)]  
0-[np(and),v,adv(together)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,np,pp(with)]  
1-[np,v,adv(easily)]  
1-[np,v,np(and)]  
1-[np,v,pp(with)]  
1-[np(and),v]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 22.1 – Verbs of Combining  
and Attaching: Mix Verbs  
15 Verbs**

add blend combine commingle concatenate  
connect cream fuse join link merge mingle  
mix network pool

**Signature #179 (8 Patterns – 8 Positive)  
uniquely identifies semantic class 22.1**

1-[np,v,np,pp(into)]  
1-[np,v,np,pp(with)]  
1-[np,v,np(and)]  
1-[np,v,np(and),adv(together)]  
1-[np,v,pp(into)]  
1-[np,v,pp(with)]  
1-[np(and),v]  
1-[np(and),v,adv(together)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 22.3 – Verbs of Combining  
and Attaching: Shake Verbs  
36 Verbs**

append attach band baste beat bind bond  
bundle cluster collate collect fasten fuse  
gather glom graft group herd jumble lump  
mass moor package pair roll scramble sew  
shake shuffle splice ...

**Signature #146 (8 Patterns – 5 Positive)  
uniquely identifies semantic class 22.3**

0-[np,v,np(and)]  
0-[np,v,pp(into)]  
0-[np(and),v,adv(together)]  
1-[np,v,np]  
1-[np,v,np,pp(into)]  
1-[np,v,adv(easily),pp(into)]  
1-[np,v,np(and),adv(together)]  
1-[np(and),v,adv(easily),adv(together)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 22.4 – Verbs of Combining and Attaching: Tape Verbs**  
59 Verbs

anchor band belt bolt bracket buckle button cement chain clamp clasp clip epoxy fetter glue gum handcuff harness hinge hitch hook knot lace lash lasso latch leash link lock loop ...

**Signature #137 (13 Patterns – 8 Positive) uniquely identifies semantic class 22.4**

0-[np,v,np,pp(with)]  
0-[np,v,np(and)]  
0-[np,v,pp(to)]  
0-[np(and),v,adv(together)]  
1-[np,v,np,adjective]  
1-[np,v,np,pp(on)]  
1-[np,v,np,pp(onto)]  
1-[np,v,np,pp(to)]  
1-[np,v,np,pp(with)]  
1-[np,v,adv(easily),pp(to)]  
1-[np,v,np(and),adv(together)]  
1-[np(and),v,adv(easily),adv(together)]  
2-[np,v,np,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 23.1 – Verbs of Separating and Disassembling: Separate Verbs**  
12 Verbs

decouple differentiate disconnect disentangle dissociate distinguish divide divorce part segregate separate sever

**Signature #127 (9 Patterns – 6 Positive) uniquely identifies semantic class 23.1**

0-[np,v,np,pp(of)]  
0-[np(and),v,adv(apart)]  
1-[np,v,np,pp(from)]  
1-[np,v,adv(easily),pp(from)]  
1-[np,v,np(and)]  
1-[np,v,pp(from)]  
1-[np(and),v]  
1-[np(and),v,adv(easily)]  
3-[np,v,np(and),adv(apart)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 22.5 – Verbs of Combining and Attaching: Cling Verbs**  
3 Verbs

adhere cleave cling

**Signature #74 (4 Patterns – 2 Positive) uniquely identifies semantic class 22.5**

0-[np,v,np]  
0-[np(and),v]  
1-[np,v,pp(to)]  
1-[np(and),v,adv(together)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

22.5 37.5

**Semantic class 23.2 – Verbs of Separating and Disassembling: Split Verbs**  
20 Verbs

blow break cut draw hack hew kick knock pry pull push rip roll saw shove slip split tear tug yank

**Signature #147 (10 Patterns – 8 Positive) uniquely identifies semantic class 23.2**

0-[np,v,np(and)]  
0-[np(and),v]  
1-[np,v,np,pp(off)]  
1-[np,v,np,pp([off,of])]  
1-[np,v,adv(easily),pp([off,of])]  
1-[np,v,np(and),adv(apart)]  
1-[np,v,pp(off)]  
1-[np,v,pp([off,of])]  
1-[np(and),v,adv(apart)]  
1-[np(and),v,adv(easily),adv(apart)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 23.3 – Verbs of Separating and Disassembling: Disassemble Verbs**  
**30 Verbs**

detach disassemble disconnect partition sift  
sunder unbolt unbuckle unbutton unchain  
unclamp unclasp unclip unfasten unglue  
unhinge unhitch unhook unlace unlatch  
unleash unlock unpeg unpin unscrew un-  
shackle unstaple unstitch untie unzip ...

**Signature #145 (7 Patterns – 3 Positive)**  
**uniquely identifies semantic class 23.3**

0-[np,v,adv(easily),pp(from)]  
0-[np,v,np(and)]  
0-[np,v,np(and),adv(apart)]  
0-[np,v,pp(from)]  
1-[np,v,np]  
1-[np,v,np,pp(from)]  
1-[np,v,adv(easily)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 23.4 – Verbs of Separating and Disassembling: Differ Verbs**  
**2 Verbs**

differ diverge

**Signature #113 (4 Patterns – 2 Positive)**  
**uniquely identifies semantic class 23.4**

0-[np,v,np,pp(from)]  
0-[np(and),v,adv(apart)]  
1-[np,v,pp(from)]  
1-[np(and),v]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

23.1 23.4

**Semantic class 24 – Verbs of Coloring**  
**13 Verbs**

color distemper dye enamel glaze japan lacquer paint shellac spraypaint stain tint varnish

**Signature #173 (4 Patterns – 4 Positive)**  
**uniquely identifies semantic class 24**

1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,np]  
1-[np,v,np,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 25.1 – Image Creation Verbs: Verbs of Image Impression**  
**14 Verbs**

applique emboss embroider engrave etch  
imprint incise inscribe mark paint set sign  
stamp tattoo

**Signature #169 (6 Patterns – 6 Positive)**  
**uniquely identifies semantic class 25.1**

1-[np,v]  
1-[np,v,np]  
1-[np,v,np,pp(on)]  
1-[np,v,np,pp(over)]  
1-[np,v,np,pp(under)]  
1-[np,v,np,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 25.2 – Image Creation Verbs: Scribble Verbs**  
**22 Verbs**

carve chalk charcoal copy crayon doodle  
draw forge ink paint pencil plot print  
scratch scrawl scribble sketch spraypaint  
stencil trace type write

**Signature #140 (7 Patterns – 6 Positive)**  
**uniquely identifies semantic class 25.2**

0-[np,v,np,pp(with)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,np,pp(on)]  
1-[np,v,np,pp(onto)]  
1-[np,v,np,pp(over)]  
1-[np,v,np,pp(under)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 25.3 – Image Creation Verbs:  
Illustrate Verbs**  
16 Verbs

address adorn autograph brand date deco-  
rate embellish endorse illuminate illustrate  
initial label letter monogram ornament tag

**Signature #129 (3 Patterns – 2 Positive)  
uniquely identifies semantic class 25.3**

0-[np,v,np,pp(on)]  
1-[np,v,np]  
1-[np,v,np,pp(with)]

The positive portion of this signature identifies  
these 4 semantic classes in the positive signature  
suite:

17.2 25.3 44 9.9

Also, the positive portion of this signature is a sub-  
set of the signatures of these 23 semantic classes:

11.1 11.4 17.2 18.1 18.2 18.3 19 20 21.1 21.2  
22.2 24 25.1 25.3 31.1 39.1 42.1 44 45.1 45.2  
45.4 9.8 9.9

**Semantic class 26.1 – Verbs of Creation and  
Transformation: Build Verbs**  
35 Verbs

arrange assemble bake blow build carve cast  
chisel churn compile cook crochet cut de-  
velop embroider fashion fold forge grind  
grow hack hammer hatch knit make mold  
pound roll sculpt sew ...

**Signature #91 (13 Patterns – 8 Positive)  
uniquely identifies semantic class 26.1**

0-[np,v,np,np]  
0-[np,v,np,pp(from),pp(into)]  
0-[np,v,np,pp(into)]  
0-[np,v,pp(into)]  
0-[np,v,pp([out,of])]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,np,np]  
1-[np,v,np,pp(for)]  
1-[np,v,np,pp(into)]  
1-[np,v,np,pp(into),pp(for)]  
1-[np,v,np,pp([out,of])]  
1-[np,v,np,pp([out,of]),pp(for)]

The positive portion of this signature uniquely identi-  
fies this semantic class in the positive signature suite.

**Semantic class 25.4 – Image Creation Verbs:  
Transcribe Verbs**  
11 Verbs

copy film forge microfilm photocopy photo-  
graph record tape televise transcribe type

**Signature #141 (3 Patterns – 2 Positive)  
uniquely identifies semantic class 25.4**

0-[np,v,np,pp(with)]  
1-[np,v,np]  
1-[np,v,np,pp(into)]

The positive portion of this signature uniquely identi-  
fies this semantic class in the positive signature suite.  
Also, the positive portion of this signature is a sub-  
set of the signatures of these 8 semantic classes:

17.1 19 22.3 25.4 26.1 26.5 45.2 51.3.2

**Semantic class 26.2 – Verbs of Creation and  
Transformation: Grow Verbs**  
5 Verbs

develop evolve grow hatch mature

**Signature #154 (5 Patterns – 4 Positive)  
uniquely identifies semantic class 26.2**

0-[np,v,pp(from),pp(into)]  
1-[np,v,np,pp(from)]  
1-[np,v,np,pp(into)]  
1-[np,v,pp(from)]  
1-[np,v,pp(into)]

The positive portion of this signature uniquely identi-  
fies this semantic class in the positive signature suite.

**Semantic class 26.3 – Verbs of Creation and Transformation: Verbs of Preparing**  
**26 Verbs**

bake blend boil brew clean clear cook fix  
fry grill hardboil iron light mix poach pour  
prepare roast roll run scramble set softboil  
toast toss wash

**Signature #20 (6 Patterns – 3 Positive)**  
**uniquely identifies semantic class 26.3**

0-[np,v]  
0-[np,v,np,pp(into)]  
1-[np,v,np]  
1-[np,v,np,np]  
1-[np,v,np,pp(for)]  
2-[np,v,np,pp(from)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 4 semantic classes:

13.5.1 26.1 26.3 26.7

**Semantic class 26.5 – Verbs of Creation and Transformation: Knead Verbs**  
**19 Verbs**

beat bend coil collect compress fold freeze  
knead melt shake squash squeeze squish  
twirl twist wad whip wind work

**Signature #6 (11 Patterns – 3 Positive)**  
**uniquely identifies semantic class 26.5**

0-[np,v]  
0-[np,v,np]  
0-[np,v,np,pp(from)]  
0-[np,v,np,pp(from),pp(into)]  
0-[np,v,np,pp(into)]  
0-[np,v,pp(from)]  
0-[np,v,pp(from),pp(into)]  
0-[np,v,pp(into)]  
1-[np,v,np]  
1-[np,v,np,pp(into)]  
1-[np,v,pp(into)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

26.5 51.3.2

**Semantic class 26.4 – Verbs of Creation and Transformation: Create Verbs**  
**20 Verbs**

coin compose compute concoct construct  
create derive design dig fabricate form invent  
manufacture mint model organize produce  
recreate style synthesize

**Signature #3 (9 Patterns – 4 Positive)**  
**uniquely identifies semantic class 26.4**

0-[np,v]  
0-[np,v,np]  
0-[np,v,np,np]  
0-[np,v,np,pp(from)]  
0-[np,v,np,pp(into)]  
1-[np,v,np]  
1-[np,v,np,pp(for)]  
1-[np,v,np,pp(from)]  
1-[np,v,np,pp([out,of])]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 26.6 – Verbs of Creation and Transformation: Turn Verbs**  
**7 Verbs**

alter change convert metamorphose transform  
transmute turn

**Signature #56 (7 Patterns – 4 Positive)**  
**uniquely identifies semantic class 26.6**

0-[np,v,np]  
0-[np,v,np,pp(from)]  
0-[np,v,pp(from)]  
1-[np,v,np,pp(from),pp(into)]  
1-[np,v,np,pp(into)]  
1-[np,v,pp(from),pp(into)]  
1-[np,v,pp(into)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 26.7 – Verbs of Creation and Transformation: Performance Verbs**  
**19 Verbs**

chant choreograph compose dance direct  
draw hum intone paint perform play pro-  
duce recite silkscreen sing spin take whistle  
write

