The Algorithm as a Human Artifact: Implications for Legal {Re}Search

Susan Nevelow Mart*

DRAFT – DO NOT CITE WITHOUT AUTHOR'S WRITTEN PERMISSION

An algorithm must be seen to be believed.[1]

Research …is not a method, it is not an object, it is a behavior….Research is the systematic indulgence of one's curiosity.[2]

"Legal research" is not merely a search for information; it is primarily a struggle for understanding. [3]

Abstract

The results of using the search algorithms in Westlaw, Lexis Advance, Fastcase, Google Scholar, Ravel and Casetext are compared. Six groups of humans created six different algorithms, and the results are a testament to the variability of human problem-solving. That variability has implications both for researching and teaching research.

TABLE OF CONTENTS

* *Associate Professor and Director of the Law Library, University of Colorado Law School, Boulder, Colorado. The author would like to thank her research assistants, Molly Hogan, James M. Murray, Erica N. Rogers, Andrea M. Short, Jordan Underhill, and Andi M. Wilt, and William A. Wise Law Library Fellow Scott Uhl. Special thanks must be given to Professor Jani S. Morrissey Little, of the University of Colorado – Boulder's Institute of Behavioral Sciences, whose help with data sets and SPSS made this work possible. I am grateful for the support of the University of Colorado Law School's Works-in-Progress Program, and especially to Harry Surden, Alexia Brunet-Marks, Sharon Jacobs, and Pierre Schlag for their thoughtful review and helpful comments on a draft of this paper. Thanks also to the participants of the Eighth Annual Boulder Conference on Legal Information: Scholarship and Teaching, in Chicago, IL for their invaluable feedback on a draft of this paper

[1] DONALD E. KNUTH, THE ART OF COMPUTER PROGRAMMING, VOLUME 1: FUNDAMENTAL ALGORITHMS 4 (3rd ed. 1997).

[2] Felix Frankfurter, Karl N. Llewellyn & Edson R. Sunderland, *The Conditions for and the Aims and Methods of Legal Research,* 6. AM. L. SCH. REV. 663, 664 (1930).

[3] Michael J. Lynch, *An Impossible Task but Everybody Has to Do It—Teaching Legal Research in Law Schools*, 89 LAW LIBR. J. 415 (1997).

I. Introduction

In the 21st century world of legal resources, finding the right information and turning that information into knowledge that can be used to solve a legal problem or advise a client requires confronting technology as a partner in the research enterprise. Having a relationship with a partner always requires an investment of time and energy, and partnering with technology is no different. Researchers need to acquire some expertise about the technology at the meta-level. If you are searching online, as all legal researchers do, you need to remember that an algorithm is being used to return your results, and that, as a Westlaw engineer once wrote me, "all of our algorithms are created by humans."[4] Those human creators made choices about how the algorithm would work that have implications for the search results returned to the researcher.

[4] Email from Mike Dahn, Senior Vice-President Product Development, Thomson Reuters, Legal, to author (Oct. 1, 2012, at 18:17 MST) (on file with the author). The advent of algorithms coding algorithms is not an impossibility, and some sort of oversight beyond "algorithmic accountability" may be necessary. *See*, e.g., Anupam Datta, Shayak Sen & Yair Zick, *Algorithmic Transparency via Quantitative Input Influence: Theory and Experiments with Learning Systems*, 2016 IEEE SYMP. ON SECURITY AND PRIVACY 598.

Those choices become the biases[5] and assumptions that are built into systems. If the search entered into a legal database has five terms[6], and only four terms appear, how will the algorithm treat the search? If the algorithm is strict, it will only return results with exactly those five terms. But the algorithm can be adjusted so that results with four of the terms will appear in the results set. The algorithm is set to determine how close those words have to be to each other to be returned in the top results. The programming team decides which of the search terms entered are automatically stemmed[7], and which are not. Only the team knows which legal phrases are recognized by the algorithm without quotation marks around the phrase, and how many pre-existing legal phrases are added to the search without user input. The researcher does not have access to the list of synonyms that are added automatically to the search, and which are not. The scope of any machine learning is not known to the researcher. Once these decisions have been made, searches are automatically executed; any bias is encoded into the system.[8] For an example of how coding choices affects results, the effect when a technician working for Amazon changed the value of the metatag "adult" from "false" to "true" is illustrative;[9] the

[5] "Bias" is not used in this paper in the usual pejorative sense. It is used to indicate a preference in a computer system. For a detailed analysis of bias in computer systems, *see* Batya Friedman & Helen Nissenbaum, *Bias in Computer Systems*, 14 ACM TRANSACTIONS ON INFO. SYSTEMS 330 (1996), discussed *infra* at XX.

[6] "Term" is used throughout this article in its function in the research process, as a word used to query a database or search engine to retrieve relevant information. *See* JOAN M. REITZ, DICTIONARY FOR LIBRARY AND INFORMATION SCIENCE 641, 712 (2004).

[7] To "stem" is to take the root of a word. *Id.* at 683. In information retrieval there are many methods of using algorithms to stem words in an index and the look for the variants. *See* Anjali Ganesh Jivani, *A Comparative Study of Stemming Algorithms*, 2 INT. J. COMPUT. TECH. & APPLICATIONS 1930 (2011).

[8] Lisa Shay et al., *Do Robots Dream of Electric Laws? An Experiment in Law as Algorithm* 7 (We Robot: Getting Down to Business, Stan. Univ., April 8, 2013), http://conferences.law.stanford.edu/werobot/wp-content/uploads/sites/29/2013/04/Shay-et-al_Lisa.pdf [https://web.archive.org/web/20150324193925/http://conferences.law.stanford.edu/werobot/wp-content/uploads/sites/29/2013/04/Shay-et-al_Lisa.pdf]. Bias is used in here in the usual sense; the coders for this project were creating algorithms that determined traffic violations for specific sets of circumstances.

