NOTES

Measuring Semantic Relatedness: A Proposal for a New Textual Tool

Judicial decisions, statutes, constitutions, sentencing guidelines, and ERISA-related documents have at least one thing in common: at a molecular level, the laws are all composed of words. The scientific study of linguistics, particularly the field of semantics, analyzes what words mean and how they are connected with each other. And yet, thus far, the legal field has taken little notice of academic and technological breakthroughs in the field of linguistic semantics. This Note seeks to highlight the potential utility of linguistic semantic tools in interpreting legal texts. Specifically, applying algorithms to a free online lexical database allows anyone with a computer to measure the level of relatedness between two nouns. Like more classical and widely accepted textual tools, these algorithms shed light on the plain meaning and semantic nuances of different words. Applying them to two prominent federal circuit splits regarding federal sentencing guidelines and ERISA benefits further underscores their usefulness across the legal discipline. The legal field stands to benefit from employing semantic linguistic algorithms in the law to help resolve semantic ambiguity in legal texts and arrive at more consistent, quantifiable conclusions.

INTRODUCTION

Justice Felix Frankfurter, when speaking of the legal profession, declared that "[a]ll our work, our whole life is a matter of semantics, because words are the tools with which we work, the materials out of which laws are made, out of which the Constitution was written. Everything depends on our understanding of them."[1] Courts' reliance on textual tools to interpret legal texts further illustrates the importance of language and linguistics to legal analysis.[2] And yet, thus far, the legal field has taken little notice of the linguistic study of semantics, which analyzes the meaning of words.[3] In particular, semantic linguistics has developed such that anyone with a computer can now measure the semantic distance between two nouns (how similar two words may be) online for free.[4] These online tools provide

1. WILLIAM T. COLEMAN & DONALD T. BLISS, COUNSEL FOR THE SITUATION: SHAPING THE LAW TO REALIZE AMERICA'S PROMISE 78 (2010).

2. *See infra* Section I.A.

3. *See* Nicholas Johnson, *Full Circle: General Semantics and the Law*, 54 ETC 130, 130 (1997).

4. *See* CHRISTIANE FELLBAUM, WORDNET: AN ELECTRONIC LEXICAL DATABASE 2 (2d prtg. 1999).

lawyers and judges the opportunity to use an unprecedented level of precision in analyzing legal texts and applying the facts to the law.

This Note seeks to begin filling the gap between the legal field and the field of computational semantics. Part I provides background information on textual tools and the potential overlap with linguistics. It also explains the computational semantic linguistic tools (WordNet and the algorithms *path*, *wup*, and *res*) and illustrates how they can be used to compare different terms. Part II provides the legal support for using these tools by analogizing their justifications to those of more well-established linguistic and quantitative tools of statutory interpretation. Parts III and IV illustrate how useful these tools can be in legal interpretation by using them to resolve circuit splits in two case studies. The first circuit split, discussed in Part III, asks whether holding someone at gunpoint can qualify as "physically restraining" a victim under the federal sentencing guidelines. The second circuit split, in Part IV, discusses whether deaths caused by autoerotic asphyxiation may qualify as accidental deaths or deaths caused by self-inflicted injury for ERISA purposes. As the case studies show, the computational semantic linguistic tools are easy to use, well justified in legal interpretation, and extremely valuable in helping to resolve semantic ambiguity.

I. TEXTUAL TOOLS AND THE OPPORTUNITY FOR LINGUISTIC ANALYSIS

In resolving semantic ambiguity, the law already substantially relies on textual tools to dissect, analyze, and interpret language. A semantic linguistic tool, WordNet, and associated algorithms can help shed light on semantic nuances behind individual words. Section A discusses the history of textual tools and linguistics and their potential intersection in the legal field. Section B explains the basic mechanics of how WordNet and semantic algorithms function.

A. Finding Meaning: Textual Tools and Linguistics

"[W]hat is chicken?" Judge Friendly famously asked in a seminal 1960 case regarding contract interpretation.[5] More than twenty years later, Justice Blackmun asked, "[W]hat does the Court mean by 'permanent'?"[6] More recently, the Supreme Court asked, "What is a

5. Frigaliment Importing Co. v. B.N.S. Int'l Sales Corp., 190 F. Supp. 116, 117 (S.D.N.Y. 1960).

6. Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419, 448 (1982) (Blackmun, J., dissenting).

'pole attachment'?"[7] A primary job of judges and lawyers is to find the meaning of ordinary words written in legal texts to apply them to real-life scenarios.

Words and their meanings are therefore integral to the legal process.[8] Meanings of words are so essential that the Supreme Court has set out a plain meaning rule: when the text of a statute is unambiguous, the inquiry starts and stops with the statutory text.[9] Therefore, sensibly, judges and lawyers start their analysis by determining the meaning of a legal authority.[10] In doing so, legal practitioners turn to a variety of textual tools.[11]

Textual tools identify the intrinsic meaning of terms or phrases and can encompass a wide variety of sources and canons.[12] A classical tool of textual interpretation is the dictionary.[13] Legal practitioners often use dictionaries to support or oppose a particular interpretation of a term.[14] Specialty dictionaries, such as thesauri and etymology dictionaries, are also frequently used.[15] Textual tools may also account for syntactic structure. For example, the last antecedent rule dictates that an explanatory clause or phrase should apply only to the noun or phrase immediately preceding it.[16]

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7. City of Arlington v. FCC, 569 U.S. 290, 300 (2013) (emphasis omitted).

8. *See Editors' Foreword*, 73 WASH. U. L.Q. 769, 769 (1995).

9. Nat'l Ass'n of Mfrs. v. Dep't of Def., 138 S. Ct. 617, 631 (2018) (quoting BedRoc Ltd. v. United States, 541 U.S. 176, 183 (2004)).

10. *See* Abbe R. Gluck & Richard A. Posner, *Statutory Interpretation on the Bench: A Survey of Forty-Two Judges on the Federal Courts of Appeals*, 131 HARV. L. REV. 1298, 1317 (2018):

> [B]oth the judges who start with the words of the statute and those who do not seem to us to engage in essentially the same mode of contextual analysis . . . . They begin by trying to understand the statute, the problem the statute addresses, and the issue in the case at a broad level of generality. This broad lens often seems necessary to understand what lengthy and complex modern statutes mean.

But see id. at 1315–16 (refuting the notion that all judges start the process of interpretation by literally reading the whole statute itself).

11. *E.g.*, Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or., 515 U.S. 687, 719–21 (1995) (Scalia, J., dissenting) (using dictionary definitions and the canons *noscitur a sociis* and *ejusdem generis* to define the statutory meaning of "harm").

12. *See* Stephen J. Safranek, *Scalia's Lament*, 8 TEX. REV. L. & POL. 315, 317 (2004).

13. As early as 1894, other law students grappled with the role dictionaries should play in legal analysis. William C. Anderson, *Law Dictionaries*, 28 AM. L. REV. 531, 535–36 (1894).

14. *Compare* Muscarello v. United States, 524 U.S. 125, 128 (1998) (using dictionary definitions to argue that "carry" can include "conveyance in a vehicle"), *with id.* at 139–40 (Ginsburg, J., dissenting) (using a dictionary definition to arrive at the opposite conclusion).

15. *E.g.*, United States v. Lopez, 514 U.S. 549, 586 (1995) (defining "commerce" using an etymology dictionary); McLaughlin v. Richland Shoe Co., 486 U.S. 128, 133 (1988) (using a thesaurus to define "willful").

16. *See, e.g.*, Barnhart v. Thomas, 540 U.S. 20, 27 (2003).

Textual tools have many possible legal justifications.[17] First and foremost, textual tools can help orient legal practitioners to the meaning of a legal text.[18] The meaning can illuminate how the enacting Congress would have resolved the issue at hand.[19] Under the theory that courts are agents of the legislature, using textual tools helps legitimize judicial decisions and "promote fidelity" to Congress.[20] Conformity to the "rules" imposed by textual tools also increases predictability of judicial interpretation.[21] This predictability further serves as a guidepost to the legislature about how courts will implement legislated acts.[22] Although academic discussion of textual tools increased with the rise of new textualism in the 1990s, largely under the influence of Justice Antonin Scalia,[23] legal practitioners of all interpretive theories employ textual tools at least as a component of their legal analysis.[24]

The study of linguistics is highly relevant to legal analysis and the field of textual tools. Many textual tools are in fact derived from principles of linguistics.[25] Linguistics, a field of study which predates Scalia's textualism by several millennia,[26] studies the science behind human communication, including subfields such as phonology (the physics of how humans produce sounds), morphology (the building blocks of how words are made), syntax (grammar), and sociolinguistics (how socioeconomic factors affect speech).[27] Perhaps most importantly to the legal profession, the study of linguistics also includes semantics—the study of what words mean.[28]

In 1995, a handful of legal academics at a symposium hosted by Northwestern University and Washington University flirted with the idea of adding linguistics to their legal analysis.[29] For example,

17. For justifications behind individual textual tools, see *infra* Part III.

18. *See* Cass R. Sunstein, *Interpreting Statutes in the Regulatory State*, 103 HARV. L. REV. 405, 454 (1989).

19. *See* Frank H. Easterbrook, *Statutes' Domains*, 50 U. CHI. L. REV. 533, 533 (1983).

20. *See* Sunstein, *supra* note 18, at 415, 425.

21. *See id.* at 441–42.

22. *See id.* at 456.

23. *See* William N. Eskridge, Jr., *The New Textualism*, 37 UCLA L. REV. 621, 624 (1990).

24. *See* Diarmuid F. O'Scannlain, Remarks, *"We Are All Textualists Now": The Legacy of Justice Antonin Scalia*, 91 ST. JOHN'S L. REV. 303, 308 (2017).

25. *See infra* Section II.A.

26. *See* RICHARD HUDSON, AN INTRODUCTION TO WORD GRAMMAR 103 (2010).

27. *See* Judith N. Levi, *Introduction: "What Is Meaning in a Legal Text?" A First Dialogue for Law and Linguistics*, 73 WASH. U. L.Q. 771, 772 (1995).

28. *See id.*

29. *See Editors' Foreword*, *supra* note 8, at 770 ("[The conference] represented the first significant interdisciplinary dialogue among scholars of law and linguistics and addressed itself to a central question: What is meaning in a legal text?").

Professor Clark Cunningham, a professor of law, collaborated with Professor Charles Fillmore, a professor of linguistics, to analyze the Supreme Court's interpretation of what it means to "use a firearm."[30] Professor Lawrence Solan contended that linguistics may be useful in cases where the statute is hard to read or the court must apply real-life scenarios to the statute.[31] While Professor Robert Rasmussen found statutes on the whole too complex for linguistic analysis, he conceded that linguistics may be especially helpful in criminal law, where the goal is to understand the statutory language as an ordinary person would.[32] In contrast, Professor Dennis Patterson dismissed the application of linguistics to legal texts as "nonsensical."[33]

Since the symposium, linguistics expanded to include the subfield of computational linguistics, which can involve mapping language into computationally tractable implementations of syntactic and semantic analysis.[34] In short, semantic analysis is now easier and more advanced with the advent and ubiquity of computers.[35] Computational linguistics has been crucial to the development of linguistic technologies such as Siri and Google Translate, to name a few.

The use of computational linguistics in the legal field has been both sparse and controversial. For example, Justice Lee on the Utah Supreme Court used linguistic tools to settle a question of statutory interpretation regarding the phrase "discharge of a firearm."[36] He then delivered an impassioned justification of using linguistic research in his analysis, arguing that linguistics can help decode language[37] and that computational linguistic tools are transparent and easy to use.[38] Nonetheless, his fellow justices dismissed his findings as "scientific research" outside of the realm of judging.[39] The 2017 *Brigham Young University Law Review* symposium on linguistics in the law played out similarly to the symposium in 1995. For example, Professor Stefan Th. Gries and Professor Brian G. Slocum's suggestion that computational

30. Clark D. Cunningham & Charles J. Fillmore, *Using Common Sense: A Linguistic Perspective on Judicial Interpretations of "Use a Firearm*,*"* 73 WASH. U. L.Q. 1159, 1160 (1995).