**Signature #39 (6 Patterns – 5 Positive)**  
**uniquely identifies semantic class 26.7**

0-[np,v]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,np,np]  
1-[np,v,np,pp(for)]  
1-[np,v,np,pp(to)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 28 – Calve Verbs**  
**10 Verbs**

calve cub fawn foal kitten lamb litter pup  
spawn whelp

**Signature #164 (1 Patterns – 1 Positive)**  
**uniquely identifies semantic class 28**

1-[np,v]

The positive portion of this signature identifies these 5 semantic classes in the positive signature suite:

28 40.1.1 40.1.3 40.4 45.5

Also, the positive portion of this signature is a subset of the signatures of these 64 semantic classes:

10.3 10.4.1 10.4.2 21.1 22.2 25.1 25.2 26.1  
26.7 28 35.1 36.1 36.3 37.3 37.4 37.5 37.6  
37.8 37.9 38 39.1 39.2 39.5 40.1.1 40.1.2  
40.1.3 40.2 40.3.1 40.3.3 40.4 40.5 40.6 40.7  
40.8.1 40.8.2 40.8.4 41.1.1 41.2.1 43.1 43.2  
43.3 43.4 45.1 45.2 45.3 45.4 45.5 45.6 47.1  
47.2 47.3 47.4 47.5.2 47.5.3 48.1.1 48.2 48.3  
49 51.1 51.3.1 51.4.1 51.4.2 51.5 53.2

**Semantic class 27 – Engender Verbs**  
**7 Verbs**

beget cause create engender generate shape  
spawn

**Signature #41 (2 Patterns – 1 Positive)**  
**identifies semantic classes: 27 55.2**

0-[np,v]  
1-[np,v,np]

The positive portion of this signature identifies these 10 semantic classes in the positive signature suite:

27 39.4 41.1.2 41.3.1 51.2 52 54.1 54.2 55.2  
9.10

Also, the positive portion of this signature is a subset of the signatures of these 99 semantic classes:

10.3 10.4.1 10.4.2 10.7 10.8 10.9 11.1 11.2  
11.4 11.5 12 13.5.1 13.5.2 15.1 17.1 17.2 18.1  
18.2 18.3 19 20 21.1 21.2 22.2 22.3 23.3 24  
25.1 25.2 25.3 25.4 26.1 26.3 26.4 26.5 26.7  
27 29.7 30.1 30.2 31.1 31.2 32.1 33 34 35.1  
36.2 36.3 37.1 37.2 37.3 37.4 37.9 38 39.1  
39.2 39.3 39.4 39.7 40.1.2 40.2 40.7 40.8.1  
41.1.1 41.1.2 41.2.2 41.3.1 42.1 42.2 43.1  
43.2 43.4 44 45.1 45.2 45.3 45.4 47.3 47.5.2  
47.8 48.1.2 51.1 51.2 51.3.2 51.4.1 51.4.2  
51.5 51.6 51.7 52 54.1 54.2 54.3 54.4 55.2  
9.10 9.4 9.8 9.9

**Semantic class 29.1 – Verbs with Predicative Complements: Appoint Verbs**  
**18 Verbs**

acknowledge adopt appoint consider crown  
deem designate elect esteem imagine mark  
nominate ordain proclaim rate reckon re-  
port want

**Signature #133 (4 Patterns – 3 Positive)**  
**uniquely identifies semantic class 29.1**

0-[np,v,np,pp(to)]  
1-[np,v,np,infinitive]  
1-[np,v,np,np]  
1-[np,v,np,pp(as)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 29.2 – Verbs with Predicative Complements: Characterize Verbs**  
**62 Verbs**

accept address appreciate bill cast certify  
characterize choose cite class classify con-  
firm count define describe diagnose disguise  
employ engage enlist enroll enter envis-  
age establish esteem hail herald hire honor  
identify ...

**Signature #101 (4 Patterns – 2 Positive)**  
**uniquely identifies semantic class 29.2**

0-[np,v,np,np]  
1-[np,v,np,infinitive]  
1-[np,v,np,pp(as)]  
3-[np,v,np,infinitive]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

29.1 29.2

**Semantic class 29.4 – Verbs with Predicative Complements: Declare Verbs**  
**16 Verbs**

adjudge adjudicate assume avow believe  
confess declare fancy find judge presume  
profess prove suppose think warrant

**Signature #102 (5 Patterns – 3 Positive)**  
**uniquely identifies semantic class 29.4**

0-[np,v,np,pp(as)]  
0-[np,v,np,pp(to)]  
1-[np,v,np,infinitive]  
1-[np,v,np,np]  
1-[np,v,s\_comp]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

29.4 37.4

**Semantic class 29.3 – Verbs with Predicative Complements: Dub Verbs**  
**19 Verbs**

anoint baptize brand call christen conse-  
crate crown decree dub label make name  
nickname pronounce rule stamp style term  
vote

**Signature #87 (4 Patterns – 1 Positive)**  
**uniquely identifies semantic class 29.3**

0-[np,v,np,infinitive]  
0-[np,v,np,pp(as)]  
0-[np,v,np,pp(to)]  
1-[np,v,np,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 20 semantic classes:

11.1 11.2 11.3 13.1 13.3 13.5.1 17.1 24 26.1  
26.3 26.7 29.1 29.3 29.4 29.8 37.1 37.2 37.4  
39.7 54.5

**Semantic class 29.5 – Verbs with Predicative Complements: Conjecture Verbs**  
**20 Verbs**

admit allow assert conjecture deny discover  
feel figure grant guarantee guess hold know  
maintain mean observe recognize repute  
show suspect

**Signature #89 (4 Patterns – 2 Positive)**  
**uniquely identifies semantic class 29.5**

0-[np,v,np,np]  
0-[np,v,np,pp(as)]  
1-[np,v,np,infinitive]  
1-[np,v,s\_comp]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 4 semantic classes:

29.4 29.5 37.4 37.9

**Semantic class 29.6 – Verbs with Predicative Complements: Masquerade Verbs**  
**11 Verbs**

act behave camouflage count masquerade  
officiate pose qualify rank rate serve

**Signature #84 (2 Patterns – 1 Positive)**  
**uniquely identifies semantic class 29.6**

0-[np,v,np]  
1-[np,v,pp(as)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.



**Semantic class 29.7 – Verbs with Predicative Complements: Orphan Verbs**  
**11 Verbs**

apprentice canonize cripple cuckold knight  
martyr orphan outlaw pauper recruit  
widow

**Signature #175 (3 Patterns – 3 Positive)**  
**uniquely identifies semantic class 29.7**

1-[np,v,np]  
1-[np,aux(be),v]  
1-[np,aux(be),v,pp(by)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 29.8 – Verbs with Predicative Complements: Captain Verbs**  
**38 Verbs**

boss bully butcher butler caddy captain  
champion chaperone chauffeur clerk coach  
cox crew doctor emcee escort guard host  
model mother nurse partner pilot pioneer  
police referee shepherd skipper sponsor star  
...

**Signature #176 (2 Patterns – 2 Positive)**  
**uniquely identifies semantic class 29.8**

1-[np,v,np,np]  
1-[np,v,pp(for)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 30.1 – Verbs of Perception: See Verbs**  
**9 Verbs**

detect discern feel hear notice see sense  
smell taste

**Signature #108 (12 Patterns – 7 Positive)**  
**uniquely identifies semantic class 30.1**

0-[np,v,np,pp(for)]  
0-[np,v,adv(easily)]  
0-[np,v,pp(at)]  
0-[np,aux(be),v,vp]  
1-[np,v,np]  
1-[np,v,np,vp]  
1-[np,v,np,pp(in)]  
1-[np,v,poss,np]  
1-[np,v,s\_comp]  
1-[np,v,vp]  
1-[np,aux(be),v,vp]  
2-[np,v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 30.2 – Verbs of Perception: Sight Verbs**  
**26 Verbs**

descry discover espy examine eye glimpse  
inspect investigate note observe overhear  
perceive recognize regard savor scan scent  
scrutinize sight spot spy study survey view  
watch witness

**Signature #63 (6 Patterns – 2 Positive)**  
**uniquely identifies semantic class 30.2**

0-[np,v,np]  
0-[np,v,s\_comp]  
0-[np,v,adv(easily)]  
0-[np,v,pp(at)]  
1-[np,v,np]  
1-[np,v,np,vp]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

30.1 30.2

**Semantic class 30.3 – Verbs of Perception: Peer Verbs**  
**18 Verbs**

check gape gawk gaze glance glare goggle  
leer listen look ogle peek peep peer sniff  
snoop squint stare

**Signature #64 (10 Patterns – 7 Positive)**  
**uniquely identifies semantic class 30.3**

0-[np,v,np]  
0-[np,v,s\_comp]  
0-[np,v,pp(at),vp]  
1-[np,v,pp(around)]  
1-[np,v,pp(at)]  
1-[np,v,pp(at),vp]  
1-[np,v,pp(into)]  
1-[np,v,pp(on)]  
1-[np,v,pp(through)]  
1-[np,v,pp(to)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 30.4 – Verbs of Perception:  
Stimulus Subject Perception Verbs  
5 Verbs**

feel look smell sound taste

**Signature #159 (4 Patterns – 2 Positive)  
uniquely identifies semantic class 30.4**

0-[np,aux(be),v]  
0-[np,aux(be),v,pp(by)]  
1-[np,v,adjective]  
1-[np,v,adjective,pp(to)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 31.2 – Verbs of Psychological  
State: Admire Verbs  
45 Verbs**

abhor admire adore appreciate cherish deplore despise detest disdain dislike distrust dread enjoy envy esteem exalt execrate fancy favor fear hate idolize lament like loathe love miss mourn pity prize ...

**Signature #97 (10 Patterns – 8 Positive)  
uniquely identifies semantic class 31.2**

0-[np,v,np,np]  
0-[np,v,adv(easily)]  
1-[np,v,np]  
1-[np,v,np,pp(as)]  
1-[np,v,np,pp(for)]  
1-[np,v,np,pp(in)]  
1-[np,v,poss,np]  
1-[np,v,s\_comp]  
1-[np,v,expl(it),s\_comp]  
1-[np,v,expl(it),w\_comp]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 31.1 – Verbs of Psychological  
State: Amuse Verbs  
220 Verbs**

abash affect afflict affront aggravate agitate agonize alarm alienate amaze amuse anger annoy antagonize appall appease arouse assuage astonish astound awe baffle beguile bewilder bewitch boggle bore bother bug calm ...

**Signature #35 (15 Patterns – 13 Positive)  
uniquely identifies semantic class 31.1**

0-[np,v]  
0-[np,v,pp(at)]  
1-[infinitive,v,np]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,pp(to)]  
1-[np,v,np,pp(with)]  
1-[np,v,adv(easily)]  
1-[np,v,pp(to)]  
1-[np,aux(be),v,pp(at)]  
1-[np,aux(be),v,pp(by)]  
1-[np,aux(be),v,pp(with)]  
1-[s\_comp,v,np]  
1-[expl(it),v,np,infinitive]  
1-[expl(it),v,np,s\_comp]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 31.3 – Verbs of Psychological  
State: Marvel Verbs  
58 Verbs**

ache anger anguish approve bask beware bleed bother care cheer cringe cry delight despair disapprove enthuse exult fear feel fret fume gladden gloat glory grieve groove gush hunger hurt luxuriate ...