[9] Andrea James, *AmazonFail: An Inside Look at what Happened*, SEATTLE POST-INTELLIGENCER: AMAZON & ONLINE RETAIL BLOG (Apr. 13, 2009, 6:32PM), http://blog.seattlepi.com/amazon/2009/04/13/amazonfail-an-inside-look-at-what-happened/ [https://perma.cc/M9R2-8JW9].

change to "true" excluded 57,000 books with tags for gay, lesbian, health, mind, body, sexual medicine and reproductive from appearing in the results.[10] In the Amazon example, users, particularly authors, noticed. Legal researchers are not likely to be able to tell how the encoded biases and assumptions are affecting search results. Legal database providers have viewed their algorithms as trade secrets, and so have been reluctant to discuss the algorithms.[11]

This article will argue that legal database providers can be much more transparent about the biases in their algorithms without compromising trade secrets. This article is, in part, a call for more algorithmic accountability. Algorithmic accountability in legal databases will help assure researchers of the reliability of their search results and will allow researchers greater flexibility in mining the rich information in legal databases. If researchers know generally what a search algorithm is privileging in its results, they will be better researchers. Law librarians will be better teachers of the kind of analysis researchers need to search in any new database. And in the likely event that researchers do not have access to all of the different databases studied in this article, knowledge about the variability of each database might mean that researchers will work search term and resource variability into their search strategies. More information about databases may also affect collection development decisions.

In the absence of transparency from the database providers themselves, there may still be

---

[10] Andrea James, *Amazon Calls Mistake "Embarrassing and Ham-fisted,"* SEATTLE POST-INTELLIGENCER: AMAZON & ONLINE RETAIL BLOG (Apr. 13, 2009, 2:43PM), http://blog.seattlepi.com/amazon/2009/04/13/amazon-calls-mistake-embarrassing-and-ham-fisted/ [https://perma.cc/EDQ3-KX2M]. The error in the system – changing the code – affected not only the sales rank of some books, which pushed them to the bottom of the list where they are unlikely to be found – but had "the effect of removing books form Amazon's main product search." *Id.*

[11] The algorithms used by Lexis and Westlaw are trade secrets. *See, e.g.*, JULIE E. COHEN, CONFIGURING THE NETWORKED SELF: LAW, CODE, AND THE PLAY OF EVERYDAY PRACTICE 209 (2012) ("Efforts to gain access to information about the algorithms that determine the order of online search results have typically been stymied by assertions of trade secrecy . . ."). The exact operation of a relevancy-ranked natural language algorithm is proprietary and usually not disclosed. *See also* Danny C.C. Poo & Christopher S.G. Khoo, *Online Catalog Subject Searching, in* ENCYCLOPEDIA OF LIBRARY AND INFORMATION SCIENCE 2218, 2224 (Miriam Drake ed., 2nd ed. 2003).

things that can be learned about system biases. This article sets out the results of a study designed to reveal how hidden biases and assumptions affect the results provided by some of the major legal databases providers.[12] While it is usually difficult to know what documents are being searched in very large databases, using jurisdictional limits creates a unique opportunity to compare how different algorithms process the same search in the same set of documents. This study utilized Casetext, Fastcase, Google Scholar, Lexis Advance, Ravel and Westlaw, and looked at the differences in results when six different sets of engineers set out to solve the same problem.

The results are a remarkable testament to the variability of human problem solving. There is hardly any overlap in the cases that appear in the top ten results returned by each database.[13] An average of 40 percent of the cases were unique to one database, and only about seven percent of the cases were returned in search results in all six databases. It is fair to say that each different set of engineers brought very different biases and assumptions to the creation of each search algorithm. The uniqueness of results may show something about the world view of each database that suggests that searching in multiple databases may be the 21st century version of making sure that multiple authorial viewpoints are highlighted in a library collection's holdings. One of the most surprising results was the clustering among the databases in terms of relevant results. The oldest database providers, Westlaw and Lexis, were at the top in terms of relevance, with 67 percent and 57 percent relevant results, respectively. The newer legal database providers, Fastcase, Google Scholar, Casetext, and Ravel, were clustered together at a lower relevance rate, each returning about 40 percent relevant results.

[12] This paper makes the following assumptions about each database provider: they each have access to and publish a similar corpus of published federal cases and each database provider is trying to accomplish a similar task: to return cases relevant to the researcher's query with the algorithm it creates.

[13] The full results and analysis discussed in this paragraph are presented in Part IV, *infra* at XX.

Legal research has always been an endeavor that required redundancy in searching; one resource does not usually provide a full answer, just as one search will not provide every necessary result. This study clearly demonstrates that the need for redundancy in searches and resources has not faded with the rise of the algorithm. From the law professor seeking to set up a corpus of cases to study, the trial lawyer seeking that one elusive case, the legal research professor showing students the limitations of algorithms, researchers who want full results will need to mine multiple resources with multiple searches. A sample legal research problem illustrating what the human construction of algorithms means for the uniqueness and relevance of results in any given database is provided. Once a researcher has determined on their own that every algorithm has a unique voice, they truly understand the need for and the usefulness of redundancy in searching.

Part II of this paper discusses algorithms in the context of legal research and sets the stage for today's research environment. Part III describes in general terms the types of search algorithms employed by legal database providers, and discusses what each provider has revealed about its algorithms in promotional material. Part IV discusses the empirical study, its protocols, the results of the empirical study and some conclusions that can be drawn. Part V concludes by returning to the question of algorithmic accountability and the cognitive impact of algorithms on legal research strategies.

II. A Brief Discussion of Algorithms and Classification

At the simplest level, an algorithm is " a set of step by step instructions, to be carried out quite mechanically, so as to achieve some desired result. ."[14] The Pythagorean theorem is an algorithm, and so is the set of instructions that Netflix uses to recommend a movie you might

[14] Jean-Luc Chabert, *Introduction, in* A HISTORY OF ALGORITHMS: FROM THE PEBBLE TO THE MICROCHIP 1, 1 (Jean-Luc Chabert ed., 1999).

like to see. Although algorithms have always had a role in modern life, [15] it is the role that algorithms play in selecting what legal information we see that is critical for legal researchers.[16] As we increasingly rely on algorithms for the assessment of information, algorithms dominate in mediating our information environment.[17] If researchers are not aware that the information they are seeking may be missing from a database, or that the results that might be helpful may not be privileged in the result set, or that the list of documents suggested may have been generated by a legal world-view that is in opposition to the path the researcher is trying to forge, a research session may terminate with no helpful results when helpful results actually exist.[18] So we have to have sets of questions to ask each algorithm. Some questions might be: how is information included or excluded from a system; how does the resource use predictive algorithms to anticipate use; how is relevance evaluated; does the "black box"[19] of the algorithm's work lend a seeming objectivity to the results; how does use of the system change result patterns?[20] For attorneys, learning to navigate black boxes is part of the ethical duty to do competent research:

---

[15] As just one example from industry, Gannt charts were simple instructions for scheduling that have been in use since the mid-1890's. Starting in 1958, those instructions were computerized with algorithmic instructions, using the Naval Ordnance Research Calculator, the most powerful computer in existence at the time. Jeffrey W. Herrmann, *A History of Production Scheduling*, *in* HANDBOOK OF PRODUCTION SCHEDULING 1, 11-12 (Jeffrey W. Herrmann ed., 2006).