31. Lawrence M. Solan, *Judicial Decisions and Linguistic Analysis: Is There a Linguist in the Court?*, 73 WASH. U. L.Q. 1069, 1072 (1995).

32. Robert K. Rasmussen, *Why Linguistics?*, 73 WASH. U. L.Q. 1047, 1053–55 (1995).

33. Dennis Patterson, *Against a Theory of Meaning*, 73 WASH. U. L.Q. 1153, 1153 (1995).

34. *See* Lenhart Schubert, *Computational Linguistics*, *in* STANFORD ENCYCLOPEDIA OF PHILOSOPHY (Edward N. Zalta et al. eds., 2020), https://plato.stanford.edu/entries/computational-linguistics/ [https://perma.cc/ZL9T-3AY3] (giving a broad overview of computational linguistics).

35. *See* FELLBAUM, *supra* note 4, at 2.

36. State v. Rasabout, 2015 UT 72, ¶¶ 80–96, 356 P.3d 1258, 1281–82 (Lee, J., concurring).

37. *Id.* at ¶¶ 58–63, 356 P.3d at 1276.

38. *Id.* at ¶¶ 80–88, 356 P.3d at 1281.

39. *Id.* at ¶¶ 17–20, 356 P.3d at 1265.

linguistics should be used to ascertain ordinary meaning[40] garnered criticism that linguistics' appeal was "superficial" and raised issues of notice and accountability.[41]

In summary, there is a difference between the way that most judges and lawyers analyze the meanings of words and the way that linguists and scientists analyze the meanings of words. While the quest for the meaning of words underpins all legal analysis, legal academia and judicial review have so far largely failed to exploit important principles of linguistic semantics. But recent developments in linguistic semantics, particularly computational linguistics, are rife with opportunity for the legal field.

B. New Linguistic Tools

One particular tool, WordNet, has caused a revolution in the field of computational linguistic analysis of semantics.[42] WordNet is free, easy to use, and operates much like conducting an internet search.[43] Princeton University operates WordNet mostly through its Department of Computer Science.[44] Anyone can apply algorithms to WordNet's database for free to measure and quantify how two terms may be semantically related—namely, how two terms' meanings relate or connect to each other.[45] Measuring semantic relatedness is especially valuable in legal interpretation, where judges must categorically apply facts to legal language and decide whether the terms match. This Section explores and explains how WordNet functions as a lexical database and allows for computation of three algorithms—*path*, *wup*, and *res*—that can quantify the semantic relatedness between two nouns.

1. WordNet as a Lexical Database

WordNet is a web tool and app developed by Princeton University that serves as a large lexical database or taxonomy.[46]

40. Stefan Th. Gries & Brian G. Slocum, *Ordinary Meaning and Corpus Linguistics*, 2017 BYU L. REV. 1417, 1418–19 (2017).

41. Carissa Byrne Hessick, *Corpus Linguistics and the Criminal Law*, 2017 BYU L. REV. 1503, 1504–05 (2017).

42. FELLBAUM, *supra* note 4, at 12–17 (listing research projects and improvements in computational linguistics using WordNet as a database).

43. *What Is WordNet?*, WORDNET, https://wordnet.princeton.edu (last visited Dec. 15, 2020) [https://perma.cc/SD7C-76Q3].

44. *People*, WORDNET, https://wordnet.princeton.edu/people (last visited Dec. 15, 2020) [https://perma.cc/CY6B-MSGP].

45. *See, e.g.*, FELLBAUM, *supra* note 4, at 14–16.

46. *What Is WordNet?*, *supra* note 43.

WordNet has many functions, including as a regular dictionary. Professional lexicographers write the definitions associated with each term, calling the different definitions "senses" and denoting different parts of speech.[47] Thus far in the legal world, WordNet's use has mainly been confined to this dictionary function.[48] WordNet also functions as a thesaurus, grouping senses that are synonymous with each other together in data sets called "synsets."[49] Distinct from a dictionary or thesaurus, however, WordNet assigns each separate sense of a word a numerical value based on the frequency at which that sense was used in language data that has been tagged by semantic linguists.[50]

Additionally, WordNet tracks super-subordinate relationships, also known as ISA relationships.[51] ISA relationships denote hypernyms and hyponyms.[52] A hypernym is a "word whose meaning includes a group of other words."[53] For example, "furniture" is a hypernym of "chair" because "furniture" encompasses groups of other words like "chair," "sofa," and "bed." Similarly, "animal" is a hypernym of "dog" and "rabbit." Conversely, a hyponym is "a word whose meaning is included in the meaning of another word."[54] Therefore, "chair" is a hyponym of "furniture," and "dog" is a hyponym of "animal."

WordNet has several other functions that are not as relevant to this Note's analysis, such as tracking how one noun may constitute a part of another (meronymy), how specifically a verb describes an event (troponymy), and how adjectives may oppose each other (antonymy).[55] Although these functions may be useful for other analyses, they are outside the scope of this Note.

As a free tool whose taxonomy can be easily downloaded and used for other computational programs, WordNet has inspired a wave of research and breakthroughs in computational semantics language processing.[56] For example, the web app Word Similarity for Java

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47. *Id.*

48. *See, e.g.*, Johnson v. Portz, 707 F. Supp. 2d 494, 501 (D. Del. 2010); Robertson v. Health Net of Cal., Inc., 34 Cal. Rptr. 3d 547, 552 (Cal. Ct. App. 2005) (casting skepticism on the source).

49. *What Is WordNet?*, *supra* note 43.

50. *Frequently Asked Questions*, WORDNET, https://wordnet.princeton.edu/frequently-asked-questions (last visited Dec. 15, 2020) [https://perma.cc/6AYP-XZ93].

51. *What Is WordNet?*, *supra* note 43. The phrase ISA literally means is-a; for example, a poodle *is a* dog.

52. *Id.*

53. *Hypernym*, CAMBRIDGE DICTIONARY, https://dictionary.cambridge.org/us/dictionary/english/hypernym (last visited Dec. 15, 2020) [https://perma.cc/N8CP-58TT].

54. *Hyponym*, CAMBRIDGE DICTIONARY, https://dictionary.cambridge.org/us/dictionary/english/hyponym (last visited Dec. 15, 2020) [https://perma.cc/4UDE-59JM].

55. *What Is WordNet?*, *supra* note 43.

56. *Related Projects*, WORDNET, https://wordnet.princeton.edu/related-projects (last visited Dec. 15, 2020) [https://perma.cc/V33J-PXQ2].

("WS4J") measures the semantic relatedness of words, using WordNet as a database and employing algorithms based on the research of various linguistic scholars.[57] For the sake of explanation, the following sections explore these algorithms by testing how similar a "button"[58] is to a "coin."[59] The resulting data would be meaningless without context of how similar other terms may be. Therefore, as a null variable, the following sections also measure the semantic distance between "nickel"[60] and "coin." Obviously, the human expectation is that "nickel" and "coin" should be more closely semantically related than "button" and "coin." Regardless, if an alien were dropped on earth with just WordNet, these algorithms, and the knowledge that humans might pay for gumballs with coins, how would he know which round metal pieces—nickels or buttons—to use? WordNet and the algorithms *path*, *wup*, and *res* would help him figure out how to buy a gumball.

2. Measuring Blunt Distance with *Path*

Each sense of a term is a "node" in the giant web of words that WordNet provides. A simple algorithm, *path*, measures semantic relatedness by finding the shortest path among the nodes of ISA relationships between senses.[61] The first step is to find the Least Common Subsumer ("LCS") between two nodes. The LCS is a hypernym that encompasses two nodes.[62] For example, the LCS of "button" and "coin" is "entity" because both buttons and coins are types of entities.[63]

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57. WS4J DEMO, http://ws4jdemo.appspot.com/ (last visited Dec. 15, 2020) [https://perma.cc/J6FP-TVFZ].

58. This analysis uses the first sense of "button," meaning "a round fastener sewn to shirts and coats." [*Button*], WORDNET, http://wordnetweb.princeton.edu/perl/webwn?s=button&sub=Search+WordNet&o2=&o0=1&o8=1&o1=1&o7=&o5=&o9=&o6=&o3=&o4=&h=000 (last visited Dec. 15, 2020) [https://perma.cc/6QN5-XFQZ].

59. This analysis uses the nominal sense of "coin," defined as "a flat metal piece (usually a disc) used as money." [*Coin*], WORDNET, http://wordnetweb.princeton.edu/perl/webwn?s=coin&sub=Search+WordNet&o2=&o0=1&o8=1&o1=1&o7=&o5=&o9=&o6=&o3=&o4=&h=0000 (last visited Dec. 15, 2020) [https://perma.cc/M3HN-4RS4].

60. The definition used is a "United States coin worth one-twentieth of a dollar." [*Nickel*], WORDNET, http://wordnetweb.princeton.edu/perl/webwn?s=nickel&sub=Search+WordNet&o2=&o0=1&o8=1&o1=1&o7=&o5=&o9=&o6=&o3=&o4=&h= (last visited Dec. 15, 2020) [https://perma.cc/JN2F-V673].

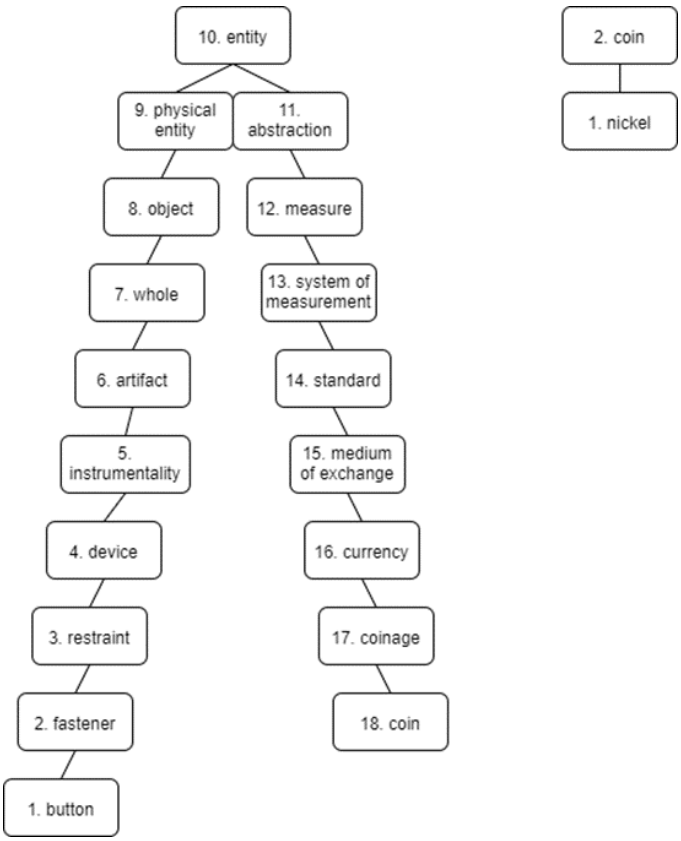
61. Linguists generally acknowledge this algorithm as emanating from the work of Roy Rada & Ellen Bicknell, *Ranking Documents with a Thesaurus*, 40 J. AM. SOC'Y FOR INFO. SCI. 304, 305 (1989). *See, e.g.*, CHAOMEI CHEN & MIN SONG, REPRESENTING SCIENTIFIC KNOWLEDGE: THE ROLE OF UNCERTAINTY 152 (2017).

62. This concept is analogous to finding the least common denominator between fractions.

63. [*Button#n#1*, *Coin#n#1*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=button%23n%231&s2=&w2=coin%23n%231 (last visited Dec. 15, 2020) [https://perma.cc/FFH8-QKLK].

There is no more specific LCS in WordNet's taxonomy.[64] In contrast, the LCS of "nickel" and "coin" is "coin" because "nickel" is a hyponym of "coin."[65] Once the LCS is determined, the algorithm *path* counts the number of nodes between the two senses at issue. The shortest path between "button" and "coin" requires traveling eighteen nodes in the ISA relationship.[66] Because 1/18 is approximately 0.06, the result of *path*(button, coin) is 0.06.[67] In contrast, *path*(nickel, coin) requires traveling only two nodes, leading to a value of 0.5.[68] Figure 1 below illustrates this concept.