**Signature #182 (2 Patterns – 2 Positive)  
uniquely identifies semantic class 31.3**

1-[np,v,pp(at)]  
1-[np,aux(be),v,pp(by)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 31.4 – Verbs of Psychological  
State: Appeal Verbs  
5 Verbs**

appeal grate jar matter niggle

**Signature #160 (3 Patterns – 1 Positive)  
uniquely identifies semantic class 31.4**

0-[np,aux(be),v]  
0-[np,aux(be),v,pp(by)]  
1-[np,v,pp(to)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 10 semantic classes:

22.5 30.3 31.1 31.4 37.3 37.4 37.5 37.8 40.3.3  
40.7

**Semantic class 32.1 – Verbs of Desire: Want Verbs**  
**6 Verbs**

covet crave desire fancy need want

**Signature #52 (7 Patterns – 3 Positive)**  
**uniquely identifies semantic class 32.1**

0-[np,v,np]  
0-[np,v,np,np]  
0-[np,v,np,pp(in)]  
1-[np,v,np]  
1-[np,v,np,pp(as)]  
1-[np,v,np,pp(for)]  
2-[np,aux(be),v,pp(by)]

The positive portion of this signature identifies these 2 semantic classes in the positive signature suite:

32.1 33

Also, the positive portion of this signature is a subset of the signatures of these 3 semantic classes:

31.2 32.1 33

**Semantic class 33 – Judgment Verbs**  
**68 Verbs**

abuse acclaim applaud backbite bless calumniate castigate celebrate censure chasten chastise chide commend compensate compliment condemn congratulate criticize decry defame denigrate denounce deprecate deride disparage eulogize excuse extol fault felicitate ...

**Signature #92 (6 Patterns – 3 Positive)**  
**uniquely identifies semantic class 33**

0-[np,v,np,np]  
0-[np,v,np,pp(in)]  
0-[np,v,adv(easily)]  
1-[np,v,np]  
1-[np,v,np,pp(as)]  
1-[np,v,np,pp(for)]

The positive portion of this signature identifies these 2 semantic classes in the positive signature suite:

32.1 33

Also, the positive portion of this signature is a subset of the signatures of these 3 semantic classes:

31.2 32.1 33

**Semantic class 32.2 – Verbs of Desire: Long Verbs**  
**15 Verbs**

ache crave dangle fall hanker hope hunger itch long lust pine pray thirst wish yearn

**Signature #183 (2 Patterns – 1 Positive)**  
**uniquely identifies semantic class 32.2**

1-[np,v,pp(for)]  
2-[np,aux(be),v]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

29.8 32.2

**Semantic class 34 – Verbs of Assessment**  
**7 Verbs**

analyze assess audit evaluate review scrutinize study

**Signature #121 (3 Patterns – 2 Positive)**  
**uniquely identifies semantic class 34**

0-[np,v,np,pp(in)]  
1-[np,v,np]  
1-[np,v,np,pp(for)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 11 semantic classes:

13.5.1 13.5.2 26.1 26.3 26.4 26.7 31.2 32.1  
33 34 35.1

**Semantic class 35.1 – Verbs of Searching:  
Hunt Verbs  
7 Verbs**

dig feel fish hunt mine poach scrounge

**Signature #168 (7 Patterns – 7 Positive)  
uniquely identifies semantic class 35.1**

1-[np,v]  
1-[np,v,np]  
1-[np,v,np,pp(for)]  
1-[np,v,np,pp(in)]  
1-[np,v,pp(for),pp(in)]  
1-[np,v,pp(in)]  
1-[np,v,pp(in),pp(for)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 35.2 – Verbs of Searching:  
Search Verbs  
24 Verbs**

advertise check comb dive drag dredge excavate patrol plumb probe prospect prowl quarry rake rifle scavenge scour scout search shop sift trawl troll watch

**Signature #122 (4 Patterns – 3 Positive)  
uniquely identifies semantic class 35.2**

0-[np,v,np,pp(in)]  
1-[np,v,np,pp(for)]  
1-[np,v,pp(for),pp(in)]  
1-[np,v,pp(in),pp(for)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

35.1 35.2

**Semantic class 35.3 – Verbs of Searching:  
Stalk Verbs  
4 Verbs**

smell stalk taste track

**Signature #152 (4 Patterns – 2 Positive)  
uniquely identifies semantic class 35.3**

0-[np,v,pp(for),pp(in)]  
0-[np,v,pp(in),pp(for)]  
1-[np,v,np,pp(for)]  
1-[np,v,np,pp(in)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 3 semantic classes:

31.2 35.1 35.3

**Semantic class 35.4 – Verbs of Searching:  
Investigate Verbs  
15 Verbs**

canvass examine explore frisk inspect investigate observe quiz raid ransack riffle scan scrutinize survey tap

**Signature #118 (4 Patterns – 1 Positive)  
uniquely identifies semantic class 35.4**

0-[np,v,np,pp(in)]  
0-[np,v,pp(for),pp(in)]  
0-[np,v,pp(in),pp(for)]  
1-[np,v,np,pp(for)]

The positive portion of this signature identifies these 2 semantic classes in the positive signature suite:

13.6 35.4

Also, the positive portion of this signature is a subset of the signatures of these 17 semantic classes:

10.5 13.5.1 13.5.2 13.6 26.1 26.3 26.4 26.7  
31.2 32.1 33 34 35.1 35.2 35.3 35.4 54.5

**Semantic class 35.5 – Verbs of Searching:  
Rummage Verbs  
20 Verbs**

bore burrow delve forage fumble grope leaf listen look page paw poke rifle root rummage scrabble scratch snoop thumb tunnel

**Signature #107 (4 Patterns – 1 Positive)  
uniquely identifies semantic class 35.5**

0-[np,v,np,pp(for)]  
0-[np,v,np,pp(in)]  
1-[np,v,pp(in),pp(for)]  
2-[np,v,pp(for),pp(in)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 3 semantic classes:

35.1 35.2 35.5

**Semantic class 35.6 – Verbs of Searching:  
Ferret Verbs**  
4 Verbs

ferret nose seek tease

**Signature #109 (3 Patterns – 1 Positive)**  
uniquely identifies semantic class 35.6

0-[np,v,np,pp(for)]  
0-[np,v,pp(for),pp(in)]  
1-[np,v,np,pp([out,of])]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 6 semantic classes:

10.6 26.1 26.4 35.6 9.4 9.5

**Semantic class 36.1 – Verbs of Social Interaction:  
Correspond Verbs**  
57 Verbs

agree argue banter bargain bicker brawl  
clash coexist collaborate collide combat  
commiserate communicate compete concur  
confabulate conflict consort cooperate cor-  
respond dicker differ disagree dispute dis-  
sent duel elope feud flirt haggle ...

**Signature #13 (6 Patterns – 4 Positive)**  
uniquely identifies semantic class 36.1

0-[np,v]  
0-[np,v,np]  
1-[np,v]  
1-[np,v,pp(with)]  
1-[np(and),v]  
1-[np(and),v,pp(about)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 36.2 – Verbs of Social Interaction:  
Marry Verbs**  
11 Verbs

court cuddle date divorce embrace hug kiss  
marry nuzzle pass pet

**Signature #158 (3 Patterns – 2 Positive)**  
uniquely identifies semantic class 36.2

0-[np,v,pp(with)]  
1-[np,v,np]  
1-[np(and),v]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 4 semantic classes:

22.2 36.2 36.3 47.8

**Semantic class 36.3 – Verbs of Social Interaction:  
Meet Verbs**  
8 Verbs

battle box consult debate fight meet play  
visit

**Signature #40 (5 Patterns – 4 Positive)**  
uniquely identifies semantic class 36.3

0-[np,v]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,pp(with)]  
1-[np(and),v]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

22.2 36.3

**Semantic class 37.1 – Verbs of Communication:  
Verbs of Transfer of a Message**  
17 Verbs

ask cite demonstrate dictate explain expli-  
cate narrate pose preach quote read recite  
relay show teach tell write

**Signature #174 (4 Patterns – 4 Positive)**  
uniquely identifies semantic class 37.1

1-[np,v,np]  
1-[np,v,np,np]  
1-[np,v,np,s\_comp]  
1-[np,v,np,pp(to)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

37.1 37.2

**Semantic class 37.2 – Verbs of Communication: Tell**

**1 Verbs**

tell

**Signature #49 (19 Patterns – 9 Positive) uniquely identifies semantic class 37.2**

0-[np,v,infinitive]  
0-[np,v,np,pp(at)]  
0-[np,v,s\_comp]  
0-[np,v,w\_comp]  
0-[np,v,pp(for),infinitive]  
0-[np,v,pp(to)]  
0-[np,v,pp(to),infinitive]  
0-[np,v,pp(to),quotation]  
0-[np,v,pp(to),s\_comp]  
0-[expl(it),aux(be),v,s\_comp]  
1-[np,v,np]  
1-[np,v,np,infinitive]  
1-[np,v,np,np]  
1-[np,v,np,quotation]  
1-[np,v,np,s\_comp]  
1-[np,v,np,pp(about)]  
1-[np,v,np,pp(to)]  
1-[np,v,w\_comp]  
1-[np,aux(be),v,s\_comp]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 37.3 – Verbs of Communication: Verbs of Manner of Speaking**

**77 Verbs**

babble bark bawl bellow bleat boom bray  
burble cackle call carol chant chatter chirp  
cluck coo croak croon crow cry drawl drone  
gabble gibber groan growl grumble grunt  
hiss holler ...

**Signature #100 (20 Patterns – 17 Positive) uniquely identifies semantic class 37.3**

0-[np,v,np,np]  
0-[expl(it),aux(be),v,s\_comp]  
1-[np,v]  
1-[np,v,infinitive]  
1-[np,v,np]  
1-[np,v,np,pp(to)]  
1-[np,v,poss,np]  
1-[np,v,quotation]  
1-[np,v,quotation,pp(at)]  
1-[np,v,s\_comp]  
1-[np,v,w\_comp]  
1-[np,v,pp(about)]  
1-[np,v,pp(at)]  
1-[np,v,pp(for),infinitive]  
1-[np,v,pp(to)]  
1-[np,v,pp(to),infinitive]  
1-[np,v,pp(to),quotation]  
1-[np,v,pp(to),s\_comp]  
1-[np,v,pp(to),w\_comp]  
2-[np,v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 37.4 – Verbs of Communication: Verbs of Instrument of Communication**

**18 Verbs**

cable e\_mail fax modem netmail phone  
radio relay satellite semaphore sign sig-  
nal telecast telegraph telephone telex wire  
wireless

**Signature #105 (20 Patterns – 18 Positive)  
uniquely identifies semantic class 37.4**

0-[np,v,np,pp(at)]  
0-[np,v,pp(to)]  
1-[np,v]  
1-[np,v,infinitive]  
1-[np,v,np]  
1-[np,v,np,infinitive]  
1-[np,v,np,np]  
1-[np,v,np,quotation]  
1-[np,v,np,w\_comp]  
1-[np,v,np,pp(about)]  
1-[np,v,np,pp(to)]  
1-[np,v,quotation]  
1-[np,v,s\_comp]  
1-[np,v,w\_comp]  
1-[np,v,pp(for),infinitive]  
1-[np,v,pp(to)]  
1-[np,v,pp(to),infinitive]  
1-[np,v,pp(to),quotation]  
1-[np,v,pp(to),s\_comp]  
1-[np,v,pp(to),w\_comp]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 37.6 – Verbs of Communication: Chitchat Verbs**

**11 Verbs**

argue chat chatter chitchat confer converse  
gab gossip rap schmooze yak

**Signature #47 (12 Patterns – 4 Positive)  
uniquely identifies semantic class 37.6**

0-[np,v,infinitive]  
0-[np,v,np]  
0-[np,v,s\_comp]  
0-[np,v,w\_comp]  
0-[np,v,pp(for),infinitive]  
0-[np,v,pp(to)]  
0-[np,v,pp(to),pp(about)]  
0-[np(and),v,adv(together)]  
1-[np,v]  
1-[np,v,pp(with)]  
1-[np,v,pp(with),pp(about)]  
1-[np(and),v]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