[16] *See, e.g.*, Tarleton Gillespie, *The Relevance of Algorithms*, *in* MEDIA TECHNOLOGIES: ESSAYS ON COMMUNICATION, MATERIALITY, AND SOCIETY 167 (Tarleton Gillespie et al. eds., 2014) [hereinafter *Relevance of Algorithms*].

[17] *Id.* at 167-168. The study of algorithms as mediators of all public information is a rich field of study on its own, but one that is beyond the scope of this article, which will limit its focus to algorithms that mediate legal information systems.

[18] *See* Gregory J. Downey, *Making Media Work: Time, Space, Identify, and Labor in the Analysis of Information and Communication Infrastructures*, *in* MEDIA TECHNOLOGIES: ESSAYS ON COMMUNICATION, MATERIALITY, AND SOCIETY, *supra* note 17, at 141; *see also* Nicholas F. Stump, *Following New Lights: Critical Legal Research Strategies as a Spark for Law Reform in Appalachia*, 23 Am. U. J. Gender Soc. Pol'y & L. 573, 639 (2015) (discussing that for the law review articles promoted to the researcher as Context & Analysis, the researcher has no way of knowing the criteria used by the publisher in picking those articles, and the work that went into making those decisions has a definite influence on the course of the research).

[19] On one level a black box is any "technical object that operates as it should. When this occurs, the complex sociotechnical relationships that constitute it are rendered invisible, or black-boxed." Darryl Cressman, *A Brief Overview of Actor-Network Theory: Punctualization, Heterogeneous Engineering & Translation*, 09-01 CTR. FOR POL'Y RES. ON SCI. & TECH. 1, 6 (2009), http://summit.sfu.ca/item/13593.

[20] *Relevance of Algorithms*, *supra* note 17, at 168.

knowing something about why you received the results that you did is a critical skill. For legal research professors, teaching this skill may involve passing on some understanding of how the systems we use today evolved.

Online legal information systems did not arise as completely new structures. The initial transition to any new technology is frequently fairly literal. Think of the "horseless" carriage or the first bicycles. The first information that made the transition online was the full text of cases, made searchable with Boolean logic.[21] Headnotes, case summaries, statutes, news, business information, and finally law reviews were added to the systems.[22] The freedom to search full text without the constraints of classification systems was supposed to unmoor the law from its structure.[23] But it turns out that trying to make sense of information without underlying ontologies or classification systems can impede automation practices.[24] Legal database providers may even make the human additives to their search explicit. Lexis boasts of the human indexing

[21] Robert C. Berring, *Legal Information and the Search for Cognitive Authority*, 88 CALIF. L. REV. 1673, 1696 (2000) ("LEXIS and WESTLAW built on the old foundations. They loaded the text of cases online, each word of each case . . . WESTLAW and LEXIS were brave pioneers, but one cannot build new information systems out of thin air. Both followed a predictable course. Like the first iteration of many systems, WESTLAW and LEXIS tried to use new technology to accomplish the old tasks. Since everyone was deeply immersed in the existing system, they aped the functions of the old system.").

[22] Bernard J. Hibbitts, *Last Writes? Reassessing the Law Review in the Age of Cyberspace*, 71 N.Y.U. L. REV. 615, 657-58 (1996) (noting that this transition took until 1982).

[23] Robert C. Berring, *Legal Research and Legal Concepts: Where Form Molds Substance*, 75 CALIF. L. REV. 15, 26-27 (1987) ("There is no underlying rational structure to the law other than what the positivists give it. Allowing people to go online in free text liberates them from any requirement to fit their thoughts into a pre-existing structure. Individual researchers are able to order legal doctrine as it suits their needs . . . .").

[24] Francisco Iacobelli et al., *Information Finding with Robust Entity Detection: The Case of an Online News Reader*, *in* HUMAN-COMPUTER INTERACTION: THE AGENCY PERSPECTIVE 375-387 (Marielba Zacarias et al. eds., 2012). To create an automated news reader that worked to find sources for news reporting, among other inputs, the authors "manually built a high-level classification system on top of Wikipedia's categories." *Id* at 381. Netflix boasts that its "secret sauce" is human indexing. Netflix's chief content officer added that in its 70-30 mix of data and judgment, "the thirty need to be on top." Tim Wu, *Netflix's Secret Special Algorithm is a Human,* NEW YORKER: CURRENCY (Jan. 27, 2015), http://www.newyorker.com/business/currency/hollywoods-big-data-big-deal [https://perma.cc/A8CY-LH46].

in Shepard's citations,[25] Westlaw is proud of its human-generated Key Numbers,[26] and Bloomberg advertises that the human indexing in its BNA treatises significantly boost search results.[27]

The complexity of the source material may require classification to aid relevant search results. Even the current "google-like" legal databases provide extensive pre-filtering, post-filtering and word wheel[28] options for granular classification by source, authority, jurisdiction and content type, and by value-added indexing by humans.[29] Some of the changes in the levels of pre-filtering and word wheel options have been in response to user demand; lawyers seem to need classification in the law.[30] Lawyers, after all, are humans, and we are all hardwired to impose structure on the world.[31]

---

[25] *Shepard's Citations Service,* LEXISNEXIS.COM, http://www.lexisnexis.com/Shepards [https://perma.cc/4TDA-FR85] (last visited Oct. 5, 2016) ("Experienced *Shepard's* attorney-editors read cases around the clock and make assessments according to strict standards and guidelines. They recognize implications, case subtleties and nuances that algorithms simply can't.").

[26] Westlaw is proud of its human-generated Key Numbers. *Topic and Key Number Overview*, WESTLAW.COM, https://lawschool.westlaw.com/marketing/display/RE/24 [https://perma.cc/QFK8-HZ3L] (last visited Oct. 5, 2016).

[27] Bloomberg advertises that the human indexing in its BNA treatises significantly boost search results. *BNA's Law School Professional Information Center: Using Online Indexes*, BNA.COM, http://subscript.bna.com/pic2/lsll.nsf/id/DTRS-5L3RPC?OpenDocument [https://perma.cc/NH3H-7N5V].

[28] A word wheel describes the autocomplete list of choices generated by a legal database provider when the researcher starts typing in the search box. For example, a researcher typing in 'american law" may get a list asking: looking for this? American Law Reports Digest; American Law Reports; American Law of Product Liability Clicking on one of these options will take the researcher directly to the legal resource listed.