FIGURE 1



64. *Id.*

65. [*Nickel#n#2*, *Coin#n#1*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=nickel%23n%232&s2=&w2=coin%23n%231 (last visited Dec. 15, 2020) [https://perma.cc/J3NC-PRB8].

66. [*Button#n#1*, *Coin#n#1*], WS4J DEMO, *supra* note 63.

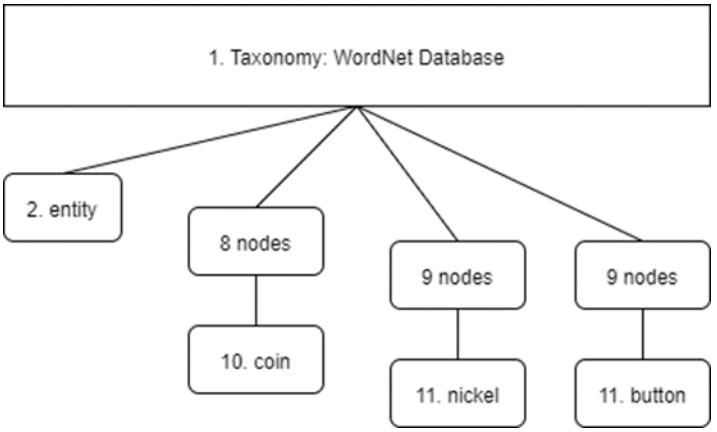
67. *Id.*

68. [*Nickel#n#2*, *Coin#n#1*], WS4J DEMO, *supra* note 65.

3. Quantifying Taxonomic Depth with *Wup*

Several algorithms complicate *path* by accounting for additional variables. For example, the algorithm *wup* also measures how many nodes are required to go from the most generalized hypernym in the taxonomy to the two terms at issue and the LCS.[69] This distance is called taxonomic depth. For example, "entity" has a taxonomic depth of 2: there is no hypernym for "entity," so *wup* counts the database as a whole and the node "entity."[70] In contrast, "coin" has a taxonomic depth of 10, as there are eight nodes between "coin" and the database.[71] The terms "nickel" and "button" each have a taxonomic depth of 11 because each has ten hypernyms.[72] This concept is illustrated by Figure 2, below.

FIGURE 2



Once the algorithm *wup* calculates the taxonomic depth of the LCS and the two terms at issue, it divides the depth of the LCS by the sum of the taxonomic depth of the two terms at issue according to the formula (2 x Depth_LCS) / (Depth_term1 + Depth_term2). This formula acknowledges that if the terms at issue and the LCS are all deep into the taxonomy, the terms are more specific and therefore more closely related, causing *wup* to yield a higher fraction. For example,

69. *See* Zhibiao Wu & Martha Palmer, *Verb Semantics and Lexical Selection*, 1994 PROC. 32D ANN. MEETING ON ASS'N FOR COMPUTATIONAL LINGUISTICS 133, 137.

70. [*Button#n#1*, *Coin#n#1*], WS4J DEMO, *supra* note 63.

71. *Id.*

72. [*Nickel#n#2*, *Coin#n#1*], WS4J DEMO, *supra* note 65.

wup(nickel, coin) yields a value of 0.95.[73] In contrast, if the LCS is rather abstract and therefore shallow in the taxonomy, while the terms at issue are deep into taxonomy, *wup* will yield a smaller fraction.[74] The value of *wup*(button, coin) is 0.19.[75] Therefore, the higher the outcome of *wup*, the higher the level of correlation between the two terms.

4. Considering Information Content with *Res*

Conversely, the algorithm *res* considers how many nodes fall below a given term.[76] This measurement is called information content.[77] For example, although "metal" and "chemical element" share the same taxonomic depth, "chemical element" contains more hyponyms than "metal" does.[78] Thus, when two terms share the LCS "metal," they will have higher information content than when two terms share only the LCS "chemical element."[79] This concept is illustrated in Figure 3, below. The algorithm *res* accounts for information content by measuring the information content of the LCS relative to the size of the entire taxonomy.[80] Similar to *wup*, the less abstract and more specific the LCS, the more its hyponyms will have in common.

73. *Id.*

74. *See* Wu & Palmer, *supra* note 69, at 137.

75. [*Button#n#1*, *Coin#n#1*], WS4J DEMO, *supra* note 63.

76. *See* Philip Resnik, *Using Information Content to Evaluate Semantic Similarity in a Taxonomy*, 1 PROC. 14TH INT'L JOINT CONF. ON A.I. 448, 451–52 (1995).

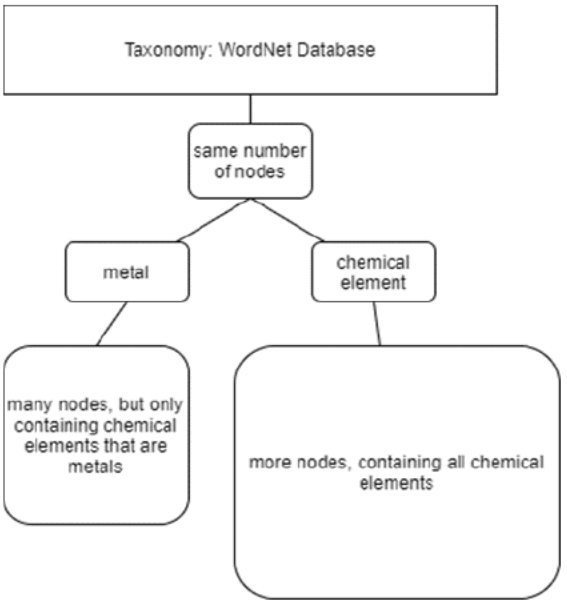
77. *Id.*

78. *See id.*

79. *See id.*

80. *See id.*

FIGURE 3



Because as an LCS "coin" has few hyponyms and therefore high information content, the *res* outcome between "nickel" and "coin" is 9.06.[81] On the other hand, because the LCS "entity" contains an enormous portion of the taxonomy, applying *res* to "button" and "coin" overwhelms the algorithm and yields a result of 0.[82] The results of employing all three algorithms (*path*, *wup*, and *res*), as reproduced in Table 1, illustrate that "nickel" is more similar to "coin" than "button" is to "coin." The algorithms therefore quantifiably confirm our human expectations.

TABLE 1

	"Nickel"—"Coin"[83]	"Button"—"Coin"[84]
path	0.50	0.06
wup	0.95	0.19
res	9.06	0; error

81. [*Nickel#n#2*, *Coin#n#1*], WS4J DEMO, *supra* note 65.
82. [*Button#n#1*, *Coin#n#1*], WS4J DEMO, *supra* note 63.
83. [*Nickel#n#2*, *Coin#n#1*], WS4J DEMO, *supra* note 65.
84. *Id.*

This discussion demonstrates there are several linguistic algorithms available that measure and quantify hierarchical relationships in semantics. Research has shown a strong correlation between the results of the algorithms and how humans perceive words semantically.[85] These algorithms consider overall distance (*path*), taxonomic depth (*wup*), and information content (*res*). *Path*, *wup*, and *res* are not the only linguistic algorithms available, but they provide a useful starting point in helping to determine whether one term can be categorized as another—a crucial determination in legal analysis.

II. LEGAL JUSTIFICATIONS FOR WORDNET AND THE ALGORITHMS

In many ways, computational linguistic tools may serve the same function as traditional textual tools. As discussed in Section I.A, a primary and uncontroversial purpose of employing textual tools is to elicit meaning.[86] Similarly, textual tools based on syntax illustrate widely held, common-sense patterns of thinking in language and communication.[87] The algorithms serve all these functions: they elicit meaning by illustrating hierarchical relationships and semantic similarity of words, and they elucidate the cognitive classifications humans have of words in a wholly objective, quantifiable manner.

Furthermore, the tools gain legitimacy through their close relationship to other more well-established tools of legal analysis. As tools of modern computational linguistics, WordNet and the algorithms discussed above are analogous both to linguistic tools that have already gained widespread acceptance in courts and to more modern, quantitative tools that have increased in popularity in recent years. This Section describes the justifications behind both classic linguistic tools and recent quantitative tools and demonstrates that those justifications similarly apply to WordNet and the algorithms *path*, *wup*, and *res*.

85. For example, *res* has a correlation of r=0.79 with human experiments. *See* CHEN & SONG, *supra* note 61, at 151.

86. *See, e.g.*, Sunstein, *supra* note 18, at 454.

87. *See* T. Alexander Aleinikoff & Theodore M. Shaw, *The Costs of Incoherence: A Comment on Plain Meaning,* West Virginia University Hospitals, Inc. v. Casey*, and Due Process of Statutory Interpretation*, 45 VAND. L. REV. 687, 688 (1992).

A. Analogy to Other Linguistic Tools

Although courts use many classical linguistic tools in statutory interpretation,[88] three textual tools are particularly salient in justifying also using WordNet and the algorithms: dictionaries, etymology, and the last antecedent rule. This Section compares WordNet to dictionaries and the algorithms to etymology and the last antecedent rule. Dictionaries, etymology, and the last antecedent rule stem from classical linguistic principles,[89] and all three tools are frequently employed in legal analysis.[90] The justifications for these tools—identifying semantic nuances and providing definitive, unbiased clarity—also apply to WordNet and associated algorithms.

1. Dictionaries

Judges often use dictionaries as a principal textual tool.[91] Lexicographers draft dictionaries based on linguistic surveys of usage and the underlying goal of descriptivism, not prescriptivism.[92] For example, *Webster's Third Dictionary*'s 1936 definitions were based on the editorial staff's collection of 4.5 billion new usages of words from excerpts of books, magazines, newspapers, pamphlets, catalogs, and journals.[93] There are many potential justifications for using dictionaries as textual tools. First and foremost, dictionaries conveniently describe the usage and meaning of words, giving full effect to the language of the legal text.[94] Indeed, using a dictionary to interpret legal language seems so obvious that "[n]o defense seems necessary."[95]

WordNet as a lexical database functions much like a dictionary and shares many of the same legal justifications.[96] As previously

88. For example, Professor Solan explains that judges act as linguists when interpreting pronouns, the difference between "and" and "or," and defining adjectives. LAWRENCE M. SOLAN, THE LANGUAGE OF JUDGES 38–59 (1993).

89. *See, e.g.*, LYLE CAMPBELL, HISTORICAL LINGUISTICS: AN INTRODUCTION 5 (2013); Solan, *supra* note 31, at 31.

90. *See, e.g.*, Barnhart v. Thomas, 540 U.S. 20, 27 (2003); Muscarello v. United States, 524 U.S. 125, 128 (1998); John Calhoun, *Measuring the Fortress: Explaining Trends in Supreme Court and Circuit Court Dictionary Use*, 124 YALE L.J. 484, 497 (2014).

91. *See* Calhoun, *supra* note 90, at 497.

92. *See* WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY 4a–5a (1993) ("Accuracy in addition to requiring freedom from error and conformity to truth requires a dictionary to state meanings in which words are in fact used, not to give editorial opinion on what their meanings should be.").

93. *Id.* at 4a.

94. *See* Rickie Sonpal, Note, *Old Dictionaries and New Textualists*, 71 FORDHAM L. REV. 2177, 2197 (2003).

95. *Id.*

96. *See supra* Section I.B.

discussed, WordNet data is objectively gathered, quantified, and tagged based on real and common usage by neutral linguists.[97] The data gathered conveniently describes the usage and meaning of words,[98] thereby giving full effect to legal text. While using WordNet to define terms may not be as obvious to courts as using a dictionary,[99] WordNet's utility and intricacies speak for themselves, as WordNet enables computational analysis for semantic relatedness of terms.[100]

2. Etymology

Etymology is a byproduct of historical linguistics (a field of linguistic study examining how languages evolve over time) that serves as another classical textual tool.[101] In *Muscarello v. United States*, Justice Scalia, writing for the Court, illustrated that the word "carry" can mean "carry in a car" in part because the Latin root of "carry" shared the meaning of transportation by vehicle.[102] Justice Thomas, in his interpretation of the Commerce Clause of the Constitution, also relied on the etymology of "commerce" in explaining that "commerce" can mean "with merchandise."[103] In fact, the Supreme Court's use of etymology as an interpretive tool dates at least as far back as the 1800s.[104] The practice of using etymology to define and describe legal terms may have its roots in Plato's works.[105]

Explicit justifications for the Court's use of etymology are sparse.[106] At its most basic, etymology can help divine the meaning of

97. *What Is WordNet?*, *supra* note 43.