37.5 37.6

**Semantic class 37.5 – Verbs of Communication: Talk Verbs**

**2 Verbs**

speak talk

**Signature #48 (14 Patterns – 7 Positive)  
uniquely identifies semantic class 37.5**

0-[np,v,infinitive]  
0-[np,v,np]  
0-[np,v,s\_comp]  
0-[np,v,w\_comp]  
0-[np,v,pp(for),infinitive]  
0-[np,v,pp(to),infinitive]  
0-[np,v,pp(to),s\_comp]  
1-[np,v]  
1-[np,v,pp(to)]  
1-[np,v,pp(to),pp(about)]  
1-[np,v,pp(with)]  
1-[np,v,pp(with),pp(about)]  
1-[np(and),v]  
1-[np(and),v,adv(together)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 37.7 – Verbs of Communication: Say Verbs**

**24 Verbs**

announce articulate blab blurt claim  
confess confide convey declare mention note  
observe proclaim propose recount reiterate  
relate remark repeat report reveal say state  
suggest

**Signature #98 (6 Patterns – 3 Positive)  
uniquely identifies semantic class 37.7**

0-[np,v,np,np]  
0-[np,v,pp(about)]  
0-[np,v,pp(to)]  
1-[np,v,np,pp(to)]  
1-[np,v,s\_comp]  
1-[np,v,pp(to),s\_comp]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 3 semantic classes:

37.3 37.4 37.7

**Semantic class 37.8 – Verbs of Communication: Complain Verbs**

**10 Verbs**

boast brag complain crab gripe grouch  
grouse grumble kvetch object

**Signature #46 (17 Patterns – 9 Positive)**  
**uniquely identifies semantic class 37.8**

0-[np,v,infinitive]  
0-[np,v,np]  
0-[np,v,np,pp(to)]  
0-[np,v,w\_comp]  
0-[np,v,pp(at)]  
0-[np,v,pp(for),infinitive]  
0-[np,v,pp(to),infinitive]  
0-[np,v,pp(to),w\_comp]  
1-[np,v]  
1-[np,v,quotation]  
1-[np,v,s\_comp]  
1-[np,v,pp(about)]  
1-[np,v,pp(about),pp(to)]  
1-[np,v,pp(at)]  
1-[np,v,pp(to)]  
1-[np,v,pp(to),quotation]  
1-[np,v,pp(to),s\_comp]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 37.9 – Verbs of Communication: Advise Verbs**

**7 Verbs**

admonish advise alert caution counsel instruct warn

**Signature #151 (16 Patterns – 14 Positive)**  
**uniquely identifies semantic class 37.9**

0-[np,v,pp(for),infinitive]  
0-[np,v,pp(to)]  
1-[np,v]  
1-[np,v,infinitive]  
1-[np,v,np]  
1-[np,v,np,infinitive]  
1-[np,v,np,quotation]  
1-[np,v,np,s\_comp]  
1-[np,v,np,w\_comp]  
1-[np,v,np,pp(about)]  
1-[np,v,np,pp(against)]  
1-[np,v,quotation]  
1-[np,v,s\_comp]  
1-[np,v,w\_comp]  
1-[np,v,pp(about)]  
1-[np,v,pp(against)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 38 – Verbs of Sounds Made by Animals**

**67 Verbs**

baa bark bay bellow blat bleat bray buzz  
cackle call caw chatter cheep chirp chirrup  
chitter cluck coo croak crow cuckoo drone  
gobble growl grunt hee\_haw hiss honk hoot  
howl ...

**Signature #150 (5 Patterns – 4 Positive)**  
**uniquely identifies semantic class 38**

0-[np,v,pp(down)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,pp(at)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 3 semantic classes:

10.4.1 21.1 38

**Semantic class 39.1 – Verbs of Ingesting: Eat Verbs**

**2 Verbs**

drink eat

**Signature #70 (7 Patterns – 5 Positive)**  
**uniquely identifies semantic class 39.1**

0-[np,v,np]  
0-[np,v,pp(on)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,np,pp(with)]  
1-[np,v,self,adjective]  
1-[np,v,pp(at)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 39.2 – Verbs of Ingesting: Chew Verbs**

**12 Verbs**

chew chomp crunch gnaw lick munch nibble  
peck pick sip slurp suck

**Signature #171 (4 Patterns – 4 Positive)**  
**uniquely identifies semantic class 39.2**

1-[np,v]  
1-[np,v,np]  
1-[np,v,pp(at)]  
1-[np,v,pp(on)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.



**Semantic class 39.3 – Verbs of Ingesting:  
Gobble Verbs  
8 Verbs**

bolt gobble gulp guzzle quaff swallow swig  
wolf

**Signature #34 (5 Patterns – 2 Positive)  
uniquely identifies semantic class 39.3**

0-[np,v]  
0-[np,v,pp(at)]  
0-[np,v,pp(on)]  
1-[np,v,np]  
1-[np,v,np,adjective]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 16 semantic classes:

10.4.1 10.4.2 12 18.1 18.2 21.1 24 31.1 38  
39.3 42.1 45.1 45.2 45.3 51.4.1 51.4.2

**Semantic class 39.5 – Verbs of Ingesting:  
Dine Verbs  
12 Verbs**

banquet breakfast brunch dine feast graze  
lunch luncheon nosh picnic snack sup

**Signature #67 (4 Patterns – 2 Positive)  
uniquely identifies semantic class 39.5**

0-[np,v,np]  
0-[np,v,pp(at)]  
1-[np,v]  
1-[np,v,pp(on)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 7 semantic classes:

39.2 39.5 40.1.2 43.1 45.4 47.1 48.1.1

**Semantic class 39.4 – Verbs of Ingesting:  
Devour Verbs  
5 Verbs**

consume devour imbibe ingest swill

**Signature #33 (4 Patterns – 1 Positive)  
uniquely identifies semantic class 39.4**

0-[np,v]  
0-[np,v,pp(at)]  
0-[np,v,pp(on)]  
1-[np,v,np]

The positive portion of this signature identifies these 10 semantic classes in the positive signature suite:

27 39.4 41.1.2 41.3.1 51.2 52 54.1 54.2 55.2  
9.10

Also, the positive portion of this signature is a subset of the signatures of these 99 semantic classes:

10.3 10.4.1 10.4.2 10.7 10.8 10.9 11.1 11.2  
11.4 11.5 12 13.5.1 13.5.2 15.1 17.1 17.2 18.1  
18.2 18.3 19 20 21.1 21.2 22.2 22.3 23.3 24  
25.1 25.2 25.3 25.4 26.1 26.3 26.4 26.5 26.7  
27 29.7 30.1 30.2 31.1 31.2 32.1 33 34 35.1  
36.2 36.3 37.1 37.2 37.3 37.4 37.9 38 39.1  
39.2 39.3 39.4 39.7 40.1.2 40.2 40.7 40.8.1  
41.1.1 41.1.2 41.2.2 41.3.1 42.1 42.2 43.1  
43.2 43.4 44 45.1 45.2 45.3 45.4 47.3 47.5.2  
47.8 48.1.2 51.1 51.2 51.3.2 51.4.1 51.4.2  
51.5 51.6 51.7 52 54.1 54.2 54.3 54.4 55.2  
9.10 9.4 9.8 9.9

**Semantic class 39.6 – Verbs of Ingesting:  
Gorge Verbs  
8 Verbs**

exist feed flourish gorge live prosper survive  
thrive

**Signature #12 (4 Patterns – 1 Positive)  
uniquely identifies semantic class 39.6**

0-[np,v]  
0-[np,v,np]  
0-[np,v,pp(at)]  
1-[np,v,pp(on)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 13 semantic classes:

12 30.3 39.2 39.5 39.6 40.1.2 43.1 45.4 47.1  
47.6 48.1.1 9.2 9.7

**Semantic class 39.7 – Verbs of Ingesting:  
Verbs of Feeding**  
6 Verbs

bottlefeed breastfeed feed forcefeed hand-  
feed spoonfeed

**Signature #83 (6 Patterns – 3 Positive)**  
uniquely identifies semantic class 39.7

0-[np,v,np]  
1-[np,v,np]  
1-[np,v,np,np]  
1-[np,v,np,pp(to)]  
2-[np,v,np,pp(on)]  
2-[np,v,np,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 8 semantic classes:

11.1 11.2 17.1 26.7 37.1 37.2 37.4 39.7

**Semantic class 40.1.2 – Verbs Involving the  
Body: Verbs of Bodily Processes: Breathe  
Verbs**  
11 Verbs

bleed breathe cough cry dribble drool puke  
spit sweat vomit weep

**Signature #51 (6 Patterns – 3 Positive)**  
uniquely identifies semantic class 40.1.2

0-[np,v,np]  
0-[np,v,np,adjective]  
0-[np,v,pp(at)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,pp(on)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 4 semantic classes:

39.2 40.1.2 43.1 45.4

**Semantic class 40.1.1 – Verbs Involving the  
Body: Verbs of Bodily Processes: Hiccup  
Verbs**  
13 Verbs

belch blush burp flush hiccup pant sneeze  
sniffle snore snuffle swallow wheeze yawn

**Signature #149 (5 Patterns – 1 Positive)**  
uniquely identifies semantic class 40.1.1

0-[np,v,pp(at)]  
0-[np,v,pp(on)]  
1-[np,v]  
2-[np,v,np]  
3-[np,v,self,adjective]

The positive portion of this signature identifies these 5 semantic classes in the positive signature suite:

28 40.1.1 40.1.3 40.4 45.5

Also, the positive portion of this signature is a subset of the signatures of these 64 semantic classes:

10.3 10.4.1 10.4.2 21.1 22.2 25.1 25.2 26.1  
26.7 28 35.1 36.1 36.3 37.3 37.4 37.5 37.6  
37.8 37.9 38 39.1 39.2 39.5 40.1.1 40.1.2  
40.1.3 40.2 40.3.1 40.3.3 40.4 40.5 40.6 40.7  
40.8.1 40.8.2 40.8.4 41.1.1 41.2.1 43.1 43.2  
43.3 43.4 45.1 45.2 45.3 45.4 45.5 45.6 47.1  
47.2 47.3 47.4 47.5.2 47.5.3 48.1.1 48.2 48.3  
49 51.1 51.3.1 51.4.1 51.4.2 51.5 53.2

**Semantic class 40.1.3 – Verbs Involving the  
Body: Verbs of Bodily Processes: Exhale  
Verbs**  
3 Verbs

exhale inhale perspire

**Signature #65 (4 Patterns – 1 Positive)**  
uniquely identifies semantic class 40.1.3

0-[np,v,np]  
0-[np,v,pp(at)]  
0-[np,v,pp(on)]  
1-[np,v]

The positive portion of this signature identifies these 5 semantic classes in the positive signature suite:

28 40.1.1 40.1.3 40.4 45.5

Also, the positive portion of this signature is a subset of the signatures of these 64 semantic classes:

10.3 10.4.1 10.4.2 21.1 22.2 25.1 25.2 26.1  
26.7 28 35.1 36.1 36.3 37.3 37.4 37.5 37.6  
37.8 37.9 38 39.1 39.2 39.5 40.1.1 40.1.2  
40.1.3 40.2 40.3.1 40.3.3 40.4 40.5 40.6 40.7  
40.8.1 40.8.2 40.8.4 41.1.1 41.2.1 43.1 43.2  
43.3 43.4 45.1 45.2 45.3 45.4 45.5 45.6 47.1  
47.2 47.3 47.4 47.5.2 47.5.3 48.1.1 48.2 48.3  
49 51.1 51.3.1 51.4.1 51.4.2 51.5 53.2

**Semantic class 40.2 – Verbs Involving the Body: Verbs of Nonverbal Expression**  
**41 Verbs**

beam cackle chortle chuckle cough cry  
frown gape gasp gawk giggle glare glower  
goggle grimace grin groan growl guffaw  
howl jeer laugh moan pout scowl sigh sim-  
per smile smirk sneeze ...

**Signature #170 (7 Patterns – 7 Positive)**  
**uniquely identifies semantic class 40.2**

1-[np,v]  
1-[np,v,np]  
1-[np,v,poss,np]  
1-[np,v,self,adjective]  
1-[np,v,pp(at)]  
1-[np,v,pp(from)]  
1-[np,v,pp(in)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 40.3.2 – Verbs Involving the Body: Verbs of Gestures/Signs Involving Body Parts: Crane Verbs**  
**47 Verbs**

arch bare bat beat blow clench click close  
cock crane crook cross drum flap flash flex  
flick flutter fold gnash grind hang hunch  
kick knit open pucker purse raise roll ...