[29] *See* the discussion of the value-added interfaces for six legal databases in Part III, *infra* p. XX..

[30] MAGGIE NELSON, THE ARGONAUTS 53 (2015) (positing an "Aristotelian, perhaps evolutionary need to put everything into categories . . . ."). Recent studies on the human mind illustrate the deep-seated desire to classify and categorize, and, in response, lawyers push online systems to recreate the systems and categories. DANIEL J. LEVITIN, THE ORGANIZED MIND: THINKING STRAIGHT IN THE AGE OF INFORMATION OVERLOAD 25 (2014) ("The formation of categories in humans is guided by the cognitive principle of wanting to encode as much information as possible with the least possible effort. Categorization systems optimize the ease of conception and the importance of being able to communicate about these systems."). Even in the evolution of online databases, where the first databases were just the stripped out text of cases, the momentum has always been towards more structure and classification in the online systems. F. Allan Hanson, *From Key Numbers to Keywords: How Automation Has Transformed the Law*, 94 LAW LIBR. J. 563, 569-572 (2002); *see also* William G. Harrington, *A Brief History of Computer-Assisted Legal Research*, 77 LAW LIBR. J. 543 (1984-85).

[31] LEVITIN, *supra* note 31, at 32. Lawyers may be singular in their need for control and order. *See, e.g.*, Margaret Hagan, *Do Lawyers Want Bad Visual Design?*, OPEN LAW LAB (June 28, 2016), http://www.openlawlab.com/2016/06/28/do-lawyers-want-bad-visual-design/ [https://perma.cc/7FWQ-AFQ5] ("Lawyers want maximum overload of information in response to queries they do; They want it listed out in detail,

The transition to online searching has increased the complexity of the search task; as more information becomes available, more research needs to be done. [32] This is an instance where automation, as is frequently the case, has made a task more complex for the humans involved. [33] In exchange for instant access, the user, to be effective, has to master increasingly complex tasks to recover information. The human reasoning, classification schemes, design decisions and other work that went into the creation of the systems the researcher is using are mostly hidden from the user.[34] Going beneath the surface of research systems, even in the pre-digital search environment, has never been the norm.[35] There is a long history in legal research of researching with only a surface understanding of the underlying structure. Speaking of lawyers at the time of transition to online searching, Bob Berring has noted that "most lawyers were unaware of the details of the classification systems imposed by the Key Number system, and in the early days of online searching, most users were unaware of the structure underlying the system."[36] It is safe to say that this is still true. But that is not to say that some basic understanding of the forces at work would not be helpful to researchers in the brave new world

with lots of information packed onto the page; They don't want white space, they want text covering as much of the screen as can fit. They want lots and lots of controls, all kinds of filters and sorting mechanisms.").

[32] Berring, *supra* note 22, at 1683-1690 (tracing the differences between the forms and content of an 1891 Supreme Court case and a 1996 Supreme Court case).

[33] DAN HARRIS, ed., ENGINEERING PSYCHOLOGY AND COGNITIVE ERGONOMICS. UNDERSTANDING HUMAN COGNITION: 10TH INTERNATIONAL CONFERENCE, EPCE 2013, HCI International 2013, Las Vegas, NV, 2013, Proceedings, Part 1, 206-207.

[34] *See* GEOFFREY C. BOWKER & SUSAN LEIGH STAR, SORTING THINGS OUT: CLASSIFICATION AND ITS CONSEQUENCES 33 (1999).

[35] Berring, *supra* note 22, at 1694.

[36] *Id.* Although in the pre-online research world, many lawyers knew that the West classification system missed a lot. Dan Dabney, *The Curse of Thamus: An Analysis of Full-Text Legal Document Retrieval*, 78 LAW LIBR. J. 5, 14 (1986) ("This short review of ideas in indexing shows that the indexing process is prone to many sorts of errors and uncertainties. Manual indexing is only as good as the ability of the indexer to anticipate questions to which the indexed document might be found relevant. It is limited by the quality of its thesaurus. It is necessarily precoordinated and is thus also limited in its depth. Finally, like any human enterprise, it is not always done as well as it might be.").

of information overload and satisficing[37] that we now live in. And that is what we need to teach legal researchers.

Lawyers are not alone, of course. Most people do not think about the underlying structures of the technologies they use.[38] But some inquiry into the forces at work in the legal research environment, at this moment when so much of the work is truly invisible, is certainly called for.[39] It is time to examine technical bias in legal computer systems.[40] Technical bias is

[37] Satisficing is a time-honored information seeking activity; it means "to settle for what is most readily available with little or no regard for costs and benefits. For quick and temporary answers, where optimizing is not a good plan." BRIAN C. O'CONNOR ET AL., HUNTING AND GATHERING ON THE INFORMATION SAVANNA: CONVERSATIONS ON MODELING HUMAN SEARCH ABILITIES 131 (2003).

[38] The classifications, design decisions, and choices made every day by information scientists in our technological environment frequently embody "moral and aesthetic choices" that impact our own decisions and thoughts., BOWKER & STAR, *supra* note 35, at, 3-4. These hidden choices can have very deep effects, as the recent "great recession" has shown. The great recession was in part a failure of algorithmic oversight. See MORTON GLANTZ AND ROBERT KISSELL, MULTI-ASSET RISK MODELING: TECHNIQUES FOR A GLOBAL ECONOMY IN AN ELECTRONIC AND ALGORITHMIC TRADING ERA 437-439 (2014).

[39] There is a large literature on bias in databases. *See, e.g.*, HUMAN VALUES AND THE DESIGN OF COMPUTER TECHNOLOGY (Batya Friedman ed., 1997); Tarleton Gillespie & Nick Seaver, *Critical Algorithm Studies: a Reading List*, SOC. MEDIA COLLECTIVE RES. BLOG (July 20, 2016), https://socialmediacollective.org/reading-lists/critical-algorithm-studies/#4.3 [https://perma.cc/4UQY-76C7]. For a discussion of how algorithms may unintentionally encode bias on the basis of protected classes (ethnicity, gender, race, religion), *see* Michael Feldman et al., *Certifying and Removing Disparate Impact*, *in* PROCEEDINGS OF THE 21TH ACM SIGKDD INTERNATIONAL CONFERENCE ON KNOWLEDGE DISCOVERY AND DATA MINING, 259 (2015), http://dl.acm.org/citation.cfm?doid=2783258.2783311. For the effect computational "non-reading" of texts – the pattern recognition that is the language of machine learning. – may have on legal interpretation, *see* Mireille Hildebrandt, *The Meaning and Mining of Legal Texts*, *in* UNDERSTANDING DIGITAL HUMANITIES 145, 148-149 (David M. Berry ed., 2012). There has been a broad discussion of bias in applications on the web. *See, e.g.*, Lucas D. Introna & Helen Nissenbaum, *Shaping the Web: Why the Politics of Search Engines Matters*, 16 INFO. SOC'Y 169 (2000).