98. *Id.*

99. *See, e.g.*, Robertson v. Health Net of Cal., Inc., 34 Cal. Rptr. 3d 547, 552 (Cal. Ct. App. 2005) (deriding WordNet as an "internet dictionary" and "on-line lexical database" in comparison to "the venerable Oxford English Dictionary").

100. *See infra* Parts III and IV.

101. *See* CAMPBELL, *supra* note 89, at 5.

102. 524 U.S. 125, 128 (1998).

103. United States v. Lopez, 514 U.S. 549, 586 (1995) (Thomas, J., concurring).

104. *See* Scott v. Sandford, 60 U.S. (19 How.) 393, 476 (1857); Smith v. Turner, 48 U.S. (7 How.) 283, 500–01 (1849); Patapsco Ins. v. Coulter, 28 U.S. (3 Pet.) 222, 230 (1830); United States v. Wiltberger, 18 U.S. (5 Wheat.) 76, 106 (1820).

105. *See* James Williams, *Legal Etymology*, 328 LAW MAG. & REV. 257, 257 (1903).

106. It is this author's opinion that the use of etymology in statutory interpretation is not justified. Just like the sounds in words change over time, the meaning of words change over time through processes such as broadening, narrowing, metaphor, amelioration, taboo replacement, and pejoration. *See* CAMPBELL, *supra* note 89, at 223–25, 227–29 (overview of semantic and lexical change); Lawrence B. Solum, *Triangulating Public Meaning: Corpus Linguistics, Immersion, and the Constitutional Record*, 2017 BYU L. REV. 1621, 1640 (2017) ("Because semantics, syntax, and punctuation change over time, contemporary linguistic intuitions are not a reliable guide to the meaning of older texts."); Stephen C. Mouritsen, *The Dictionary Is Not a Fortress: Definitional Fallacies and a Corpus-Based Approach to Plain Meaning*, 2010 BYU L. REV. 1915, 1939–41 (2010) (explaining that accepting a given meaning as valid due to etymology alone would lead to absurd

particular antiquated or "fancy" words.[107] In its more frequent legal use, however, courts employ etymology to elucidate the meaning of a term.[108] The study of etymology shows how and when a word originated through its form and meaning.[109] Therefore, judges who use etymology presume that although the sounds and spelling of a word have changed over time, the word retains at least a connotation of its historical meaning. Etymology therefore aids judges in ascertaining the semantic nuances of words.

Similarly, the algorithms quantify hierarchical relationships and therefore the interrelatedness of terms.[110] The results of employing the algorithms reveal a level of interconnectedness that correlates to cognitive perceptions of how related two words may be.[111] Accordingly, like etymology, the algorithms can help elucidate semantic nuances of words that are not evident from their current dictionary definitions.

3. The Last Antecedent Rule

There are also many parallels between the algorithms and the last antecedent rule. The last antecedent rule aligns with the cognitive linguistic principle of "late closure," which indicates that humans tend to associate the newest words we process with the words we have processed most recently.[112] Under the last antecedent rule, a clause or phrase should apply only to the noun or phrase immediately preceding it. In an example provided by Justice Scalia, if parents going out of town tell their teenager not to "throw a party or engage in any other activity that damages the house," the parents can still punish the teenager for throwing a party that does not cause damage.[113] In this colorful example, the last antecedent rule dictates that the phrase "that damages the house" applies only to the phrase "engage in any other

results). Further critique of etymology as a tool of statutory interpretation is outside the scope of this paper, but this author believes that if judges can somehow justify using etymology in statutory interpretation, WordNet and subsequent algorithms are also justifiable.

107. *See* Williams, *supra* note 105, at 267.

108. *See, e.g.*, Muscarello v. United States, 524 U.S. 125, 128 (1998).

109. *See* Robert Mailhammer, *Introduction: Etymology Beyond Word Histories* to LEXICAL AND STRUCTURAL ETYMOLOGY: BEYOND WORD HISTORIES 2 (Robert Mailhammer ed., 2013).

110. *See supra* Section I.B.

111. *See* CHEN & SONG, *supra* note 61, at 149.

112. *See* SOLAN, *supra* note 88, at 31–32.

113. *See, e.g.*, Barnhart v. Thomas, 540 U.S. 20, 27 (2003).

activity."[114] Although judges have recently increased their usage of the last antecedent rule, use of the rule goes as far back as at least 1799.[115]

Although the last antecedent rule garners a substantial amount of critique,[116] it boasts several potential justifications. First, the rule acknowledges inherent ambiguities in the English language and attempts to resolve them decisively.[117] Additionally, the last antecedent rule provides evidence of the "common sense" meanings of certain phrases.[118] Furthermore, employing the last antecedent rule to all legal texts shows a lack of ideological bias, as the text may thereafter read to align with more liberal or more conservative values.[119]

These same justifications support use of the algorithms. For example, the algorithms acknowledge that there are hierarchical structures to words in the English language and seek to quantify them definitively.[120] In addition, the algorithms elucidate cognitive perceptions of what words mean and how they are related, which can help shed light on how common people understand the words.[121] Moreover, the algorithms are politically and ideologically neutral.

WordNet and the algorithms therefore have many of the same justifications as more widely accepted linguistic textual tools. WordNet and the algorithms objectively account for linguistic realities, elucidate meanings of terms, highlight semantic nuances, and acknowledge structural relationships.

B. Analogy to Cost-Benefit Analysis: A Quantitative Tool

The algorithms also share common justifications with the quantitative textual tool, cost-benefit analysis. Cost-benefit analysis is

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114. *See id.*

115. *See* Jeremy L. Ross, *A Rule of Last Resort: A History of the Doctrine of the Last Antecedent in the United States Supreme Court*, 39 SW. L. REV. 325, 327, 336 (2009).

116. *See, e.g.*, Joseph Kimble, *The Doctrine of the Last Antecedent, the Example in* Barnhart*, Why Both Are Weak, and How Textualism Postures*, 16 SCRIBES J. LEGAL WRITING 5, 5 (2015) ("A court that resolved this ambiguity by applying the doctrine (or rule, or canon) of the last antecedent would be a court that's at a loss. And a court that uses it to support a decision made for other reasons is throwing in a feather."); Ross, *supra* note 115, at 326 ("Two recent Supreme Court decisions have revealed that the decision to apply the Rule may be less a matter of common sense than nonsensical statutory construction.").

117. *See* Terri LeClercq, *Doctrine of the Last Antecedent: The Mystifying Morass of Ambiguous Modifiers*, 2 LEGAL WRITING 81, 85 (1996).

118. *See* 82 C.J.S. *Statutes* § 443 (2020).

119. *Cf.* Margaret H. Lemos, *The Politics of Statutory Interpretation*, 89 NOTRE DAME L. REV. 849, 887 (2013) (reviewing ANTONIN SCALIA & BRYAN A. GARNER, READING LAW: THE INTERPRETATION OF LEGAL TEXTS (2012)) ("Textualism could be used by liberals to equal (albeit opposite) effect . . . .").

120. *See* Wu & Palmer, *supra* note 69, at 136.

121. *See What Is WordNet?*, *supra* note 43.

a tool that agencies use when deciding whether or how to promulgate a regulation.[122] Before an agency issues a significant regulatory action, it must assess the anticipated benefits (including economic, health, environmental, and social benefits) and anticipated costs (including administrative, economic, health, environmental, and social costs) of the regulation.[123] Both Congress and the President have increasingly asked for cost-benefit analysis from agencies, and courts have, with increasing consistency, encouraged the initiative.[124] Arguably, cost-benefit analysis is just another tool of statutory interpretation that happens to be designed for agencies: cost-benefit analysis can help an agency determine what is "appropriate and necessary,"[125] what is "reasonably necessary or appropriate,"[126] or what it means for technology to be the "best" or "most advantageous"[127] according to the agency's organic statute. For example, it is estimated that the National Highway Traffic Safety Administration ("NHTSA") regulation on passive restraints (or seatbelts), around the time of its enactment, cost three hundred dollars for every life saved and saved 1,850 lives annually.[128] The Supreme Court determined that, given the data surrounding the costs and benefits of the regulation on seatbelts, NHTSA's rescission of the regulation was "arbitrary and capricious."[129]

One of many potential justifications for using cost-benefit analysis as an interpretive tool is that cost-benefit analysis can help overcome cognitive biases.[130] For example, due to media attention or current events, a particular risk may get overblown attention among the public.[131] Conversely, the public may underestimate or overlook a higher, more problematic risk.[132] Through quantitative and technical evaluation, cost-benefit analysis can help correct the cognitive biases that misestimate certain risks.[133] Similarly, cost-benefit analysis can help prevent emotions or hysteria from entering into interpretation of

122. *See, e.g.*, Robert H. Frank & Cass R. Sunstein, *Cost-Benefit Analysis and Relative Position*, 68 U. CHI. L. REV. 323, 323 (2001).

123. *See* Exec. Order No. 12,866, 58 Fed. Reg. 51735 (Sept. 30, 1993).

124. *See* Frank & Sunstein, *supra* note 122, at 324.

125. *See, e.g.*, Michigan v. EPA, 135 S. Ct. 2699, 2708–09 (2015).

126. *See, e.g.*, Indus. Union Dep't, AFL-CIO v. Am. Petroleum Inst. (*Benzene*), 448 U.S. 607, 642–44 (1980).

127. *See, e.g.*, Entergy Corp. v. Riverkeeper, Inc., 556 U.S. 208, 218 (2009).

128. *See* John F. Morrall III, *A Review of the Record*, 10 REGULATION 25, 30 (1986).

129. *See* Motor Vehicle Mfrs. Ass'n of the U.S., Inc. v. State Farm Mut. Auto. Ins., 463 U.S. 29, 52 (1983).

130. *See* Cass R. Sunstein, *Cognition and Cost-Benefit Analysis*, 29 J. LEGAL STUDS. 1059, 1060 (2000).

131. *See id.* at 1066–67.

132. *See id.*

133. *See id.*

a legal text.[134] Although critics may argue that cost-benefit analysis lacks precision or accuracy,[135] it is still a pragmatic tool to provide additional information to other qualitative assessments.[136]

WordNet and its associated algorithms may also help overcome cognitive biases in legal analysis. For example, a judge's cognitive perception of a word may differ from the general public's perception of the word, and the judge may misapply the word more narrowly or more broadly than other legal practitioners or ordinary people would.[137] Applying the algorithms to the words at issue would ensure greater consistency across the legal field, as a judge would be less likely to manipulate or pervert the level of semantic relatedness between two terms according to his or her subjective preferences. Furthermore, the particular facts and circumstances of a case may cause emotions to distort a judge's application of the law.[138] Using the algorithms would mitigate the effects of emotions on the judge's ruling, as the algorithms provide a more objective view into words' meanings and semantic relatedness.

More broadly, none of the analogous tools discussed in this Section (dictionaries, etymology, the last antecedent rule, and cost-benefit analysis) are intended to apply in isolation from other tools.[139] Similarly, the algorithms should not be the sole deciding factor in cases involving interpretation of legal texts, and judges may choose to rightfully disregard algorithmic outcomes in favor of findings from other textual tools. For example, disregarding algorithms in favor of other interpretational tools may be justified if the algorithm's results are ambiguous, the algorithm leads to absurd results, all other textual

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134. *See id*. at 1071.

135. *See* Lisa Heinzerling, *Regulatory Costs of Mythic Proportions*, 107 YALE L.J. 1981, 1984 (1998).

136. *See* Sunstein, *supra* note 130, at 1077 ("[Cost-benefit analysis] is best taken as pragmatic instrument, agnostic on the deep issues and designed to assist people in making complex judgments where multiple goods are involved.").

137. *See* Lawrence Solan, Terri Rosenblatt & Daniel Osherson, *False Consensus Bias in Contract Interpretation*, 108 COLUM. L. REV. 1268, 1294 (2008) ("[A] judge may consider language to be plain when in fact different people do not understand it the same way, and this may happen even when the judge's understanding is shared only by a minority of people in general.").