**Signature #9 (7 Patterns – 2 Positive)**  
**uniquely identifies semantic class 40.3.2**

0-[np,v]  
0-[np,v,np]  
0-[np,v,poss,np]  
0-[np,aux(be),v]  
0-[np,aux(be),v,pp(by)]  
1-[np,v,np,pp(at)]  
1-[np,v,poss,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 40.3.1 – Verbs Involving the Body: Verbs of Gestures/Signs Involving Body Parts: Wink Verbs**  
**9 Verbs**

blink clap nod point shrug squint wag wave  
wink

**Signature #59 (10 Patterns – 4 Positive)**  
**uniquely identifies semantic class 40.3.1**

0-[np,v,np]  
0-[np,v,poss,np]  
0-[np,aux(be),v]  
0-[np,aux(be),v,w\_comp]  
0-[np,aux(be),v,pp(by)]  
1-[np,v]  
1-[np,v,poss,np]  
1-[np,v,pp(at)]  
1-[np,v,pp(in)]  
2-[np,v,pp(at)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

40.2 40.3.1

**Semantic class 40.3.3 – Verbs Involving the Body: Verbs of Gestures/Signs Involving Body Parts: Curtsey Verbs**  
**7 Verbs**

bob bow curtsey genuflect kneel salaam  
salute

**Signature #78 (4 Patterns – 3 Positive)**  
**uniquely identifies semantic class 40.3.3**

0-[np,v,np]  
1-[np,v]  
1-[np,v,poss,np]  
1-[np,v,pp(to)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

37.3 40.3.3

**Semantic class 40.4 – Verbs Involving the Body: Snooze Verbs**  
7 Verbs

catnap doze drowse nap sleep slumber  
snooze

**Signature #75 (2 Patterns – 1 Positive)**  
identifies semantic classes: 40.4 45.5

0-[np,v,np]  
1-[np,v]

The positive portion of this signature identifies these 5 semantic classes in the positive signature suite:

28 40.1.1 40.1.3 40.4 45.5

Also, the positive portion of this signature is a subset of the signatures of these 64 semantic classes:

10.3 10.4.1 10.4.2 21.1 22.2 25.1 25.2 26.1  
26.7 28 35.1 36.1 36.3 37.3 37.4 37.5 37.6  
37.8 37.9 38 39.1 39.2 39.5 40.1.1 40.1.2  
40.1.3 40.2 40.3.1 40.3.3 40.4 40.5 40.6 40.7  
40.8.1 40.8.2 40.8.4 41.1.1 41.2.1 43.1 43.2  
43.3 43.4 45.1 45.2 45.3 45.4 45.5 45.6 47.1  
47.2 47.3 47.4 47.5.2 47.5.3 48.1.1 48.2 48.3  
49 51.1 51.3.1 51.4.1 51.4.2 51.5 53.2

**Semantic class 40.6 – Verbs Involving the Body: Verbs of Body-Internal States of Existence**  
9 Verbs

convulse cower quake quiver shake shiver  
shudder tremble writhe

**Signature #79 (4 Patterns – 3 Positive)**  
identifies semantic classes: 40.6 40.8.4

0-[np,v,np]  
1-[np,v]  
1-[np,v,pp(at)]  
1-[np,v,pp(from)]

The positive portion of this signature identifies these 2 semantic classes in the positive signature suite:

40.6 40.8.4

Also, the positive portion of this signature is a subset of the signatures of these 3 semantic classes:

40.2 40.6 40.8.4

**Semantic class 40.5 – Verbs Involving the Body: Flinch Verbs**  
7 Verbs

balk cower cringe flinch recoil shrink wince

**Signature #61 (4 Patterns – 2 Positive)**  
uniquely identifies semantic class 40.5

0-[np,v,np]  
0-[np,v,poss,np]  
1-[np,v]  
1-[np,v,pp(at)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 13 semantic classes:

10.4.1 21.1 37.3 37.8 38 39.1 39.2 40.2 40.3.1  
40.5 40.6 40.8.4 48.3

**Semantic class 40.7 – Verbs Involving the Body: Suffocate Verbs**  
5 Verbs

asphyxiate choke drown stifle suffocate

**Signature #155 (5 Patterns – 3 Positive)**  
uniquely identifies semantic class 40.7

0-[np,v,pp(to)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,pp(to)]  
2-[np,v,adv(easily)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 3 semantic classes:

37.3 37.4 40.7

**Semantic class 40.8.1 – Verbs Involving the Body: Verbs of Bodily State and Damage to the Body: Pain Verbs**  
5 Verbs

ache bother hurt itch pain

**Signature #60 (6 Patterns – 3 Positive)**  
uniquely identifies semantic class 40.8.1

0-[np,v,np]  
0-[np,v,poss,np]  
0-[np,aux(be),v,pp(by)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,pp(from)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 5 semantic classes:

10.3 40.2 40.8.1 43.4 51.1

**Semantic class 40.8.3 – Verbs Involving the Body: Verbs of Bodily State and Damage to the Body: Hurt Verbs**  
24 Verbs

bark bite break bruise bump burn chip cut  
fracture hurt injure nick prick pull rupture  
scald scratch skin split sprain strain stub  
turn twist

**Signature #10 (8 Patterns – 2 Positive)**  
uniquely identifies semantic class 40.8.3

0-[np,v]  
0-[np,v,np]  
0-[np,v,self]  
0-[np,aux(be),v]  
0-[np,aux(be),v,w\_comp]  
0-[np,aux(be),v,pp(by)]  
1-[np,v,poss,np]  
1-[np,v,self]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

20 40.8.3

**Semantic class 40.8.2 – Verbs Involving the Body: Verbs of Bodily State and Damage to the Body: Tingle Verbs**  
14 Verbs

burn hum pound prickle pucker reel smart  
spin split sting swim throb tickle tingle

**Signature #62 (4 Patterns – 2 Positive)**  
uniquely identifies semantic class 40.8.2

0-[np,v,np]  
0-[np,v,poss,np]  
1-[np,v]  
1-[np,v,pp(from)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 10 semantic classes:

10.3 40.2 40.6 40.8.1 40.8.2 40.8.4 43.4  
48.1.1 48.2 51.1

**Semantic class 40.8.4 – Verbs Involving the Body: Verbs of Bodily State and Damage to the Body: Verbs of Change of Bodily State**  
4 Verbs

blanch faint sicken swoon

**Signature #79 (4 Patterns – 3 Positive)**  
identifies semantic classes: 40.6 40.8.4

0-[np,v,np]  
1-[np,v]  
1-[np,v,pp(at)]  
1-[np,v,pp(from)]

The positive portion of this signature identifies these 2 semantic classes in the positive signature suite:

40.6 40.8.4

Also, the positive portion of this signature is a subset of the signatures of these 3 semantic classes:

40.2 40.6 40.8.4

**Semantic class 41.1.1 – Verbs of Grooming and Bodily Care: Verbs of Caring for the Whole Body: Dress Verbs**  
12 Verbs

bathe change disrobe dress exercise preen  
primp shave shower strip undress wash

**Signature #143 (4 Patterns – 3 Positive)**  
uniquely identifies semantic class 41.1.1

0-[np,v,poss,np]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,self]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 41.2.1 – Verbs of Grooming and Bodily Care: Verbs of Caring for a Specific Body Part: Floss Verbs**  
4 Verbs

brush floss shave wash

**Signature #144 (3 Patterns – 2 Positive)**  
uniquely identifies semantic class 41.2.1

0-[np,v,self]  
1-[np,v]  
1-[np,v,poss,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 8 semantic classes:

21.1 37.3 40.2 40.3.1 40.3.3 41.2.1 45.1 53.2

**Semantic class 41.1.2 – Verbs of Grooming and Bodily Care: Verbs of Caring for the Whole Body: Groom Verbs**  
2 Verbs

curry groom

**Signature #28 (3 Patterns – 1 Positive)**  
uniquely identifies semantic class 41.1.2

0-[np,v]  
0-[np,v,self]  
1-[np,v,np]

The positive portion of this signature identifies these 10 semantic classes in the positive signature suite:

27 39.4 41.1.2 41.3.1 51.2 52 54.1 54.2 55.2  
9.10

Also, the positive portion of this signature is a subset of the signatures of these 99 semantic classes:

10.3 10.4.1 10.4.2 10.7 10.8 10.9 11.1 11.2  
11.4 11.5 12 13.5.1 13.5.2 15.1 17.1 17.2 18.1  
18.2 18.3 19 20 21.1 21.2 22.2 22.3 23.3 24  
25.1 25.2 25.3 25.4 26.1 26.3 26.4 26.5 26.7  
27 29.7 30.1 30.2 31.1 31.2 32.1 33 34 35.1  
36.2 36.3 37.1 37.2 37.3 37.4 37.9 38 39.1  
39.2 39.3 39.4 39.7 40.1.2 40.2 40.7 40.8.1  
41.1.1 41.1.2 41.2.2 41.3.1 42.1 42.2 43.1  
43.2 43.4 44 45.1 45.2 45.3 45.4 47.3 47.5.2  
47.8 48.1.2 51.1 51.2 51.3.2 51.4.1 51.4.2  
51.5 51.6 51.7 52 54.1 54.2 54.3 54.4 55.2  
9.10 9.4 9.8 9.9

**Semantic class 41.2.2 – Verbs of Grooming and Bodily Care: Verbs of Caring for a Specific Body Part: Braid Verbs**  
31 Verbs

bob braid brush clip coldcream comb condition  
crimp crop curl cut dye file henna lather  
manicure part perm plait pluck powder  
rinse rouge set shampoo soap talc tease  
towel trim ...

**Signature #29 (4 Patterns – 2 Positive)**  
uniquely identifies semantic class 41.2.2

0-[np,v]  
0-[np,v,self]  
1-[np,v,np]  
1-[np,v,poss,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 9 semantic classes:

15.1 20 21.1 30.1 31.2 37.3 40.2 41.2.2 45.1

**Semantic class 41.3.1 – Verbs of Grooming and Bodily Care: Verbs of Dressing: Simple Verbs of Dressing**  
**3 Verbs**

doff don wear

**Signature #11 (4 Patterns – 1 Positive)**  
**uniquely identifies semantic class 41.3.1**

0-[np,v]  
0-[np,v,np]  
0-[np,v,self,pp(in)]  
1-[np,v,np]

The positive portion of this signature identifies these 10 semantic classes in the positive signature suite:

27 39.4 41.1.2 41.3.1 51.2 52 54.1 54.2 55.2  
9.10

Also, the positive portion of this signature is a subset of the signatures of these 99 semantic classes:

10.3 10.4.1 10.4.2 10.7 10.8 10.9 11.1 11.2  
11.4 11.5 12 13.5.1 13.5.2 15.1 17.1 17.2 18.1  
18.2 18.3 19 20 21.1 21.2 22.2 22.3 23.3 24  
25.1 25.2 25.3 25.4 26.1 26.3 26.4 26.5 26.7  
27 29.7 30.1 30.2 31.1 31.2 32.1 33 34 35.1  
36.2 36.3 37.1 37.2 37.3 37.4 37.9 38 39.1  
39.2 39.3 39.4 39.7 40.1.2 40.2 40.7 40.8.1  
41.1.1 41.1.2 41.2.2 41.3.1 42.1 42.2 43.1  
43.2 43.4 44 45.1 45.2 45.3 45.4 47.3 47.5.2  
47.8 48.1.2 51.1 51.2 51.3.2 51.4.1 51.4.2  
51.5 51.6 51.7 52 54.1 54.2 54.3 54.4 55.2  
9.10 9.4 9.8 9.9