[40] Friedman & Nissenbaum, *supra* note 6, at 330. Technical bias is one of the three biases that computer systems can display; these are preexisting, technical and emergent. Emergent biases are those that arise in the actual use of the database; these biases can relate to new societal knowledge, differing expertise, differing values or a mismatch between the user and the system design. *Id.* at 335. The preexisting bias in legal databases is, at a minimum, the structure of the law itself, and the content and classification systems that have been imposed on the law by legal vendors. *Id.* at 333; *see also* Hanson, *supra* note 31, at 569-572. This was a gradual change, as the first computer retrieval systems were the simple text of cases, with no structure or classification; the evolution to structure and classification was gradual. Harrington, *supra* note 31, at 543*; see also* Berring, *supra* note 22, at 1693, 1696. For an excellent history of the evolution of ideas about the effect of classification schemes on legal thinking, *see* Richard A. Danner, *Legal Information and the Development of American Law: Writings on the Form and Structure of the Published Law*, 99 LAW LIBR. J. 193 (2007). The classification systems may also hide assumptions about the nature of the law that mask paths to justice. *See* Stump, *supra* note 19, at 573*; see also* Hildebrandt, *supra* note 40, at 148-49 (discussing the effect computational "non-reading" of texts–the pattern recognition that is the language of machine learning–may have on legal interpretation).

built into systems. We just don't see it, because the systems we use are black boxes.[41] The following attributes contribute to the biases that programmers embed in the black box:

- prioritization ("emphasizing certain things at the expense of others, like relevance ranking");
- classification (putting an entity in a constituent class – data training may import human biases);
- association ("marks relationships between entities"); and
- filtering, which includes or excludes information "according to various rules or criteria."[42]

An interesting example of how assumptions or biases inform results is from a study on coding algorithms to enforce that exemplary seemingly simple rule of law, the speed limit.[43] What seems a relatively straightforward problem becomes dense with assumptions when one thinks about how to implement the law: do you enforce the letter of the law or the intent of the law; is every second you exceed the speed limit a separate violation; do weather or road conditions matter; how often should a driver be given a ticket; does context matter?[44] There were three groups of coders using actual driving data taken from a vehicle's computer: the first group was asked to implement the letter of the law; the second group was asked to implement the intent of the law; the third group was asked to follow a detailed written specification.[45] The differences in the results of each coding scheme are stark: the number of tickets issued by the algorithms varied from zero to 661, for the same driving pattern.[46] All of the groups made assumptions

[41] Cressman, *supra* note 20, at 6.

[42] Nicholas Diakopoulos, *Algorithmic Accountability: Journalistic Investigation of Computational Power Structures*, 3 DIG. JOURNALISM 398, 399 (2015), http://dx.doi.org/10.1080/21670811.2014.976411. Black boxes result in technological opacity.

[43] Shay et al., *supra* note 9, at 1.

[44] See *Id.* at 20 for a chart summarizing the differences in results for three groups of coders who were given three different assignments for coding violations.

[45] *Id.* at 4-5.

[46] *Id.* at 20.

independent of their instructions; for example, there were significant differences in how the first two groups coded tolerances for exceeding the speed limit, and all of the groups assumed, without instruction, perfect driving conditions.[47] As the authors of the study note, transparency about coding assumptions may be the only solution to success in implementing automated legal compliance or enforcement in a fair and open manner. [48]

Algorithmic accountability is the term for disclosing prioritization, classification, association, and filtering.[49] What we need is a frank discussion with database providers about what it means to search in their databases. Trade secrets should not prevent algorithmic accountability. Some database providers do provide some search tips that can help their users understand what is happening between the input of the researcher's search terms and the output the researcher sees.[50] And legal database providers do of course publish basic search information for their users.[51] The more a researcher understands something about the input into the black

[47] *Id.* at 7-8, 14-15. The variations and subtle assumptions are quite varied and the Shay article only discusses a few.

[48] *Id.* at 30-31.

[49] Diakopoulos, *supra* note 43, at 402.

[50] For example, this information is from a help protocol from Summon, a discovery layer search product, transmitted in an email to the author because the information is behind the password-protected administrative module. E-mail from Joan Policastri, Collection Serv. and Research Librarian, Univ. of Colo. Law Sch., to author (Jan. 8, 2016, 12:05PM MST) (on file with author). It would be more helpful if the information was readily available to users.

"**Boolean search and Summon relevancy algorithm:** Boolean queries get processed by the same relevancy algorithm as any other query. This means relevancy enhancements that come from the application of stemming, character normalization, etcetera will apply in Boolean queries as well.
Applying the relevancy algorithm to Boolean queries is particularly helpful in Boolean searches using multiple search terms. For example:

- **paint drying time (glass OR wood)**

The above Boolean query will provide a small relevancy boost for documents containing the words *paint*, *drying*, and *time* in close proximity to each other, which is a relevancy enhancement that previously did not apply to Boolean queries."

Legal professionals who were expert searchers had complied their own special tips and tricks for getting the best results, but those tips and tricks were for pre-2010 Boolean searching. New tips and tricks are necessary for keyword searching in the current set of search algorithms, but for the most part, these tips and tricks have not been revealed.

[51] *See infra* Part III.

box, even without knowing the code for the algorithm, the more we can begin to see how the system operates in practice. At the moment, we can really only see the output of the systems, and that will be what this study will investigate.

The need to know about the input, the paths that mark the way to the results, only increases as the amount of work being done by the algorithms increases. A case in point is the use of IBM's artificial intelligence program, Watson, by the medical community.[52] Watson is IBM's supercomputer, which uses artificial intelligence and machine learning to leverage large amounts of data.[53] Watson is better than humans at reading through documents, and is starting to be used as a "quick-witted digital assistant" in oncology clinics, but with a caveat: doctors use it in conjunction with Watson Paths,

> a visual tool that allows a doctor to see the underlying evidence and inference paths Watson took in making a recommendation. It's not sufficient to give a black-box answer,' said Eric Brown, IBM's director of Watson technologies.[54]

As decision makers, doctors want knowledge, not technological determinism.[55] Legal researchers need to request the same kind of transparency.