138. *See* Laura E. Little, *Adjudication and Emotion*, 3 FLA. COASTAL L.J. 205, 212–15 (2002) (arguing that the emotions envy and jealousy threaten the impartiality and competence of judges). *But see* Terry A. Maroney, *The Persistent Cultural Script of Judicial Dispassion*, 99 CALIF. L. REV. 629, 633 (2011) (arguing that the cultural script lauding judicial dispassion is both unrealistic and detrimental to good judging).

139. *See* Michigan v. EPA, 576 U.S. 743, 754–55 (2015) (deciding that cost is one of multiple relevant factors an agency should consider based on its statute); Muscarello v. United States, 524 U.S. 125, 128–30 (1998) (listing etymology as one source of support among many others, such as modern dictionary definitions and common usages); Kimble, *supra* note 116, at 23 (finding that in the vast majority of cases, the last antecedent rule was used as a supporting reason—not the main reason—for interpreting the statute in a certain way).

tools come out the other way, or legislative history clearly and uniformly points in another direction. Nonetheless, the algorithms can still help inform legal analysis by fulfilling the underlying justifications of other more well-established legal analysis tools: WordNet and its associated algorithms describe obscure semantic nuances, objectively resolve ambiguity, and help overcome cognitive biases. Accordingly, the legal field should incorporate WordNet and the algorithms as additional textual tools in its analysis of legal texts.

III. CASE STUDY: IS HOLDING A PERSON AT GUNPOINT AND DIRECTING THE PERSON NOT TO MOVE "PHYSICALLY RESTRAINING" THE PERSON?

This case study further illustrates how useful computational semantic tools can be in legal analysis. Federal circuits currently split in their interpretation of federal sentencing guidelines in terms of whether pointing a gun at a person qualifies as physically restraining the person. Section III.A provides more details on the circuit split, including how traditional legal tools of interpretation preserve the ambiguity. Section III.B applies WordNet and the algorithms to help resolve the split.

A. Introducing the Circuit Split

Michael Anglin entered a bank in New York, gun in his hands.[140] He ordered two bank tellers to get down on the floor and not to look at him, thrusting the gun in one teller's face for about fifteen seconds.[141] At a bank in South Carolina, Elianer Dimache also pointed a gun at three bank tellers, ordering one to empty her cash drawer and two others to get on the floor and be quiet.[142] Both Anglin and Dimache followed the archetype of an armed bank robbery, as they brandished guns and ordered tellers about.[143] Both Anglin and Dimache were convicted of armed robbery under 18 U.S.C. § 2113.[144] Nonetheless,

140. United States v. Anglin, 169 F.3d 154, 157 (2d Cir. 1999).
141. *Id.*
142. United States v. Dimache, 665 F.3d 603, 604 (4th Cir. 2011).
143. *Id.*; *Anglin*, 169 F.3d at 157.
144. *Dimache*, 665 F.3d at 604; *Anglin*, 169 F.3d at 156.

Anglin and Dimache received disparate treatment under federal sentencing guidelines for roughly the same actions.[145]

In the federal sentencing guideline for robbery, "if any person was physically restrained in order to facilitate commission of the offense or to facilitate escape," the sentence should be increased by two levels.[146] Another guideline for victim-related adjustments contains similar language: "[I]f a victim was physically restrained in the course of an offense, increase by [two] levels."[147] The commentary to the federal sentencing guidelines defines "physically restrained" as "the forcible restraint of the victim such as by being tied, bound, or locked up."[148] Judges are obligated to consider these guidelines as a preliminary benchmark when issuing sentencing orders, but the guidelines are advisory, rather than mandatory, in nature.[149]

The First, Fourth, Sixth, Tenth, and Eleventh Circuits have indicated that brandishing a gun and telling someone not to move qualifies as physically restraining the victim.[150] On the other hand, the Second, Fifth, Seventh, Ninth, and D.C. Circuits have decided that threatening a victim with a gun is not a physical restraint under the guidelines.[151] The Seventh and Ninth Circuits have switched positions over time.[152] The Third and Eighth Circuits apply the enhancement in

145. *Compare Dimache*, 665 F.3d at 604 (affirming the application of a sentencing enhancement), *with Anglin*, 169 F.3d at 156, 163 (vacating a sentence for resentencing on the grounds of misapplication of the sentencing enhancement).

146. U.S. SENT'G GUIDELINES MANUAL § 2B3.1(b)(4)(B) (U.S. SENT'G COMM'N 2018).

147. *Id.* § 3A1.3.

148. *Id.* § 1B1.1 cmt. n.1(L).

149. *See* 18 U.S.C. § 3553(a) (providing factors to be considered in imposing a sentence); Gall v. United States, 552 U.S. 38, 47–50, 56 (2007) (establishing that judges may impose sentences outside of the guidelines as long as it is not an abuse of a discretion); Rita v. United States, 551 U.S. 338, 350 (2007) (stating that courts will vary in their application of the sentencing guidelines); United States v. Booker, 543 U.S. 220, 264–65 (2005) (arguing that Congress wanted to permit sufficient flexibility to permit individualized sentences).

150. United States v. Coleman, 664 F.3d 1047, 1049–51 (6th Cir. 2012); *Dimache*, 665 F.3d at 604–05; United States v. Miera, 539 F.3d 1232, 1233 (10th Cir. 2008); United States v. Wallace, 461 F.3d 15, 33–35 (1st Cir. 2006); United States v. Wilson, 198 F.3d 467, 471–72 (4th Cir. 1999); United States v. Gonzalez, 183 F.3d 1315, 1327 (11th Cir. 1999).

151. United States v. Herman, 930 F.3d 872, 875–76 (7th Cir. 2019); United States v. Parker, 241 F.3d 1114, 1118–19 (9th Cir. 2001); United States v. Drew, 200 F.3d 871, 880 (D.C. Cir. 2000); United States v. Anglin, 169 F.3d 154, 163 (2d Cir. 1999); United States v. Hickman, 151 F.3d 446, 460–62 (5th Cir. 1998).

152. Initially, the Seventh Circuit ruled that the enhancement should apply when the defendant herded tellers into a bathroom with a sawed-off shotgun and violent threats, but the court denied application of the enhancement in all instances of "herding." *See* United States v. Doubet, 969 F.2d 341, 346 (7th Cir. 1992). Later, the court ruled that pointing a gun required "something more," which could include a "sustained focus" of the defendant on the victim. *See* United States v. Carter, 410 F.3d 942, 954 (7th Cir. 2005). Judge Posner affirmed the *Carter* approach as governing. United States v. Taylor, 620 F.3d 812, 815 (7th Cir. 2010). However, the Seventh Circuit took a more definitive approach in the past year to align itself with other circuits

cases where a gun is used to herd or move a victim but not in all cases where a gun is pointed at a victim.[153] In 2012, the U.S. Supreme Court denied a petition for writ of certiorari to review this split.[154]

Notably, these circuit courts often used the same textual tools to arrive at different results. For example, courts rarely employed dictionaries when addressing this problem, but when they did, they met conflicting information.[155] The Sixth Circuit analyzed the meaning of "forcible restraint," noting that *Black's Law Dictionary* provides an illustrative example of holding someone at gunpoint in a robbery.[156] When the Seventh Circuit supported using this enhancement more frequently, it also defined "force" as encompassing "the operation of circumstances that permit no alternative to compliance."[157] The Second Circuit instead focused on defining "physical," indicating that the restraint must be "of the body as opposed to the mind."[158]

All courts agreed that the list of actions contained in the commentary ("being bound, tied, or locked up") was intended to be illustrative rather than exhaustive.[159] Nonetheless, both camps employed the principle *ejusdem generis* to arrive at drastically different results. *Ejusdem generis* stands for the principle that if a legal text provides a list, then unlisted terms should have a similar nature for the provision to apply.[160] Supporters of employing the sentencing enhancement invoked the purpose of binding, tying, or locking someone

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denying the use of the enhancement in this case. *See Herman*, 930 F.3d at 877. The Ninth Circuit originally ruled that no touching is required to employ this enhancement, as evidenced by the inclusion of "locked up" in the commentary. *See* United States v. Thompson, 109 F.3d 639, 641 (9th Cir. 1997). This approach was later affirmed, as threatening a victim with a gun pragmatically restrains the victim's movement. *See* United States v. Nelson, 137 F.3d 1094, 1112 (9th Cir. 1998). The Ninth Circuit then invoked the "sustained focus" standard to distinguish the cases and hold that pointing a gun at the victim and commanding the victim to get down did not qualify for this enhancement. *See Parker*, 241 F.3d at 1118–19 (arguing that the victims must be moved into a different room to constitute sustained focus).

153. *See* United States v. Stevens, 580 F.3d 718, 720–22 (8th Cir. 2009) (stating a key factor in determining physical restraint is if the victim is forced to move at gunpoint); United States v. Greenstein, 322 F. App'x. 259, 265–66 (3d Cir. 2009) (providing that physical restraint encompasses herding victims into a separate room).

154. Coleman v. United States, 566 U.S. 914, 914 (2012).

155. *Cf.* Easterbrook, *supra* note 19, at 534 (positing that deciding which statute or rule governs the issue in the case can make all the difference).

156. United States v. Coleman, 664 F.3d 1047, 1049 (6th Cir. 2012).

157. *Doubet*, 969 F.2d at 347 (quoting THE AMERICAN HERITAGE DICTIONARY OF THE ENGLISH LANGUAGE 513 (10th ed. 1981)).

158. United States v. Anglin, 169 F.3d 154, 164 (2d Cir. 1999) (quoting WEBSTER'S DELUXE UNABRIDGED DICTIONARY 1353 (1979)).

159. *E.g.*, United States v. Wallace, 461 F.3d 15, 33 (1st Cir. 2006); United States v. Parker, 241 F.3d 1114, 1118 (9th Cir. 2001); United States v. Drew, 200 F.3d 871, 880 (D.C. Cir. 2000); United States v. Gonzalez, 183 F.3d 1315, 1327 (11th Cir. 1999); *Anglin*, 169 F.3d at 163; United States v. Hickman, 151 F.3d 446, 461 (5th Cir. 1998).

160. 82 C.J.S. *Statutes* § 438 (2020).

up: restricting movement and forcing compliance.[161] Using a gun can be as effective at restricting someone's movement and forcing compliance as using traditional forms of restraint.[162]

On the other hand, courts leaning against employing the sentencing enhancement claimed the list invokes a requirement of physical contact or barrier with the victims.[163] Moreover, the sentencing enhancement at issue focuses on the actions of the defendant, not the victim; the victim's reaction to move or not to move when faced with a gun should not determine whether the sentencing enhancement applies.[164]

Interestingly, also under *ejusdem generis*, some courts on both sides of the split found a need for the defendant to exert a "sustained focus" on the victim in order for this enhancement to apply.[165] Proponents of employing the enhancement contended that holding someone at gunpoint involves intense, personal interaction between the robber and the victim, even though there may never be any physical contact.[166] The Ninth Circuit posited that pointing or brandishing a gun does not involve such intense interaction.[167]

When examined as a whole, the sentencing guidelines caution against "double counting" the same aggravating or mitigating factors.[168] Under the guidelines for robbery, defendants may also receive sentencing enhancements for the discharge, use, brandishing, or possession of a firearm.[169] Judge Posner of the Seventh Circuit notes

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161. *See Coleman*, 664 F.3d at 1049–50; United States v. Dimache, 665 F.3d 603, 607 (4th Cir. 2011); United States v. Miera, 539 F.3d 1232, 1234 (10th Cir. 2008); *Wallace*, 461 F.3d at 34.

162. *See Coleman*, 664 F.3d at 1050; *Dimache*, 665 F.3d at 605 (quoting the district court, "[T]hat gun is, I think, just as effective, if not more effective, in restraining [the victims] as duct tape or some kind of twine or rope would have been as well."); *Miera*, 539 F.3d at 1235–36.

163. *E.g.*, United States v. Herman, 930 F.3d 872, 875–76 (7th Cir. 2019); *Anglin*, 169 F.3d at 164 ("[I]f § 2B3.1(b)(4)(B) said only that the enhancement would apply 'if any person was restrained,' the courts would become involved in mental, moral, philosophical, even theological considerations, in addition to physical ones. No, the restraint must be 'physical' . . . ."); *Drew*, 200 F.3d at 880.