**Semantic class 41.3.2 – Verbs of Grooming and Bodily Care: Verbs of Dressing: Verbs of Dressing Well**  
**4 Verbs**

doll dress spruce tog

**Signature #30 (5 Patterns – 3 Positive)**  
**uniquely identifies semantic class 41.3.2**

0-[np,v]  
0-[np,v,self]  
1-[np,v,self,pp(before)]  
1-[np,v,pp(before)]  
1-[np,aux(be),v,pp(for)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 41.3.3 – Verbs of Grooming and Bodily Care: Verbs of Dressing: Verbs of Being Dressed**  
**4 Verbs**

attire clad garb robe

**Signature #117 (4 Patterns – 1 Positive)**  
**uniquely identifies semantic class 41.3.3**

0-[np,v,np,pp(in)]  
0-[np,v,self,pp(in)]  
0-[np,v,pp(in)]  
1-[np,aux(be),v,pp(in)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 42.1 – Verbs of Killing: Murder Verbs**  
**12 Verbs**

assassinate butcher dispatch eliminate execute immolate kill liquidate massacre murder slaughter slay

**Signature #2 (7 Patterns – 3 Positive)**  
**uniquely identifies semantic class 42.1**

0-[np,v]  
0-[np,v,np]  
0-[np,v,np,adjective]  
0-[np,v,adv(easily)]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 8 semantic classes:

18.1 18.2 21.1 24 31.1 42.1 45.1 45.2

**Semantic class 42.2 – Verbs of Killing: Poison Verbs**

**13 Verbs**

asphyxiate crucify drown electrocute garrotte hang knife poison shoot smother stab strangle suffocate

**Signature #32 (5 Patterns – 2 Positive) uniquely identifies semantic class 42.2**

0-[np,v]  
0-[np,v,adv(easily)]  
1-[np,v,np]  
1-[np,v,np,pp(to)]  
3-[np,aux(be),v,pp(to)]

The positive portion of this signature identifies these 2 semantic classes in the positive signature suite:

42.2 51.7

Also, the positive portion of this signature is a subset of the signatures of these 19 semantic classes:

11.1 11.2 11.4 11.5 17.1 18.3 21.1 26.7 31.1  
37.1 37.2 37.3 37.4 39.7 42.2 45.1 45.3 51.7  
9.4

**Semantic class 43.2 – Verbs of Emission: Verbs of Sound Emission**

**119 Verbs**

babble bang beat beep bellow blare blast blat boom bubble burble burr buzz chatter chime chink chir chitter chug clack clang clank clap clash clatter click cling clink clomp clump ...

**Signature #72 (9 Patterns – 7 Positive) uniquely identifies semantic class 43.2**

0-[np,v,np]  
0-[np,aux(be),v,pp(by)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,pp(down)]  
1-[np,v,pp(in)]  
1-[np,v,pp(with)]  
1-[pp(in),v,np]  
1-[pp(in),expl(there),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 43.1 – Verbs of Emission: Verbs of Light Emission**

**21 Verbs**

beam blaze blink burn flame flare flash flicker glare gleam glimmer glint glisten glitter glow incandesce scintillate shimmer shine sparkle twinkle

**Signature #77 (7 Patterns – 6 Positive) uniquely identifies semantic class 43.1**

0-[np,v,np]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,pp(on)]  
1-[np,v,pp(with)]  
1-[pp(on),v,np]  
1-[pp(on),expl(there),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 43.3 – Verbs of Emission: Verbs of Smell Emission**

**3 Verbs**

reek smell stink

**Signature #82 (4 Patterns – 2 Positive) uniquely identifies semantic class 43.3**

0-[np,v,np]  
1-[np,v]  
1-[np,v,pp(of)]  
3-[np,v,pp(in)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.



**Semantic class 43.4 – Verbs of Emission:  
Verbs of Substance Emission  
27 Verbs**

belch bleed bubble dribble drip drool emanate exude foam gush leak ooze pour puff radiate seep shed slop spew spill spout sprout spurt squirt steam stream sweat

**Signature #76 (9 Patterns – 8 Positive)  
uniquely identifies semantic class 43.4**

0-[np,v,np]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,pp(from)]  
1-[np,v,pp(over)]  
1-[np,v,pp(through)]  
1-[np,v,pp(with)]  
1-[pp(over),v,np]  
1-[pp(over),expl(there),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 45.1 – Verbs of Change of State: Break Verbs  
13 Verbs**

break chip crack crash crush fracture rip shatter smash snap splinter split tear

**Signature #134 (12 Patterns – 8 Positive)  
uniquely identifies semantic class 45.1**

0-[np,v,np,pp(with)]  
0-[np,v,self]  
0-[np,v,self,pp(on)]  
0-[np,v,pp(at)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,pp(against)]  
1-[np,v,np,pp(to)]  
1-[np,v,np,pp(with)]  
1-[np,v,poss,np]  
1-[np,v,adv(easily)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 44 – Destroy Verbs  
14 Verbs**

annihilate blitz decimate demolish destroy devastate exterminate extirpate obliterate ravage raze ruin waste wreck

**Signature #14 (10 Patterns – 2 Positive)  
uniquely identifies semantic class 44**

0-[np,v]  
0-[np,v,np,adjective]  
0-[np,v,np,pp(from)]  
0-[np,v,np,pp(from),pp(into)]  
0-[np,v,np,pp(into)]  
0-[np,v,np,pp(to)]  
0-[np,v,adv(easily)]  
0-[np,v,pp(at)]  
1-[np,v,np]  
1-[np,v,np,pp(with)]

The positive portion of this signature identifies these 4 semantic classes in the positive signature suite:

17.2 25.3 44 9.9

Also, the positive portion of this signature is a subset of the signatures of these 23 semantic classes:

11.1 11.4 17.2 18.1 18.2 18.3 19 20 21.1 21.2  
22.2 24 25.1 25.3 31.1 39.1 42.1 44 45.1 45.2  
45.4 9.8 9.9

**Semantic class 45.2 – Verbs of Change of State: Bend Verbs  
7 Verbs**

bend crease crinkle crumple fold rumple wrinkle

**Signature #115 (10 Patterns – 7 Positive)  
uniquely identifies semantic class 45.2**

0-[np,v,np,pp(in)]  
0-[np,v,np,pp(with)]  
0-[np,v,pp(at)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,pp(against)]  
1-[np,v,np,pp(into)]  
1-[np,v,np,pp(with)]  
1-[np,v,adv(easily)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 45.3 – Verbs of Change of State: Cooking Verbs**  
**44 Verbs**

french\_fry bake barbecue blanch boil braise  
broil brown charbroil charcoal\_broil cod-  
dle cook crisp deep\_fry fry grill hardboil  
heat microwave oven\_fry oven\_poach over-  
cook pan\_broil pan\_fry parboil parch per-  
colate perk plank poach ...

**Signature #66 (8 Patterns – 6 Positive)**  
**uniquely identifies semantic class 45.3**

0-[np,v,np]  
0-[np,v,pp(at)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,pp(in)]  
1-[np,v,np,pp(to)]  
1-[np,v,adv(easily)]

The positive portion of this signature uniquely identi-  
fies this semantic class in the positive signature suite.

**Semantic class 45.5 – Verbs of Change of State: Verbs of Entity-Specific Change of State**  
**21 Verbs**

blister bloom blossom burn corrode decay  
deteriorate erode ferment flower germinate  
molder molt rot rust sprout stagnate swell  
tarnish wilt wither

**Signature #75 (2 Patterns – 1 Positive)**  
**identifies semantic classes: 40.4 45.5**

0-[np,v,np]  
1-[np,v]

The positive portion of this signature identifies  
these 5 semantic classes in the positive signature  
suite:

28 40.1.1 40.1.3 40.4 45.5

Also, the positive portion of this signature is a sub-  
set of the signatures of these 64 semantic classes:

10.3 10.4.1 10.4.2 21.1 22.2 25.1 25.2 26.1  
26.7 28 35.1 36.1 36.3 37.3 37.4 37.5 37.6  
37.8 37.9 38 39.1 39.2 39.5 40.1.1 40.1.2  
40.1.3 40.2 40.3.1 40.3.3 40.4 40.5 40.6 40.7  
40.8.1 40.8.2 40.8.4 41.1.1 41.2.1 43.1 43.2  
43.3 43.4 45.1 45.2 45.3 45.4 45.5 45.6 47.1  
47.2 47.3 47.4 47.5.2 47.5.3 48.1.1 48.2 48.3  
49 51.1 51.3.1 51.4.1 51.4.2 51.5 53.2

**Semantic class 45.4 – Verbs of Change of State: Other Alternating Verbs of Change of State**  
**257 Verbs**

abate accelerate acetify acidify advance  
age agglomerate air alkalify alter amelio-  
rate americanize atrophy attenuate awake  
awaken balance blacken blast blunt blur  
brighten broaden brown burn burst calcify  
capsize caramelize carbonify ...

**Signature #57 (13 Patterns – 7 Positive)**  
**uniquely identifies semantic class 45.4**

0-[np,v,np]  
0-[np,v,np,pp(with)]  
0-[np,v,pp(at)]  
0-[np,v,pp(with)]  
0-[pp(on),v,np]  
0-[pp(on),expl(there),v,np,pp(of)]  
1-[np,v]  
1-[np,v,adjective]  
1-[np,v,np]  
1-[np,v,np,pp(on)]  
1-[np,v,np,pp(with)]  
1-[np,v,adv(easily)]  
1-[np,v,pp(on)]

The positive portion of this signature uniquely identi-  
fies this semantic class in the positive signature suite.

**Semantic class 45.6 – Verbs of Change of State: Verbs of Callibratable Changes of State**  
**25 Verbs**

appreciate balloon climb decline decrease  
depreciate differ diminish drop fall fluc-  
tuate gain grow increase jump mushroom  
plummet plunge rise rocket skyrocket soar  
surge tumble vary

**Signature #73 (5 Patterns – 2 Positive)**  
**uniquely identifies semantic class 45.6**

0-[np,v,np]  
0-[expl(there),v,np,pp(in)]  
0-[pp(in),v,np]  
1-[np,v]  
1-[np,v,pp(in)]

The positive portion of this signature uniquely identi-  
fies this semantic class in the positive signature suite.  
Also, the positive portion of this signature is a sub-  
set of the signatures of these 9 semantic classes:

35.1 40.2 40.3.1 43.2 45.6 47.1 47.2 47.4  
47.5.2

**Semantic class 46 – Lodge Verbs**  
**11 Verbs**

bivouac board camp dwell live lodge reside  
settle shelter stay stop

**Signature #119 (8 Patterns – 4 Positive)**  
**uniquely identifies semantic class 46**

0-[np,v,np,pp(in)]  
0-[np,v,pp(with)]  
0-[expl(there),v,np,pp(at)]  
0-[pp(at),v,np]  
1-[np,v,np,pp(in)]  
1-[np,v,pp(at)]  
1-[np,v,pp(in)]  
1-[np,v,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 47.2 – Verbs of Existence:  
Verbs of Entity-Specific Modes of Being**  
**42 Verbs**

billow bloom blossom blow breathe bristle  
bulge burn cascade corrode decay decompose  
effervesce erode ferment fester fizz  
flow flower foam froth germinate grow molt  
propagate rage ripple roil rot rust ...

**Signature #130 (8 Patterns – 7 Positive)**  
**uniquely identifies semantic class 47.2**

0-[np,v,np,pp(over)]  
1-[np,v]  
1-[np,v,pp(in)]  
1-[np,v,pp(over)]  
1-[np,v,pp(through)]  
1-[np,v,pp(with)]  
1-[pp(in),expl(there),v,np]  
1-[pp(through),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 47.1 – Verbs of Existence:  
Exist Verbs**  
**26 Verbs**

coexist correspond depend dwell endure exist  
extend flourish languish linger live loom  
lurk overspread persist predominate prevail  
prosper remain reside shelter stay survive  
thrive tower wait

**Signature #132 (7 Patterns – 5 Positive)**  
**uniquely identifies semantic class 47.1**

0-[np,v,np,pp(to)]  
0-[np,v,pp(with)]  
1-[np,v]  
1-[np,v,pp(in)]  
1-[np,v,pp(on)]  
1-[expl(there),v,np]  
1-[pp(in),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 47.3 – Verbs of Existence:  
Verbs of Modes of Being Involving Motion**  
**35 Verbs**

bob bow creep dance drift eddy flap float  
flutter hover jiggle joggle oscillate pulsate  
quake quiver revolve rock rotate shake stir  
sway swirl teeter throb totter tremble undulate  
vibrate waft ...