---

[52] Steve Lohr, *If Algorithms Know All, How Much Should Humans Help?,* N.Y. TIMES, Apr. 6, 2015, http://www.nytimes.com/2015/04/07/upshot/if-algorithms-know-all-how-much-should-humans-help.html [https://perma.cc/48HA-N92U].

[53] Lauren M. Friedman, *IBM's Watson Supercomputer May Soon Be the Best Doctor in the World,* BUS. INSIDER, Apr. 22, 2014, http://www.businessinsider.com/ibms-watson-may-soon-be-the-best-doctor-in-the-world-2014-4 [https://perma.cc/UTD8-KQNR].

[54] *Id.; see also IBM Research: WatsonPaths,* IBM.COM, http://www.research.ibm.com/cognitive-computing/watson/watsonpaths.shtml [https://perma.cc/7FZZ-78JR] (last visited Oct. 11, 2016) (highlighting the visual image of the decision paths Watson shares with doctors to aid transparency and help doctors authenticate the value of the decision). IBM recently released Ross, the legal version of Watson, but nothing has been released about similar transparency in decision paths on the legal side. *See Watson Takes the Stand,* THEATLANTIC.COM, http://www.theatlantic.com/sponsored/ibm-transformation-of-business/watson-takes-the-stand/283/ [https://perma.cc/PQ5U-U4SQ] (last visited Oct. 11, 2016).

[55] *See* Julie E. Cohen, *Network Stories,* 70 LAW & CONTEMP. PROBS. 91, 92 (2007), http://scholarship.law.duke.edu/lcp/vol70/iss2/5/ ("What makes the network good can only be defined by generating richly detailed ethnographies of the experiences the network enables and the activities it supports, and articulating a normative theory to explain what is good, and worth preserving, about those experiences and activities.").

III. What Legal Database Providers Say About the Search Experience

There is, of course, some information on the kind of search experience available on each legal database. In terms of the basic types of search, researchers tend to refer to Boolean searching – meaning that the researcher uses terms and connectors, such as "and", "or", and "not",[56] to construct a search – and natural language searching – meaning that the researcher uses keywords without connectors.[57] However, the reference to natural language searching is frequently a misuse of a technical term that refers to a complex attempt to pattern match speech or text "through references to a database with the aid of grammatical structures models,"[58] and does not technically refer to keyword searching where the terms entered into a text box are then ranked by algorithms for relevance, word count, citation count, or other non-grammatical structures.[59] This article will refer to searches entered into a legal database's search box without

[56] George Boole was a 19th century mathematician, and his work on the analogies between algebraic symbols and symbols that represent logical forms and syllogisms resulted in the application of what is known as Boolean logic to searching. *George Boole*, BRITANNICA.COM, http://www.britannica.com/biography/George-Boole [https://perma.cc/K6WK-9WQG] (last visited Oct. 11, 2016); Gerald Salton et al., *Extended Boolean Information Retrieval*, 26 COMM. ACM 1022 (1983), http://dl.acm.org/citation.cfm?id=358466. This kind of searching is now more commonly referred to as "terms & connectors" searching. *See, e.g.*, *Search Terms and Connectors*, https://www3.law.ox.ac.uk/lrsp/e/searchterms.php [https://perma.cc/8TBA-KRMN] (last visited Oct. 11, 2016).

[57] *How You Search: Natural Language v. Terms & Connectors Searching*, WASH. U. L., http://libguides.law.wustl.edu/LRMSearchingIntro/SearchTypes [https://perma.cc/Q2PX-DPMN] (last updated Sept. 30, 2016**) (**"Natural Language Searching refers to the type of search you would do in Google: enter a few relevant terms in any order. The online service's search algorithm takes control and delivers results it determines to be most relevant. Sometimes called Descriptive Term Searching, although technically Natural Language Searching is a different process. Terms & Connectors Searching refers to a targeted search strategy that instructs the computer to look for specific terms, often in a specific order and/or a specific proximity to one another. Also called Boolean Searching.").

[58] Takeshi Matsumoto et al., *Application of Search Algorithms to Natural Language Processing*, 1 PROC. AUSTRALASIAN LANGUAGE TECH. WORKSHOP U03-1003 (2003), http://aclweb.org/anthology/U/U03/U03-1003.pdf.

[59] Natural language searching may "involve vector space models, Bayesian inference net models, and language models," Jack G. Conrad & Qiang Lu, *Next Generation Legal Search – It's Already Here*, LEGAL INFO. INST.: VOXPOPULII (Mar. 28, 2013, 9:13AM), https://blog.law.cornell.edu/voxpop/2013/03/28/next-generation-legal-search-its-already-here/ [https://perma.cc/4YPV-G8KM]. Maxwell Tamsin, speaking of free text searching decontextualizing information, commented: "One thing to notice about current methods in open domain IR, including vector space models, probabilistic models and language models, is that the only context they are taking into account is proximate terms (phrases). At heart, they treat all terms as independent." Maxwell Tamsin, *Pushing the Envelope: Innovation in Legal Search*, LEGAL INFO. INST.: VOXPOPULII (Sept. 17, 2009, 1:56PM), https://blog.law.cornell.edu/voxpop/2009/09/17/pushing-the-envelope-innovation-in-legal-search/

terms and connectors as keyword searches, although efforts will be made to determine and then note whether or not there is natural language grammatical parsing utilized for a specific legal database. Even though this study focuses on one possible first step in the research process, where the researcher formulates a query, puts keywords in the search box, and looks at the first few results, the full research process is a more iterative, intuitive, and complex process,[60] and there are multiple methods of starting and continuing a search.[61] What the study in this article illustrates is that, since every algorithm and database interface is a completely human construct,[62] and every search is a completely human construct, the researcher must view the search process a human interaction, moderated by technology, and not as a technological interaction.

[https://perma.cc/L8NQ-TR4G]. But, Dr. Tamsin continues, inference networks used in commercial legal information retrieval are not applied in the open domain, and they can incorporate index numbers, terms, phrases, citations, topics, and any other desired information in a "directed acyclic graph (the network)," which can then be used to estimate the probability of a "user's information need being met" by a specific document. *Id.; see also* Staffan Malmgren, Towards a Theory of Jurisprudential Relevance Ranking: Using Link Analysis on EU Case Law (Sept. 4, 2011) (unpublished Master of Laws thesis, Stockholm University), http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.397.3802&rep=rep1&type=pdf (discussing the hidden complication of natural language indexing of documents in databases: attempts to augment the authentic text of legal sources with semantic metadata introduces an interpretation of the legal sources, which get hidden in the system unbeknownst to the user, even if users' interpretations may differ from the systems).