164. *See Herman*, 930 F.3d at 876.

165. *See* United States v. Carter, 410 F.3d 942, 954 (7th Cir. 2005); United States v. Parker, 241 F.3d 1114, 1118 (9th Cir. 2001).

166. *See Coleman*, 664 F.3d at 1050 (holding the defendant exerted a "sustained focus" on the victim when ordering the victim to move around at gunpoint); *Wallace*, 461 F.3d at 34 (finding that a victim was physically restrained in part due to the defendant's blocking of the victim's path and aiming a gun at the victim's face and chest at close range). *But cf. Miera*, 539 F.3d at 1235–36 (determining that there is no requirement for prolonged individual interaction for this sentencing guideline but finding that it would be met by waving a gun around at the room).

167. *See Parker*, 241 F.3d at 1118–19 (reasoning that Congress must have meant for the enhancement to include something more than brandishing a gun because nearly all armed robberies include such an act).

168. U.S. SENT'G GUIDELINES MANUAL § 1B1.1 cmt. n.4 (U.S. SENT'G COMM'N 2018).

169. *Id.* § 2B3.1(b)(2).

that the enhancement of sentences for both brandishing a firearm and physically restraining a person qualifies as "double counting."[170] The Sixth Circuit rejects this argument, holding that the singular action may have discrete and separate effects that warrant separate enhancements.[171]

Identifying the intention of the U.S. Sentencing Commission in drafting these guidelines is also murky. The Fourth Circuit posits that the enhancement was intended to punish the defendant for depriving a person of his or her ability to move.[172] Other courts note that, if this sentencing enhancement were applied every time a defendant threatened someone with a firearm, every armed robbery would receive this enhancement.[173] They therefore assert that the U.S. Sentencing Commission must have intended the sentencing enhancement to be restricted to more narrow circumstances.[174]

Considered in toto, traditional tools preserve the ambiguity surrounding whether holding a victim at gunpoint and ordering the person to move or not to move qualifies as physically restraining the victim. Many of the tools, particularly *ejusdem generis*, can be employed to achieve opposite results. When interpreting the meaning of the sentencing enhancement, judges should therefore look to linguistics for clarity on the meaning of "restrain." WordNet and the algorithms *path*, *wup*, and *res* help elucidate the plain meaning of the language.

B. Applying Algorithms to the Circuit Split

Employing the computational linguistic tools analyzed in Section I.B helps interpret the legal language and resolve the circuit split. As measured by WordNet and the algorithms *path*, *wup*, and *res*, "gun" and "firearm" are closely related enough to "restraint" to legally permit using the sentence enhancement.[175]

First, it is important to frame the legal question in a measurable way. After all, legal analysis involves the matching of a real-life scenario with the words in a legal text, and the real-life scenario must

170. *See* United States v. Taylor, 620 F.3d 812, 814–15 (7th Cir. 2010).

171. United States v. Fisher, 132 F.3d 1327, 1329 (10th Cir. 1997).

172. United States v. Dimache, 665 F.3d 603, 609 (4th Cir. 2011).

173. *See* United States v. Parker, 241 F.3d 1114, 1118–19 (9th Cir. 2001); United States v. Anglin, 169 F.3d 154, 165 (2d Cir. 1999) ("It would require a quixotic robber to display his gun, and then say to the tellers or bank customers, 'this is a holdup, but feel free to move about the bank, and if any of you have to leave for an appointment elsewhere, that's fine.' "); United States v. Hickman, 151 F.3d 446, 461–62 (5th Cir. 1998).

174. *See Parker*, 241 F.3d at 1118–19; *Anglin*, 169 F.3d at 165.

175. *See infra* Table 4.

therefore be carefully put into words first.[176] In the circuit split, courts asked broadly whether holding a person at gunpoint and ordering the person not to move qualified as physical restraint.[177] For the sake of analysis, it is helpful to have distinct words rather than entire phrases, as entire phrases lead to more difficult quantification and may not be available in WordNet.[178] Accordingly, this analysis answers the question of whether a "gun" or "firearm" can qualify as a "restraint." Admittedly, this does lend itself to some slight semantic differences, as the actions of pointing a gun at a person and any verbal cues given are potentially material to judges' evaluation of the situation and interpretation of the guideline.[179] At the heart of their analyses, however, courts are evaluating whether a gun can be used in place of a rope, twine, or handcuffs (which obviously qualify as restraints) in order to control the victim.[180]

Next, the precise senses used are crucial to the analysis. In WordNet, the term "restraint" has six senses,[181] and the sentencing guideline is ambiguous as to which one it supports.[182] Because this analysis measures ISA relationships, it is most helpful to pick the sense that has the most hyponyms that are similar to what judges would think of as restraints.[183] The sixth sense of "restraint" fits this criterion, as it contains hyponyms such as "band," "chain," "knot," "lock," "gag," and "leash."[184] Therefore, this analysis uses the sixth sense of "restraint." In addition, because the terms "gun" and "firearm" are

176. *Cf.* Solan, *supra* note 31, at 1072 (contending that linguistics is helpful when applying the law to real-life scenarios).

177. *See supra* notes 152–155 and accompanying text.

178. The phrase "hold at gunpoint" is not available on WordNet. [*Hold at gunpoint*], WORDNET, http://wordnetweb.princeton.edu/perl/webwn?s=hold+at+gunpoint&sub=Search+WordNet&o2=&o0=1&o8=1&o1=1&o7=&o5=&o9=&o6=&o3=&o4=&h= (last visited Dec. 15, 2020) [https://perma.cc/3E47-ZRWP].

179. *See* United States v. Coleman, 664 F.3d 1047, 1050 (6th Cir. 2012) (finding that the defendant's verbal orders to walk out of his office rather than remain in place were material to the determination of whether the defendant restrained the victim).

180. *See* United States v. Dimache, 665 F.3d 603, 605 (4th Cir. 2011) (quoting the district court comparing the gun used to a rope or piece of twine).

181. In WordNet, "restraint" can mean: (1) "the act of controlling by restraining someone or something," (2) "discipline in personal and social activities," (3) "the state of being physically constrained," (4) "a rule or condition that limits freedom," (5) "lack of ornamentation," or (6) "a device that retards something's motion." [*Restraint*], WORDNET, http://wordnetweb.princeton.edu/perl/webwn?s=restraint&sub=Search+WordNet&o2=&o0=1&o8=1&o1=1&o7=&o5=&o9=&o6=&o3=&o4=&h= (last visited Dec. 15, 2020) [https://perma.cc/Y5LG-PMW3].

182. *See* U.S. SENT'G GUIDELINES MANUAL § 1B1.1 cmt. n.1(L) (U.S. SENT'G COMM'N 2018) (" 'Physically restrained' means the forcible restraint of the victim such as by being tied, bound up, or locked up.").

183. *See supra* notes 53–55 and accompanying text.

184. [*Restraint*], WORDNET, *supra* note 181.

interchangeable to this analysis, both "gun" and "firearm" will be analyzed.

Table 2 illustrates the results of employing linguistic algorithms *path* (measuring pure distance), *wup* (considering taxonomic depth), and *res* (accounting for information content) between "gun" and "restraint" and between "firearm" and "restraint." The LCS for both sets of senses was "device."[185] It took six nodes to travel between "firearm" and "restraint," and five nodes to travel between "gun" and "restraint," leading to an average *path* value of 0.19. Considering that "device," "firearm," and "restraint" are all relatively deep into the taxonomy, employing *wup* yielded a relatively high fraction of 0.78. Similarly, "device," "firearm," and "restraint" all have very few hyponyms and therefore high information content relative to the size of the WordNet taxonomy, yielding a *res* value of 4.37.

TABLE 2

	"Firearm"—"Restraint"[186]	"Gun"—"Restraint"[187]	Average
path	0.17	0.20	0.19
wup	0.76	0.80	0.78
res	4.37	4.37	4.37

Additionally, it is useful to have a null variable to compare to "gun" and "firearm," in the same way that "button" provided relative context for "nickel" in Section I.B. It is undisputed that a defendant who used handcuffs to restrain his or her victim would qualify for this sentence enhancement.[188] Similarly, the Fourth Circuit conjectured that the defendant could have used rope and twine interchangeably with a gun.[189] Therefore, to encompass a wide range of other potential "restraints," this analysis employs "handcuff," "rope," and "twine" as null variables. The results are shown in Table 3.

185. *See* [*Firearm#n#1*, *Restraint#n#6*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=firearm%23n%231&s2=&w2=restraint%23n%236 (last visited Dec. 15, 2020) [https://perma.cc/WHW3-6CYR]; [*Gun#n#1*, *Restraint#n#6*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=gun%23n%231&s2=&w2=restraint%23n%236, (last visited Dec. 15, 2020) [https://perma.cc/E8HG-VH7E].

186. [*Firearm#n#1*, *Restraint#n#6*], *supra* note 185.

187. [*Gun#n#1*, *Restraint#n#6*], *supra* note 185.

188. *See, e.g.*, United States v. Shamah, 624 F.3d 449, 457–59 (7th Cir. 2010) (holding that a police officer who used his handcuffs while robbing drug dealers was subject to the physical restraint enhancement); United States v. Latimer, No. 93-5672, 1995 U.S. App. LEXIS 1013, at *6 (4th Cir. Jan. 19, 1995) (reasoning that while a handcuffed bank manager could still move within the bank, the handcuffs still controlled his movement).

189. United States v. Dimache, 665 F.3d 603, 605 (4th Cir. 2011).

TABLE 3

	"Handcuff"—"Restraint"[190]	"Rope"—"Restraint"[191]	"Twine"—"Restraint"[192]
path	0.33	0.17	0.14
wup	0.90	0.71	0.67
res	7.55	2.49	2.49

The LCS between "handcuff" and "restraint" was "restraint" because "handcuff" is a hyponym of "shackle," which is a hyponym of "restraint."[193] Therefore, employing *path* required a distance of only three nodes, yielding a high value of 0.33.[194] Because "restraint" and "handcuff" are relatively deep within the taxonomy, there is a high *wup* value of 0.9.[195] Additionally, because "handcuff" and "restraint" both have relatively few hyponyms, the two terms have high information contents, yielding a *res* value of 7.55.[196]

In contrast, (rope, restraint) and (twine, restraint) are less semantically related. The LCS for both sets of terms was "artifact," which required traveling through six or seven nodes—twice as many as for "handcuff."[197] Because "artifact" is relatively shallow in the taxonomy and holds a lot of information content, the *wup* and *res* values were both lower.[198]

This leads to the conclusion that "firearm/gun" is within the legally permissible range of semantic relatedness to "restraint" to apply the sentence enhancement. Although not as closely semantically related to "restraint" as "handcuff" is, "firearm" and "gun" are more closely related to "restraint" than "rope" or "twine." All three algorithms measuring blunt distance between nodes, taxonomic depth, and

190. [*Handcuff#n#1*, *Restraint#n#6*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=handcuff%23n%231&s2=&w2=restraint%23n%236 (last visited Dec. 15, 2020) [https://perma.cc/PH7U-SD9Y].

191. [*Rope#n#1*, *Restraint#n#6*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=rope%23n%231&s2=&w2=restraint%23n%236 (last visited Dec. 15, 2020) [https://perma.cc/9NJW-395Y].

192. [*Twine#n#1*, *Restraint#n#6*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=twine%23n%231&s2=&w2=restraint%23n%236 (last visited Dec. 15, 2020) [https://perma.cc/UNQ8-AE39].

193. [*Handcuff#n#1*, *Restraint#n#6*], WS4J DEMO, *supra* note 190.

194. *Id.*

195. *Id.*

196. *Id.*

197. [*Rope#n#1*, *Restraint#n#6*], WS4J DEMO, *supra* note 191; [*Twine#n#1*, *Restraint#n#6*], WS4J DEMO, *supra* note 192.

198. [*Rope#n#1*, *Restraint#n#6*], WS4J DEMO, *supra* note 191; [*Twine#n#1*, *Restraint#n#6*], WS4J DEMO, *supra* note 192.

information content indicate that if "rope" is closely semantically related to "restraint," then "firearm" and "gun" should be considered closely semantically related, as well.