**Signature #71 (7 Patterns – 5 Positive)**  
**uniquely identifies semantic class 47.3**

0-[np,v,np]  
0-[np,v,pp(with)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,pp(over)]  
1-[pp(over),v,np]  
1-[pp(over),expl(there),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

43.4 47.3

**Semantic class 47.4 – Verbs of Existence:  
Verbs of Sound Existence  
6 Verbs**

din echo resonate resound reverberate  
sound

**Signature #81 (7 Patterns – 6 Positive)  
uniquely identifies semantic class 47.4**

0-[np,v,np]  
1-[np,v]  
1-[np,v,pp(in)]  
1-[np,v,pp(through)]  
1-[np,v,pp(with)]  
1-[pp(through),v,np]  
1-[pp(through),expl(there),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 47.5.1 – Verbs of Existence:  
Verbs of Group Existence: Swarm Verbs  
10 Verbs**

abound bustle crawl creep hop run swarm  
swim teem throng

**Signature #116 (6 Patterns – 4 Positive)  
uniquely identifies semantic class 47.5.1**

0-[np,v,np,pp(in)]  
0-[np,v,np,pp(with)]  
1-[np,v,pp(in)]  
1-[np,v,pp(with)]  
1-[pp(in),v,np]  
1-[pp(in),expl(there),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

43.2 47.5.1

**Semantic class 47.5.2 – Verbs of Existence:  
Verbs of Group Existence: Herd Verbs  
14 Verbs**

accumulate aggregate amass assemble cluster collect congregate convene flock gather group herd huddle mass

**Signature #157 (4 Patterns – 3 Positive)  
uniquely identifies semantic class 47.5.2**

0-[np,v,pp(with)]  
1-[np,v]  
1-[np,v,np]  
1-[np,v,pp(in)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 4 semantic classes:

35.1 40.2 43.2 47.5.2

**Semantic class 47.5.3 – Verbs of Existence:  
Verbs of Group Existence: Bulge Verbs  
3 Verbs**

bristle bulge seethe

**Signature #58 (5 Patterns – 2 Positive)  
uniquely identifies semantic class 47.5.3**

0-[np,v,np]  
0-[np,v,np,pp(with)]  
0-[np,v,pp(in)]  
1-[np,v]  
1-[np,v,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 12 semantic classes:

22.2 36.1 36.3 37.5 37.6 43.1 43.2 43.4 47.2  
47.4 47.5.3 53.2

**Semantic class 47.6 – Verbs of Existence:  
Verbs of Spatial Configuration  
39 Verbs**

balance bend bow crouch dangle flop fly hang hover jut kneel lean lie loll loom lounge nestle open perch plop project protrude recline rest rise roost sag sit slope slouch ...

**Signature #180 (5 Patterns – 5 Positive)  
uniquely identifies semantic class 47.6**

1-[np,v,np,pp(on)]  
1-[np,v,pp(on)]  
1-[np,v,pp(next,to)]  
1-[expl(there),v,pp(on),np]  
1-[pp(on),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 47.7 – Verbs of Existence:  
Meander Verbs  
18 Verbs**

cascade climb crawl cut drop go meander plunge run straggle stretch sweep tumble turn twist wander weave wind

**Signature #184 (4 Patterns – 4 Positive)  
uniquely identifies semantic class 47.7**

1-[np,v,pp(from),pp(to)]  
1-[np,v,pp(through)]  
1-[expl(there),v,pp(through),np]  
1-[pp(through),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 47.8 – Verbs of Existence:  
Verbs of Contiguous Location**  
40 Verbs

abut adjoin blanket border bound bracket  
bridge cap contain cover cross dominate  
edge encircle enclose fence fill flank follow  
frame head hit hug intersect line meet miss  
overhang precede rim ...

**Signature #161 (5 Patterns – 3 Positive)**  
uniquely identifies semantic class 47.8

0-[np,aux(be),v]  
0-[np(and),v]  
1-[np,v,np]  
1-[np,aux(be),v,pp(by)]  
1-[np(and),v]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 48.1.2 – Verbs of Appearance,  
Disappearance, and Occurrence:  
Verbs of Appearance: Reflexive Verbs of  
Appearance**  
15 Verbs

assert declare define express form intrude  
manifest offer pose present proffer recom-  
mend shape show suggest

**Signature #37 (6 Patterns – 3 Positive)**  
uniquely identifies semantic class 48.1.2

0-[np,v]  
0-[expl(there),v,self,np]  
0-[pp(to),v,self,np]  
1-[np,v,np]  
1-[np,v,self]  
1-[np,v,self,pp(to)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 48.2 – Verbs of Appearance,  
Disappearance, and Occurrence: Verbs of  
Disappearance**  
6 Verbs

die disappear expire lapse perish vanish

**Signature #123 (6 Patterns – 3 Positive)**  
uniquely identifies semantic class 48.2

0-[np,v,np,pp(into)]  
1-[np,v]  
1-[np,v,pp(from)]  
1-[np,v,pp(into)]  
3-[expl(there),v,pp(from),np]  
3-[pp(from),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 48.1.1 – Verbs of Appearance,  
Disappearance, and Occurrence:  
Verbs of Appearance: Appear Verbs**  
36 Verbs

appear arise awake awaken break burst  
come dawn derive develop emanate emerge  
erupt evolve exude flow form grow gush issue  
materialize open plop pop\_up result rise  
show\_up spill spread steal ...

**Signature #114 (6 Patterns – 5 Positive)**  
uniquely identifies semantic class 48.1.1

0-[np,v,np,pp(from)]  
1-[np,v]  
1-[np,v,pp(from)]  
1-[np,v,pp(on)]  
1-[expl(there),v,np,pp(on)]  
1-[pp(on),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 48.3 – Verbs of Appearance,  
Disappearance, and Occurrence: Verbs of  
Occurrence**  
6 Verbs

ensue eventuate happen occur recur transpire

**Signature #80 (6 Patterns – 5 Positive)**  
uniquely identifies semantic class 48.3

0-[np,v,np]  
1-[np,v]  
1-[np,v,pp(at)]  
1-[np,v,pp([in,front,of])]  
1-[expl(there),v,np]  
1-[pp([in,front,of]),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 49 – Verbs of Body-Internal Motion**

**15 Verbs**

buck fidget flap gyrate kick rock squirm  
sway teeter totter twitch waggle wiggle  
wobble wriggle

**Signature #50 (7 Patterns – 4 Positive)**  
uniquely identifies semantic class 49

0-[np,v,np]  
0-[np,v,np,adjective]  
0-[np,v,poss,np]  
1-[np,v]  
1-[np,v,self,pp(into)]  
1-[np,v,pp(down)]  
1-[np,v,pp([out,of])]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 50 – Verbs of Assuming a Position**

**19 Verbs**

bend bow crouch flop hang kneel lean lie  
perch plop rise sit slouch slump sprawl  
squat stand stoop straddle

**Signature #163 (5 Patterns – 2 Positive)**  
uniquely identifies semantic class 50

0-[expl(there),v,np,pp(in)]  
0-[expl(there),v,pp(in),np]  
0-[pp(in),v,np]  
1-[np,v,pp(in)]  
1-[np,v,pp(onto)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 51.1 – Verbs of Motion: Verbs of Inherently Directed Motion**

**20 Verbs**

advance arrive ascend climb come cross depart  
descend enter escape exit fall flee go  
leave plunge recede return rise tumble

**Signature #45 (6 Patterns – 4 Positive)**  
uniquely identifies semantic class 51.1

0-[np,v,adjective]  
0-[np,v,np]  
1-[np,v]  
1-[np,v,adjective]  
1-[np,v,np]  
1-[np,v,pp(from)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 51.2 – Verbs of Motion: Leave Verbs**

**3 Verbs**

abandon desert leave

**Signature #153 (2 Patterns – 1 Positive)**  
identifies semantic classes: 51.2 52

0-[np,v,pp(from)]  
1-[np,v,np]

The positive portion of this signature identifies these 10 semantic classes in the positive signature suite:

27 39.4 41.1.2 41.3.1 51.2 52 54.1 54.2 55.2  
9.10

Also, the positive portion of this signature is a subset of the signatures of these 99 semantic classes:

10.3 10.4.1 10.4.2 10.7 10.8 10.9 11.1 11.2  
11.4 11.5 12 13.5.1 13.5.2 15.1 17.1 17.2 18.1  
18.2 18.3 19 20 21.1 21.2 22.2 22.3 23.3 24  
25.1 25.2 25.3 25.4 26.1 26.3 26.4 26.5 26.7  
27 29.7 30.1 30.2 31.1 31.2 32.1 33 34 35.1  
36.2 36.3 37.1 37.2 37.3 37.4 37.9 38 39.1  
39.2 39.3 39.4 39.7 40.1.2 40.2 40.7 40.8.1  
41.1.1 41.1.2 41.2.2 41.3.1 42.1 42.2 43.1  
43.2 43.4 44 45.1 45.2 45.3 45.4 47.3 47.5.2  
47.8 48.1.2 51.1 51.2 51.3.2 51.4.1 51.4.2  
51.5 51.6 51.7 52 54.1 54.2 54.3 54.4 55.2  
9.10 9.4 9.8 9.9

**Semantic class 51.3.1 – Verbs of Motion: Manner of Motion Verbs: Roll Verbs**

**18 Verbs**

bounce coil drift drop float glide move revolve  
roll rotate slide spin swing turn twirl  
twist whirl wind

**Signature #54 (9 Patterns – 6 Positive)**  
uniquely identifies semantic class 51.3.1

0-[np,v,np]  
0-[np,v,np,pp(down)]  
0-[np,v,np,pp(off)]  
1-[np,v]  
1-[np,v,adjective]  
1-[np,v,np,pp(down)]  
1-[np,v,pp(down)]  
1-[np,v,pp(into)]  
1-[np,v,pp(over)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 51.3.2 – Verbs of Motion:  
Manner of Motion Verbs: Run Verbs  
124 Verbs**

amble backpack bolt bounce bound bowl  
canter carom cavort charge clamber climb  
clump coast crawl creep dart dash dodder  
drift file flit float fly frolic gallop gambol  
glide goosetstep hasten ...

**Signature #69 (14 Patterns – 12 Positive)  
uniquely identifies semantic class 51.3.2**

0-[np,v,np]  
0-[np,v,pp(into)]  
1-[np,v,np]  
1-[np,v,np,pp(into)]  
1-[np,v,np,pp(off)]  
1-[np,v,np,pp(over)]  
1-[np,v,np,pp(through)]  
1-[np,v,pp(across)]  
1-[np,v,pp(into)]  
1-[np,v,pp(over)]  
1-[np,v,pp(through)]  
1-[np,v,pp([out,of])]  
1-[expl(there),v,pp([out,of]),np]  
1-[pp([out,of]),v,np]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 51.4.1 – Verbs of Motion:  
Verbs of Motion Using a Vehicle: Verbs  
That Are Vehicle Names  
39 Verbs**

balloon bicycle bike boat bobsled bus  
cab canoe caravan chariot coach cycle  
dogsled ferry gondola helicopter jeep jet  
kayak moped motor motorbike motorcycle  
parachute punt raft rickshaw rocket skate  
skateboard ...