[60] BOULDER STATEMENT ON LEGAL RESEARCH EDUCATION (June 21-22, 2009), https://lawlibrary.colorado.edu/sites/default/files/images/docs/2009_boulder_statement_on_legal_research_education.pdf [https://web.archive.org/web/20150922115957/http://lawlibrary.colorado.edu/sites/default/files/images/docs/2009_boulder_statement_on_legal_research_education.pdf]; Marcia J. Bates**,** *The Design of Browsing and Berrypicking Techniques for the Online Search Interface*, 13 ONLINE REV. 407, 408 ("Each new piece of information they encounter gives them new ideas and directions to follow and, consequently, a new conception of the query. At each stage they are not just modifying the search terms used in order to get a better match for a single query. Rather the query itself (as well as the search terms used) is continually shifting in part or in whole." *See also* Aaron Kirschenfeld, *Everything is Editorial: Why Algorithms Are Hand-Made, Human, and Not Just for Search Anymore*, LEGAL INFO. INST.: VOXPOPULII (Nov. 20, 2013, 9:56AM), https://blog.law.cornell.edu/voxpop/2013/11/20/everything-is-editorial-why-algorithms-are-hand-made-human-and-not-just-for-search-anymore/ [https://perma.cc/26VD-9X5Y] ("Computer assisted legal research cannot be about merely returning ranked lists of relevant results, even as today's algorithms get better and better at producing those lists. Search must be only one component of a holistic research experience in which the searcher consults many tools, which used together, are greater than the sum of their parts.").

[61] O'CONNOR ET AL., *supra* note 38, at 127. The techniques most utilized by the novice researcher would seem to be grazing and satisficing. Grazing is "foraging in a space where evaluation and supply are not issues" and satisficing is a form of settling for "what is most readily available with little or no regard for costs and benefits." *Id.* at 129, 131.

[62] *Id.* at 106; Kirschenfeld, *supra* note 61 (discussing the "artisanal" quality of algorithms, as something "massaged and kneaded by caring craftsmen").

There are many modes of searching, and keyword searching is just one of them.[63] Each database provider seeks to provide access to some of these other modes of searching and to enhance the search options with different tools that are presented to the researcher on the results screen. [64] This article is not investigating these secondary prompts provided by each database provider. The article is investigating one possible first step in the research process and comparing the results, to see how database algorithms differ. No researcher should stop their inquiry after just looking at the top ten results from one keyword search.

Algorithms in legal databases are processing search terms, assessing the information in their databases, and then representing a set of the "best results."[65] Even so simple seeming a task as assembling the information to be searched may have implications that may be important to understanding the context of the information we see as a result of a search.[66] Tarleton Gillespie calls this dimension "patterns of inclusion."[67] Before an algorithm is deployed, the dataset of information to search must be assembled, and this involves choices as to what is collected, how it

[63] Bates, *supra* note 61, at 408.

[64] See *infra* pp. ___ (discussing the information a searcher might finds to enhance the search process in each of the six legal databases in this study).

[65] *Relevance of Algorithms*, *supra* note 17, at 167-168 (speaking generally of algorithms in search); *see also* Conrad & Lu, *supra* note 60 (discussing the actual separation of retrieval from ranking in WestlawNext). The difficulty of getting from the input – the processing of search terms – to the output – documents that satisfy the researcher's information need is the age –old problem of information retrieval. Bates, *supra* note 61, at 407-408. This is the same philosophical problem the structuralists are dealing with even enhanced with machine-learning and natural language processing, the match in the middle is so difficult to achieve because of the "value" between the signifier and the signified articulated by the structuralists. Barton Beebe, *The Semiotic Analysis of Trademark Law*, 51 UCLA L. Rev. 621, 6326-642 (2004). In a structuralist model of search; the document (or text) would be represented in the search process (by the algorithm creators) as a signifier. The researcher with the information need creates a query which is intended to retrieve information matching the mental idea or the signified. But there is always a problem in understanding caused by the context-specificity of words, or their "value;" for structuralists, words only have meaning in relation to "that which exists outside it" such as synonyms or context. *Id.* at 641-642. The structuralists have identified a problem that exists in all human communication; our own "natural language processing" when communicating with each other is not fool-proof. When communicating with a computer, the problem is certainly no easier.

[66] *Relevance of Algorithms*, *supra* note 17, at 167-168.

[67] *Id*.; s*ee also*, Richard Delgado & Jean Stefanic, *Why Do We Ask the Same Questions: The Triple Helix Dilemma Revisited*, 99 L. LIBR. J. 307, 317-318 (2006) (finding the freedom to be free from categories imposed by legal publishers in the online search environment somewhat illusory).

is readied for the algorithm, and what is excluded or demoted.[68] In legal databases, while primary law should be similar across legal databases, that law may be readied for the algorithm in different ways, by the elements of metadata, relational or object-oriented database architecture, and categories of classification that are chosen. Historical notes can be included or excluded. For all secondary sources, the effect of inclusion and exclusion in a database has an obvious effect on the results that are returned. Exclusion may be based on copyright, licensing, or editorial concerns.

The following section is a brief review of the information about the search algorithm each database provider has published and of the various mechanisms each database provider uses to enhance the search experience beyond the return of "relevant" cases. Just as no good legal researcher stops with reviewing the results of just one search string in a case law database, so no legal database provider stops with returning cases as a dead end to research. Indeed, each provider adds enhancements to the search results page to facilitate connections, in ways that may encourage those serendipitous connections that expert researchers prize and that some expert researchers worry the online interface will prevent.[69]

---

[68] *Id*. at 170-172; Jeffrey Alan Johnson, *Representing "Inforgs" in Data-Driven Decisions, in* DIGITAL SOCIOLOGIES (Jessie Daniels et al., eds., forthcoming Nov. 2016) ("Creating data requires some process that narrows the many possible representations of a given state of the world to a single data state. This process is carried out within translation regimes: systems of technical rules and social practices that establish a one-to-one correspondence between a given state of the world and a data state.").

[69] O'CONNOR ET AL., *supra* note 38, at 10-11. One dominant metaphor for searching has been "the classic, Aristotelian nature of access systems – which fails to address the whole of human engagement . . . ." *Id*. The authors suggest the use of a bricoleur model." *Id.* Bricoleur is being used here in the Levi-Straussian sense of thinking and doing with the materials at hand. *Id.* For a full list of the kinds of search behavior that researchers engage in, many of which are not fully integrated into an online environment, *see Id.* at 127-134. It is not really clear if serendipity plays the same role in online searching as it does in print research or browsing the stacks; print resources have generally been felt to provide the most opportunities for analogic surprise. *See, e.g.*, Ryan Metheny, *Re-Searching: While Search Engines Have Made It Easy to Find Facts, Legal Research Still Benefits from a Methodological* Approach, L.A. LAW, Dec. 2014, at 27; Robert J. Sheran & Douglas K. Amdahl, *Minnesota Judicial System: Twenty-Five Years of Radical Change,* 26 HAMLINE L. REV. 219, 365 (2003).