TABLE 4

	"Handcuff"—"Restraint"[199]	**"Firearm/Gun"—"Restraint"[200]**	"Rope"—"Restraint"[201]	"Twine"—"Restraint"[202]
path	0.33	**0.19**	0.17	0.14
wup	0.90	**0.78**	0.71	0.67
res	7.55	**4.37**	2.49	2.49

Employing algorithms to resolve this legal question in the sentencing guidelines helps shed light on the plain meaning of the guideline. The algorithms reveal semantic nuances between the terms that are otherwise obscure and difficult to quantify. Unlike other interpretive tools, the algorithms resolve the ambiguity decisively—they cannot easily be twisted or contorted to reach opposite results. Additionally, WordNet and the algorithms can help overcome cognitive biases and increase consistency across courts. Whether a defendant is particularly sympathetic or unsympathetic is irrelevant to the application of this specific guideline.

This is not to say that WordNet and the associated algorithms should be used in isolation from other interpretive tools. For example, a judge may put increased value into the presumption against double counting, as courts and legislatures increasingly grapple with the problem of mass incarceration. But when the goals of legal analysis are objectivity, clarity, and consistency, the algorithms discussed above decisively resolve the circuit split in favor of applying the sentencing enhancement.

IV. CASE STUDY: IS DEATH BY AUTOEROTIC ASPHYXIATION "ACCIDENTAL" OR AN "INTENTIONAL, SELF-INFLICTED INJURY"?

The usefulness of computational linguistic tools is not confined to criminal cases.[203] Section IV.A introduces a circuit split regarding

199. [*Handcuff#n#1*, *Restraint#n#6*], WS4J DEMO, *supra* note 190.

200. *See supra* Table 2 (calculating the average of the linguistic algorithms as between "gun" and "restraint" and between "firearm" and "restraint").

201. [*Rope#n#1*, *Restraint#n#6*], WS4J DEMO, *supra* note 191.

202. [*Twine#n#1*, *Restraint#n#6*], WS4J DEMO, *supra* note 192.

203. *But see* Rasmussen, *supra* note 32, at 1055.

interpretation of policy exceptions under the Employment Retirement Income Security Act ("ERISA"). Section IV.B then applies the algorithms to the circuit split to further illustrate the semantic nuances of the words at issue and the potential utility of WordNet and the algorithms.

A. Introducing the Circuit Split

Under ERISA, a fiduciary has the duty to discharge a benefits plan in the interest of the participants and beneficiaries and in accordance with the documents and instruments governing the plan.[204] Plans may contain exceptions, conditions, and exemptions; for example, many life insurance policies pay premiums for "accidental" deaths, but deaths caused by "intentionally self-inflicted injury" do not qualify as "accidental."[205] ERISA grants beneficiaries the right to bring suits to enforce their plans in federal courts,[206] and courts typically interpret plans based on federal common law.[207] Federal common law currently dictates that courts interpret plans according to their plain meaning from the perspective of a reasonable layperson.[208]

Federal circuits diverge as to whether the exception for deaths caused by "self-inflicted injury" applies to deaths caused by autoerotic asphyxiation.[209] Autoerotic asphyxiation is "the practice of limiting the flow of oxygen to the brain during masturbation in an attempt to heighten sexual pleasure."[210] The Seventh and Eighth Circuits have indicated that autoerotic asphyxiation qualifies as a "self-inflicted injury," thereby blocking beneficiaries of the decedents from receiving benefits under some accidental-death plans.[211] On the other hand, the Second and Ninth Circuits have indicated that autoerotic asphyxiation is not a "self-inflicted injury," thus interpreting the plans in favor of the

204. 29 U.S.C. § 1104(a)(1)(D).

205. *See* Tran v. Minn. Life Ins., 922 F.3d 380, 382 (7th Cir. 2019).

206. 29 U.S.C. § 1132(a)(3).

207. *See* Pilot Life Ins. v. Dedeaux, 481 U.S. 41, 55–56 (1987) (describing how ERISA's civil enforcement provision was based on the exclusive remedy provision of the Labor Management Relations Act, which provision the Supreme Court held had preemptive force that entirely displaced any state cause of action).

208. *E.g.*, *Tran*, 922 F.3d at 382; Padfield v. AIG Life Ins., 290 F.3d 1121, 1125 (9th Cir. 2002).

209. *See Tran*, 922 F.3d at 386 (autoerotic asphyxiation was a self-inflicted injury); Critchlow v. First UNUM Life Ins. Co. of Am., 378 F.3d 246, 260, 264 (2d Cir. 2004) (autoerotic asphyxiation was not a self-inflicted injury); *Padfield*, 290 F.3d at 1127, 1129 (autoerotic asphyxiation was not a self-inflicted injury); Todd v. AIG Life Ins., 47 F.3d 1448, 1456 (5th Cir. 1995) (autoerotic asphyxiation was not a self-inflicted injury); Sigler v. Mut. Benefit Life Ins., 663 F.2d 49, 49–50 (8th Cir. 1981) (autoerotic asphyxiation was a self-inflicted injury).

210. *Todd*, 47 F.3d at 1450.

211. *See Tran*, 922 F.3d at 386; *Sigler*, 663 F.2d at 49–50.

beneficiaries.[212] Judges on the Ninth, Seventh, and Second Circuits have issued dissenting opinions.[213] The Supreme Court denied review of the split in 2002.[214] While the Fifth Circuit has not ruled on whether autoerotic asphyxiation is a "self-inflicted injury," it has indicated that deaths caused by autoerotic asphyxiation are "accidental."[215] Even though not all federal circuits have directly ruled on this issue, the split permeates federal district courts and state courts, as well.[216] Although the question of a death being "accidental" and the question of a death being caused by "self-inflicted injury" are not mutually exclusive,[217] courts tend to find that when a death is truly accidental, it is not caused by self-inflicted injury.[218]

When deciding whether the exclusion applies, judges look to define a "self-inflicted injury." If the term is defined in a plan, the judges will use the definition provided.[219] For example, in one of its ERISA plans, AIG Life Insurance Company defined "injury" as "bodily injury caused by an accident occurring while this policy is in force as to the Insured Person and resulting directly and independently of all other causes in loss covered by this policy."[220] When the term is undefined or the definition leaves the ambiguity intact, courts aim to interpret the term from the perspective of a reasonable layperson.[221] Courts may then use dictionaries in their analysis.[222] The dissenting judge in the Ninth Circuit further applied elemental analysis to the "plain meaning" of the plan and ruled that an "intentionally self-inflicted injury" has three elements: (1) the act is upon oneself, (2) the act is done with an intent

212. *See Critchlow*, 378 F.3d at 260, 264; *Padfield*, 290 F.3d at 1127, 1129.

213. *Tran*, 922 F.3d at 386 (Bauer, J., dissenting); *Critchlow*, 378 F.3d at 265 (Van Graafeiland, J., dissenting); *Padfield*, 290 F.3d at 1130 (Leavy, J., concurring in part and dissenting in part).

214. AIG Life Ins. v. Padfield, 537 U.S. 1067, 1067 (2002).

215. *See Todd*, 47 F.3d at 1452, 1459 (noting that the plan at-issue included no general exclusion for self-inflicted injury).

216. *Compare* Hamilton v. AIG Life Ins., 182 F. Supp. 2d 39, 49 (D.D.C. 2002) (holding that autoerotic asphyxiation is an injury), *with* Bennett v. Am. Int'l Life Assurance Co., 956 F. Supp. 201, 212–13 (N.D.N.Y. 1997) (positing that death by autoerotic asphyxiation may be accidental); *compare also* Conn. Gen. Life Ins. v. Tommie, 619 S.W.2d 199, 203 (Tex. App. 1981) (finding under Texas law that autoerotic asphyxiation did not constitute self-inflicted injury), *with* Sims v. Monumental Gen. Ins., 960 F.2d 478, 480 (5th Cir. 1992) (holding under Louisiana law that autoerotic asphyxiation did constitute a self-inflicted injury).

217. *See* Fawcett v. Metro. Life Ins., No. C-3-97-540, 2000 U.S. Dist. LEXIS 10061, at *20 (S.D. Ohio June 28, 2000).

218. *See Critchlow*, 378 F.3d at 260, 264; *Padfield*, 290 F.3d at 1127, 1129.

219. *See Todd*, 47 F.3d at 1452.

220. *Id.*

221. *See Tran*, 922 F.3d at 384.

222. *See Todd*, 47 F.3d at 1452.

to injure, and (3) an injury occurs.[223] Determining that the decedent intended to asphyxiate himself and death did result, the judge found application of the exclusion appropriate.[224]

According to federal common law in ERISA litigation, whether an act qualifies as "intentional, self-inflicted injury" or "accidental" can turn on the following test: (1) whether the decedent had the subjective intent and expectation to survive uninjured, and (2) whether that expectation was objectively reasonable.[225] Most courts acknowledge that the decedents had the subjective intention to survive and were not suicidal.[226] Courts differ, however, on how "reasonable" the expectation of lack of injury is. For example, the Seventh Circuit emphasized that even if the asphyxiation were not supposed to be lethal, a reasonable person would think that being partially choked was an injury.[227] In contrast, the Second and Ninth Circuits held that the decedents' expectations of a lack of injury were reasonable, especially given that the decedents in those cases had previous experience with autoerotic asphyxiation.[228]

Indeed, data on the dangers and prevalence of autoerotic asphyxiation can support either expectation. On the one hand, autoerotic asphyxiation is so "widely practiced" that it has "permeated popular culture and has become a commonplace punchline."[229] Engaging in autoerotic asphyxiation usually has a nonfatal outcome.[230] On the other hand, autoerotic asphyxiation causes approximately one to two deaths per million people per year, meaning that the annual death toll for U.S. citizens dying from autoerotic asphyxiation numbers in the hundreds.[231]

Further analyzing the nature of the act also yields mixed analysis. For example, the Second and Ninth Circuits separate the act of autoerotic asphyxiation from death by noting that engaging in a risky activity is not ipso facto injurious.[232] By contrast, the Seventh Circuit

223. Padfield v. AIG Life Ins., 290 F.3d 1121, 1130 (9th Cir. 2002) (Leavy, J., concurring in part and dissenting in part).

224. *Id.* at 1131.

225. *See Tran*, 922 F.3d at 385; Critchlow v. First UNUM Life Ins. Co. of Am., 378 F.3d 246, 257–58 (2d Cir. 2004); *Padfield*, 290 F.3d at 1129.

226. *See Tran*, 922 F.3d at 388 (Bauer, J., dissenting); *Padfield*, 290 F.3d at 1126–27.

227. *Tran*, 922 F.3d at 384.

228. *Critchlow*, 378 F.3d at 260; *Padfield*, 290 F.3d at 1130.

229. *Tran*, 922 F.3d at 388 (Bauer, J., dissenting).

230. *See Padfield*, 290 F.3d at 1125–26.

231. *Id.* at 1125 (citing Bennett v. Am. Int'l Life Assurance Co. of N.Y., 956 F. Supp. 201, 204 (N.D.N.Y. 1997)).

232. *See Critchlow*, 378 F.3d at 260 (holding that ruling otherwise "tends to merge the concepts of intent and result"); *Padfield*, 290 F.3d at 1129 ("[V]oluntary risky acts resulting in injury are not necessarily acts that result in 'intentionally self-inflicted injury.' ").

highlights the continuity of the act and points out that there is no intervening cause between the decedent's autoerotic asphyxiation and his death.[233]

Courts' standards of review of ERISA plans weigh in the disputed beneficiaries' favor. In cases of ambiguity, courts tend to find in favor of the insured.[234] In some jurisdictions, the insurer has the burden of proving that an exclusion to benefits applies, and courts read such exclusions narrowly.[235]

In summary, courts can use the same traditional tools to support opposing conclusions as to whether autoerotic asphyxiation may qualify as an "accidental" death or as a death caused by "self-inflicted injury." Traditional definitions, subjective versus objective reasoning, data, and causation analysis yield conflicting results. Especially given that courts must interpret plain language as a common layperson would,[236] linguistic tools can offer strong support in resolving the circuit split.[237]

B. Applying Algorithms to the Circuit Split

Applying the algorithms resolves the circuit split in favor of qualifying autoerotic asphyxiation as a "self-inflicted injury." After determining the appropriate test terms, linguistic analysis shows that "asphyxiation" is more related to "injury" than it is to "accident."[238] This follows the pattern of the well-established injury of "cuts" and deviates from a traditional "accident," such as a car crash.[239] WordNet and its associated algorithms therefore once again illuminate the semantic nuances of the different terms.