**Signature #166 (7 Patterns – 7 Positive)  
uniquely identifies semantic class 51.4.1**

1-[np,v]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,pp(around)]  
1-[np,v,pp(across)]  
1-[np,v,pp(along)]  
1-[np,v,pp(around)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 51.4.2 – Verbs of Motion:  
Verbs of Motion Using a Vehicle: Verbs  
That Are Not Vehicle Names  
10 Verbs**

cruise drive fly oar paddle pedal ride row  
sail tack

**Signature #165 (6 Patterns – 6 Positive)  
uniquely identifies semantic class 51.4.2**

1-[np,v]  
1-[np,v,np]  
1-[np,v,np,adjective]  
1-[np,v,np,pp(across)]  
1-[np,v,pp(across)]  
1-[np,v,pp(along)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 51.5 – Verbs of Motion:  
Waltz Verbs  
20 Verbs**

boogie bop cancan clog conga dance foxtrot  
jig jitterbug jive pirouette polka quickstep  
rumba samba shuffle squaredance tango  
tapdance waltz

**Signature #167 (7 Patterns – 7 Positive)  
uniquely identifies semantic class 51.5**

1-[np,v]  
1-[np,v,np]  
1-[np,v,np,pp(across)]  
1-[np,v,np,pp(off)]  
1-[np,v,pp(across)]  
1-[np,v,pp(into)]  
1-[np,v,pp(through)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 51.6 – Verbs of Motion:  
Chase Verbs  
7 Verbs**

chase follow pursue shadow tail track trail

**Signature #36 (5 Patterns – 3 Positive)  
uniquely identifies semantic class 51.6**

0-[np,v]  
0-[np,v,pp(down)]  
1-[np,v,np]  
1-[np,v,np,pp(down)]  
1-[np,v,pp(after)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 51.7 – Verbs of Motion: Accompany Verbs**  
**6 Verbs**

accompany conduct escort guide lead shepherd

**Signature #44 (3 Patterns – 2 Positive) uniquely identifies semantic class 51.7**

0-[np,v]  
1-[np,v,np]  
1-[np,v,np,pp(to)]

The positive portion of this signature identifies these 2 semantic classes in the positive signature suite:

42.2 51.7

Also, the positive portion of this signature is a subset of the signatures of these 19 semantic classes:

11.1 11.2 11.4 11.5 17.1 18.3 21.1 26.7 31.1  
37.1 37.2 37.3 37.4 39.7 42.2 45.1 45.3 51.7  
9.4

**Semantic class 53.1 – Verbs of Lingering and Rushing: Verbs of Lingering**  
**8 Verbs**

dally dawdle delay dither hesitate linger loiter tarry

**Signature #131 (3 Patterns – 2 Positive) uniquely identifies semantic class 53.1**

0-[np,v,np,pp(over)]  
1-[np,v,pp(in)]  
1-[np,v,pp(over)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 2 semantic classes:

47.2 53.1

**Semantic class 52 – Avoid Verbs**  
**8 Verbs**

avoid boycott dodge duck elude evade shun sidestep

**Signature #153 (2 Patterns – 1 Positive) identifies semantic classes: 51.2 52**

0-[np,v,pp(from)]  
1-[np,v,np]

The positive portion of this signature identifies these 10 semantic classes in the positive signature suite:

27 39.4 41.1.2 41.3.1 51.2 52 54.1 54.2 55.2  
9.10

Also, the positive portion of this signature is a subset of the signatures of these 99 semantic classes:

10.3 10.4.1 10.4.2 10.7 10.8 10.9 11.1 11.2  
11.4 11.5 12 13.5.1 13.5.2 15.1 17.1 17.2 18.1  
18.2 18.3 19 20 21.1 21.2 22.2 22.3 23.3 24  
25.1 25.2 25.3 25.4 26.1 26.3 26.4 26.5 26.7  
27 29.7 30.1 30.2 31.1 31.2 32.1 33 34 35.1  
36.2 36.3 37.1 37.2 37.3 37.4 37.9 38 39.1  
39.2 39.3 39.4 39.7 40.1.2 40.2 40.7 40.8.1  
41.1.1 41.1.2 41.2.2 41.3.1 42.1 42.2 43.1  
43.2 43.4 44 45.1 45.2 45.3 45.4 47.3 47.5.2  
47.8 48.1.2 51.1 51.2 51.3.2 51.4.1 51.4.2  
51.5 51.6 51.7 52 54.1 54.2 54.3 54.4 55.2  
9.10 9.4 9.8 9.9

**Semantic class 53.2 – Verbs of Lingering and Rushing: Verbs of Rushing**  
**3 Verbs**

hasten hurry rush

**Signature #172 (4 Patterns – 4 Positive) uniquely identifies semantic class 53.2**

1-[np,v]  
1-[np,v,poss,np]  
1-[np,v,pp(through)]  
1-[np,v,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.



**Semantic class 54.1 – Measure Verbs: Register Verbs**  
**5 Verbs**

measure read register total weigh

**Signature #99 (3 Patterns – 1 Positive)**  
**uniquely identifies semantic class 54.1**

0-[np,v,np,np]  
0-[np,aux(be),v,pp(by)]  
1-[np,v,np]

The positive portion of this signature identifies these 10 semantic classes in the positive signature suite:

27 39.4 41.1.2 41.3.1 51.2 52 54.1 54.2 55.2  
9.10

Also, the positive portion of this signature is a subset of the signatures of these 99 semantic classes:

10.3 10.4.1 10.4.2 10.7 10.8 10.9 11.1 11.2  
11.4 11.5 12 13.5.1 13.5.2 15.1 17.1 17.2 18.1  
18.2 18.3 19 20 21.1 21.2 22.2 22.3 23.3 24  
25.1 25.2 25.3 25.4 26.1 26.3 26.4 26.5 26.7  
27 29.7 30.1 30.2 31.1 31.2 32.1 33 34 35.1  
36.2 36.3 37.1 37.2 37.3 37.4 37.9 38 39.1  
39.2 39.3 39.4 39.7 40.1.2 40.2 40.7 40.8.1  
41.1.1 41.1.2 41.2.2 41.3.1 42.1 42.2 43.1  
43.2 43.4 44 45.1 45.2 45.3 45.4 47.3 47.5.2  
47.8 48.1.2 51.1 51.2 51.3.2 51.4.1 51.4.2  
51.5 51.6 51.7 52 54.1 54.2 54.3 54.4 55.2  
9.10 9.4 9.8 9.9

**Semantic class 54.2 – Measure Verbs: Cost Verbs**  
**4 Verbs**

carry cost last take

**Signature #53 (5 Patterns – 1 Positive)**  
**uniquely identifies semantic class 54.2**

0-[np,v,np]  
0-[np,v,np,np]  
0-[np,aux(be),v]  
0-[np,aux(be),v,pp(by)]  
1-[np,v,np]

The positive portion of this signature identifies these 10 semantic classes in the positive signature suite:

27 39.4 41.1.2 41.3.1 51.2 52 54.1 54.2 55.2  
9.10

Also, the positive portion of this signature is a subset of the signatures of these 99 semantic classes:

10.3 10.4.1 10.4.2 10.7 10.8 10.9 11.1 11.2  
11.4 11.5 12 13.5.1 13.5.2 15.1 17.1 17.2 18.1  
18.2 18.3 19 20 21.1 21.2 22.2 22.3 23.3 24  
25.1 25.2 25.3 25.4 26.1 26.3 26.4 26.5 26.7  
27 29.7 30.1 30.2 31.1 31.2 32.1 33 34 35.1  
36.2 36.3 37.1 37.2 37.3 37.4 37.9 38 39.1  
39.2 39.3 39.4 39.7 40.1.2 40.2 40.7 40.8.1  
41.1.1 41.1.2 41.2.2 41.3.1 42.1 42.2 43.1  
43.2 43.4 44 45.1 45.2 45.3 45.4 47.3 47.5.2  
47.8 48.1.2 51.1 51.2 51.3.2 51.4.1 51.4.2  
51.5 51.6 51.7 52 54.1 54.2 54.3 54.4 55.2  
9.10 9.4 9.8 9.9

**Semantic class 54.3 – Measure Verbs: Fit Verbs**  
**12 Verbs**

carry contain feed fit hold house seat serve  
sleep store take use

**Signature #162 (3 Patterns – 2 Positive)**  
**uniquely identifies semantic class 54.3**

0-[np,aux(be),v,pp(in)]  
1-[np,v,np]  
1-[np,v,np,pp(in)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 7 semantic classes:

19 30.1 31.2 35.1 45.3 54.3 9.8

**Semantic class 54.4 – Measure Verbs: Price Verbs**  
**8 Verbs**

appraise assess estimate fix peg price rate  
value

**Signature #68 (4 Patterns – 2 Positive)**  
**uniquely identifies semantic class 54.4**

0-[np,v,np]  
0-[np,v,pp(at)]  
1-[np,v,np]  
1-[np,v,np,pp(at)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 4 semantic classes:

13.5.1 13.5.2 17.1 54.4

**Semantic class 54.5 – Measure Verbs: Bill Verbs**  
**12 Verbs**

bet bill charge fine mulct overcharge save  
spare tax tip undercharge wager

**Signature #103 (4 Patterns – 2 Positive)**  
**uniquely identifies semantic class 54.5**

0-[np,v,np,pp(as)]  
0-[np,v,np,pp(to)]  
1-[np,v,np,np]  
1-[np,v,np,pp(for)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 5 semantic classes:

13.5.1 26.1 26.3 26.7 54.5

**Semantic class 55.1 – Aspectual Verbs: Begin Verbs**  
**14 Verbs**

begin cease commence continue end finish  
halt keep proceed repeat resume start stop  
terminate

**Signature #177 (2 Patterns – 2 Positive)**  
**uniquely identifies semantic class 55.1**

1-[np,v,np,pp(at)]  
1-[np,v,pp(at)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.

**Semantic class 55.2 – Aspectual Verbs: Complete Verbs**  
**4 Verbs**

complete discontinue initiate quit

**Signature #41 (2 Patterns – 1 Positive)**  
**identifies semantic classes: 27 55.2**

0-[np,v]  
1-[np,v,np]

The positive portion of this signature identifies these 10 semantic classes in the positive signature suite:

27 39.4 41.1.2 41.3.1 51.2 52 54.1 54.2 55.2  
9.10

Also, the positive portion of this signature is a subset of the signatures of these 99 semantic classes:

10.3 10.4.1 10.4.2 10.7 10.8 10.9 11.1 11.2  
11.4 11.5 12 13.5.1 13.5.2 15.1 17.1 17.2 18.1  
18.2 18.3 19 20 21.1 21.2 22.2 22.3 23.3 24  
25.1 25.2 25.3 25.4 26.1 26.3 26.4 26.5 26.7  
27 29.7 30.1 30.2 31.1 31.2 32.1 33 34 35.1  
36.2 36.3 37.1 37.2 37.3 37.4 37.9 38 39.1  
39.2 39.3 39.4 39.7 40.1.2 40.2 40.7 40.8.1  
41.1.1 41.1.2 41.2.2 41.3.1 42.1 42.2 43.1  
43.2 43.4 44 45.1 45.2 45.3 45.4 47.3 47.5.2  
47.8 48.1.2 51.1 51.2 51.3.2 51.4.1 51.4.2  
51.5 51.6 51.7 52 54.1 54.2 54.3 54.4 55.2  
9.10 9.4 9.8 9.9

**Semantic class 56 – Weekend Verbs**  
**9 Verbs**

december holiday honeymoon overnight so-  
journ summer vacation weekend winter

**Signature #181 (1 Patterns – 1 Positive)**  
**uniquely identifies semantic class 56**

1-[np,v,pp(at)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite. Also, the positive portion of this signature is a subset of the signatures of these 24 semantic classes:

10.4.1 11.2 11.4 12 18.1 18.2 19 21.1 30.3  
31.3 37.3 37.8 38 39.1 39.2 40.2 40.3.1 40.5  
40.6 40.8.4 46 48.3 55.1 56

**Semantic class 57 – Weather Verbs**  
**27 Verbs**

blow clear drizzle fog freeze gust hail howl  
lightning mist mizzle pelt pour precipitate  
rain roar shower sleet snow spit spot sprin-  
kle storm swelter teem thaw thunder

**Signature #186 (3 Patterns – 3 Positive)**  
**uniquely identifies semantic class 57**

1-[expl(it),v]  
1-[expl(it),v,np]  
1-[expl(it),v,pp(with)]

The positive portion of this signature uniquely identifies this semantic class in the positive signature suite.