Unfortunately, the current configuration of WordNet does not permit the comparison of adjectives.[240] Therefore, it is technologically infeasible to use the computational semantic tools to analyze whether *autoerotic* asphyxiation constitutes an *intentional, self-inflicted* injury.[241] Notwithstanding this limitation, initial linguistic analysis shows that the inability to quantify adjectives does not preclude

233. *See Tran*, 922 F.3d at 384.

234. *See id.* at 382; Todd v. AIG Life Ins., 47 F.3d 1448, 1452–53 (5th Cir. 1995).

235. *See Critchlow*, 378 F.3d at 256 (asserting that ambiguous terms should be construed against the insurer particularly when the ambiguity is found in an exclusionary clause).

236. *See Tran*, 922 F.3d at 382; *Padfield*, 290 F.3d at 1125.

237. *See infra* Section IV.B.

238. *See infra* Table 5.

239. *See infra* Tables 6 and 7.

240. *See* [*Intentional#a#1*, *Autoerotic#a#1*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=intentional%23a%231&s2=&w2=autoerotic%23a%231 (last visited Dec. 15, 2020) [https://perma.cc/T6PJ-PAS8] (showing a pair of adjectives is unsupported by the program).

241. *Id.*

application of the algorithms to this circuit split. The prefix "auto" in "autoerotic" is a reflexive, meaning it describes an act someone does to himself or herself.[242] Therefore, "auto" is synonymous with "self-inflicted."[243] Similarly, in this context, the fact that an act was "erotic" means that it was also largely intentional; the decedents in these cases intended to restrict their airflow to increase their sexual gratification.[244]

Consequently, the remaining question is whether "asphyxiation" may constitute an "injury," or whether it is more like an "accident." As discussed above, these terms are not mutually exclusive,[245] but when courts find an act to be accidental, it is usually not a self-inflicted injury.[246] As discussed in Section III.B, choosing the senses of words to use in analysis can affect the outcome. This analysis uses the most common sense of asphyxiation—"the condition of being deprived of oxygen"—because the only other sense of the word prejudged that the act would end in death.[247] Similarly, this analysis employs the first sense of "injury" as meaning "any physical damage to the body" because latter senses had fewer hyponyms and distinct connotations.[248] In addition, the first sense of "accident" is more pertinent to this analysis because it has the connotation of misfortune rather than good luck.[249] Applying the algorithms yields the results illustrated in Table 5.

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242. *See Aut-*, MERRIAM-WEBSTER, https://www.merriam-webster.com/dictionary/aut- (last visited Dec. 15, 2020) [https://perma.cc/2J8K-NG9S].

243. "Self-inflicted" is defined as "inflicted or caused by oneself." *Self-inflicted*, MERRIAM-WEBSTER, https://www.merriam-webster.com/dictionary/self-inflicted (last visited Dec. 15, 2020) [https://perma.cc/XTV4-6P4V].

244. *See* Tran v. Minn. Life Ins., 922 F.3d 380, 386 (7th Cir. 2019).

245. *See* Fawcett v. Metro. Life Ins., No. C-3-97-540, 2000 U.S. Dist. LEXIS 10061, at *20 (S.D. Ohio June 28, 2000).

246. *See* Critchlow v. First UNUM Life Ins. Co. of Am., 378 F.3d 246, 260, 264 (2d Cir. 2004) (determining that decedent's death was accidental and was not a self-inflicted injury); Padfield v. AIG Life Ins., 290 F.3d 1121, 1127, 1129 (9th Cir. 2002) (indicating that voluntary acts that result in injury are not necessarily self-inflicted).

247. The other sense of "asphyxiation" was "killing by depriving of oxygen." [*Asphyxiation*], WORDNET, http://wordnetweb.princeton.edu/perl/webwn?s=asphyxiation&sub=Search+WordNet&o2=&o0=1&o8=1&o1=1&o7=&o5=&o9=&o6=&o3=&o4=&h=00000 (last visited Dec. 15, 2020) [https://perma.cc/UGS2-T4JX].

248. The second sense of "injury" had a connotation of "accident"; other senses involved combat, physical damage, or legal injuries. [*Injury*], WORDNET, http://wordnetweb.princeton.edu/perl/webwn?s=injury&sub=Search+WordNet&o2=&o0=1&o8=1&o1=1&o7=&o5=&o9=&o6=&o3=&o4=&h=00 (last visited Dec. 15, 2020) [https://perma.cc/TEK5-ZM8J].

249. [*Accident*], WORDNET, http://wordnetweb.princeton.edu/perl/webwn?s=accident&sub=Search+WordNet&o2=&o0=1&o8=1&o1=1&o7=&o5=&o9=&o6=&o3=&o4=&h= (last visited Dec. 15, 2020) [https://perma.cc/FFD6-628Y].

TABLE 5

	"Asphyxiation"—"Injury"[250]	"Asphyxiation"—"Accident"[251]
path	0.14	0.07
wup	0.70	0.30
res	5.62	0.78

This analysis reveals that "asphyxiation" is much more closely related to "injury" than it is to "accident." Traveling from "asphyxiation" to "injury" only required a distance of seven nodes under *path*;[252] the distance between "asphyxiation" and "accident" was fifteen nodes.[253] While "asphyxiation" and "injury" shared the LCS "physical condition,"[254] the terms "asphyxiation" and "accident" shared the LCS "abstraction."[255] Although "injury" and "accident" have the same taxonomic depth, the fact that "physical condition" is much deeper in the taxonomy than "abstraction" lends a much higher *wup* score to (asphyxiation, injury).[256] Similarly, "physical condition" has a much higher information content than "abstraction," leading to a higher *res* score for (asphyxiation, injury).[257]

Analyzing null variables for comparison confirms this analysis. The Seventh Circuit decision points out that cutting oneself and then dying from the wounds would uncontroversially qualify as a self-inflicted injury.[258] Table 6 confirms that a "cut"[259] is more like an "injury" than an "accident"—similar to how "asphyxiation" is closer to "injury" than it is to "accident."

250. [*Asphyxiation#n#1*, *Injury#n#1*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=asphyxiation%23n%231&s2=&w2=injury%23n%231 (last visited Dec. 15, 2020) [https://perma.cc/49LM-3VYG].

251. [*Asphyxiation#n#1*, *Accident#n#1*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=asphyxiation%23n%231&s2=&w2=accident%23n%231 (last visited Dec. 15, 2020) [https://perma.cc/6R5M-BQ3A].

252. [*Asphyxiation#n#1*, *Injury#n#1*], WS4J DEMO, *supra* note 250.

253. [*Asphyxiation#n#1*, *Accident#n#1*], WS4J DEMO, *supra* note 251.

254. [*Asphyxiation#n#1*, *Injury#n#1*], WS4J DEMO, *supra* note 250.

255. [*Asphyxiation#n#1*, *Accident#n#1*], WS4J DEMO, *supra* note 251.

256. Both terms have a taxonomic depth of ten nodes. [*Asphyxiation#n#1*, *Injury#n#1*], WS4J DEMO, *supra* note 250; [*Asphyxiation#n#1*, *Accident#n#1*], WS4J DEMO, *supra* note 251.

257. [*Asphyxiation#n#1*, *Injury#n#1*], WS4J DEMO, *supra* note 250; [*Asphyxiation#n#1*, *Accident#n#1*], WS4J DEMO, *supra* note 251.

258. Tran v. Minn. Life Ins., 922 F.3d 380, 384–85 (7th Cir. 2019).

259. This experiment uses the fifth sense of the noun "cut," meaning "a wound made by cutting." [*Cut*], WORDNET, http://wordnetweb.princeton.edu/perl/webwn?s=cut&sub=Search+WordNet&o2=&o0=1&o8=1&o1=1&o7=&o5=&o9=&o6=&o3=&o4=&h=000000000000000000 (last visited Dec. 15, 2020) [https://perma.cc/XB49-KNBJ].

TABLE 6

	"Cut"—"Injury"[260]	"Cut"—"Accident"[261]
path	0.33	0.06
wup	0.91	0.27
res	7.72	0.78

In addition, the website of one life insurance provider, AIG, indicates that many events may qualify as accidental deaths under their plan, including crashes on trains, buses, planes, or boats.[262] As illustrated by Table 7, the term "crash"[263] is semantically much closer to "accident" than to "injury"—yielding the opposite outcome as both "asphyxiation" and "cut."

TABLE 7

	"Crash"—"Injury"[264]	"Crash"—"Accident"[265]
path	0.06	0.50
wup	0.28	0.95
res	0.78	8.77

In conclusion, the data from WordNet and its associated algorithms show that deaths caused by autoerotic asphyxiation should semantically qualify as self-inflicted injuries rather than accidents. This data reveals more information about the plain meaning of the terms in an insurance plan, lending credence to the admission of the

260. [*Cut#n#5*, *Injury#n#1*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=cut%23n%235&s2=&w2=injury%23n%231 (last visited Dec. 15, 2020) [https://perma.cc/X596-AA46].

261. [*Cut#n#5*, *Accident#n#1*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=cut%23n%235&s2=&w2=accident%23n%231 (last visited Dec. 15, 2020) [https://perma.cc/GE35-EAH5].

262. *Accidental Death Insurance (AD&D Insurance)*, AIG DIRECT, https://www.aigdirect.com/life-insurance-products/accidental-death-insurance (last visited Dec. 15, 2020) [https://perma.cc/29AM-DCYN].

263. For this experiment, I used the second nominal sense of "crash," meaning "a serious accident (usually involving one or more vehicles)." [*Crash*], WORDNET, http://wordnetweb.princeton.edu/perl/webwn?s=crash&sub=Search+WordNet&o2=&o0=1&o8=1&o1=1&o7=&o5=&o9=&o6=&o3=&o4=&h=00000000000000000000000000000000000000000000000000000000000000000000000000000000000000 (last visited Dec. 15, 2020) [https://perma.cc/JK43-PLBE].

264. [*Crash#n#2*, *Injury#n#1*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=crash%23n%232&s2=&w2=injury%23n%231 (last visited Dec. 15, 2020) [https://perma.cc/LDQ4-GSGT].

265. [*Crash#n#2*, *Accident#n#1*], WS4J DEMO, http://ws4jdemo.appspot.com/?mode=w&s1=&w1=crash%23n%232&s2=&w2=accident%23n%231 (last visited Dec. 15, 2020) [https://perma.cc/3SHV-QVB5].

algorithms as textual tools.[266] As with the previous case study, judges may give special analytical weight to contextual considerations that tend to tip the scale in favor of the decedents. Nonetheless, the algorithms aid in uncovering and quantifying the semantic nuances present in ambiguous insurance plans, deciding cases involving autoerotic asphyxiation consistently across circuits, and overcoming potential cognitive biases in cases where the decedent may be particularly sympathetic or the cause of death especially taboo.[267]

CONCLUSION

The law is a profession of words, and lawyers are wordsmiths by trade. The common usage of textual tools to analyze legal authorities illustrates the importance of linguistic analysis to the law. Linguistics, particularly the fields of computational linguistics and semantics, can help shed light on the plain meaning of words. And yet, computational linguistic tools have so far been largely overlooked by the legal field. This Note seeks to correct this oversight by showing that computational semantic tools (WordNet and the algorithms *path*, *wup*, and *res*) are approachable, easy to use, helpful, and accurate. The tools uncover semantic nuances in words and objectively resolve difficult legal questions, blind to potential cognitive biases and context. For example, employing the linguistic tools to current circuit splits showed that firearms and guns could be used to physically restrain a person and that autoerotic asphyxiation was more strongly associated with injuries than with accidents. Although this Note limited the algorithms' use to resolving two circuit splits, the possibilities for the algorithms' further potential benefits in answering legal questions are endless.

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266. *See supra* Part I.

267. *See supra* Part II.

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