A. Westlaw

Westlaw has described its search functionality as a combination of methodologies, and it is not clear from the promotional material if the methodologies include true natural language searching or not.[70] The Westlaw interface lists its search as a "plain language" search, [71] while early WestlawNext promotional material calls it "natural language" searching.[72] The search algorithm removes stop words, generates variations of words, identifies legal phrases, citations, topics and key numbers and then uses knowledge-based engineering, machine-learning techniques, and statistical classification to improve results.[73] What is clear from the promotional material is that the algorithm created by Westlaw utilizes value-added content such as the human-generated Key Number system, notes of decisions and headnotes, and KeyCite's citation networks, as well as user document interaction history to return relevance-ranked results beyond the exact search terms entered.[74] Qiang Lu and Jack Conrad revealed that WestlawNext separated the function of document retrieval from document ranking, so that retrieval results in high recall (retrieving the highest possible number of relevant results of all the relevant results in the database) and then results are ranked, which "allows potentially dozens of weighted features

[70] *WestSearch: The World's Most Advanced Legal Search Engine*, THOMSONREUTERS.COM, http://info.legalsolutions.thomsonreuters.com/pdf/wln2/l-355700_v2.pdf [https://perma.cc/U8BP-NT37] (last visited Oct. 12, 2016).

[71] *Tips and Tricks to Get You Started on Westlaw*, THOMSONREUTERS.COM, http://static.legalsolutions.thomsonreuters.com/product_files//westlaw/wlawdoc/wlres/wln_tips_tricks_ug.pdf [https://perma.cc/3FEQ-LGDV] (last visited Oct. 13, 2016).

[72] *WestSearch: WestlawNext Search Technology*, THOMSONREUTERS.COM, https://info.legalsolutions.thomsonreuters.com/documentation/westlaw/wlawdoc/web/wlnwsrch.pdf [https://web.archive.org/save/_embed/https://info.legalsolutions.thomsonreuters.com/documentation/westlaw/wlawdoc/web/wlnwsrch.pdf] (last visited Oct. 13, 2016) ("The WestSearch federated search employs natural language processing to retrieve relevant documents . . . [and] builds on the Westlaw®Natural Language search method.").

[73] *Id.*; JIN ZHANG, VISUALIZATION FOR INFORMATION RETRIEVAL 25 (2008) ("Stop words are words that are not important within full text, and most search engines will have a list of such words; common words are 'a,' 'the,' and 'and.').

[74] *supra*, notes 71-73.

to be taken into account and tracked as part of the optimal ranking process."[75] This theoretically means that the benefits of searching a small group of documents, which used to be the preferred way to produce fewer results with higher recall, may not necessarily work in Westlaw anymore.[76]

Once those results are returned,[77] Westlaw offers many options to enhance the search experience. The researcher can filter results by jurisdiction, topic, reported status, judge, attorney, law firm, Key Number, party, and docket number. In addition, Westlaw's results page recommends secondary sources on the right, as "Related Documents." These documents may or may not be relevant to the information need of the researcher, depending on the level of the search's success in retrieving relevant results.[78]

[75] Conrad & Lu, *supra* note 60. It has been, until recently, an inviolable law of search that as recall goes up, precision goes down. Paul D. Callister, *Working the Problem*, 91 ILL. B. J. 43, 44 (2003). As far back as 1994, Westlaw's own study of the relationship between precision and recall in the Federal Supplement database showed that as precision went up, recall went down at almost the identical rate. *Id*.

[76] Research assistants were given sample instructions on limiting their search to a specific case database for each of the six databases in the study; in the example used, the reverse was true for Westlaw; pre-filtering produced *more* results. Here were the instructions and the numbers:

> On the start page, click on cases
> Click on Federal District Court Cases under "Federal Cases by court"
> Click on the State where your district court is located (e.g. Michigan)
> Run your search (e.g. agency follows clear congressional intent)
> On the left, click open the District Court box, and select your actual district (e.g. E.D. Mich.) ALSO use the filters on the left to limit your searches to reported cases, and click APPLY FILTERS .(e.g. 2920)
>
> Please note that in Westlaw, the results are different if you follow this path (e.g. 2920 cases) than if you enter the search in the main search box first, and then limit the jurisdiction (e.g. 4 cases).

[77] For purposes of the discussion about the enhancements each database provider offers, I am using Query 1 from Appendix A (the search is "criminal sentence enhancement findings by jury required;" entered as keywords; the jurisdiction is the Sixth Circuit). The legal framework for evaluating results is: You are looking for cases discussing the constitutionality of increasing the penalty for a crime when the jury did not make a factual determination about facts that enhanced the penalty). So the enhancements are what shows up on the screen after limiting the jurisdiction and entering Query 1. For a full discussion of the search protocols, see *infra* Part IV.

[78] The relevance of the secondary sources recommended is related to the relevance of the results generated by the search. See *infra* Part __. In this **one** instance, the secondary sources were not helpful.

B. Lexis Advance

Lexis Advance's stated world view is that their search results should not only be as inclusive as possible but the same whether jurisdictional filtering is performed before or after entering the search terms.[79] Lexis Advance engineers produced a video on the search algorithm, and they state that their customized search algorithm uses automatic phrase recognition, case name recognition, proximity search between terms, and activity score boosting in the ranking algorithm.[80] The video calls search without connectors "natural language" searching.[81] Relevance ranking purportedly gives priority to legal phrases, and moves documents up based on concentration of terms (how close the terms are to each other), coverage of terms (are all of the

[79] *Differences That Deliver: The Power of Lexis Advance® Search*, LEXISNEXIS.COM, http://www.lexisnexis.com/documents/pdf/20160803090042_large.pdf [https://web.archive.org/save/_embed/http://www.lexisnexis.com/documents/pdf/20160803090042_large.pdf] (last visited Oct. 13, 2016). This information was provided by Lexis after the author discussed the concept of algorithmic accountability with a Lexis representative, so asking for help is a useful thing to do. David Dilenschneider, Senior Dir. of Client Relations for LexisNexis, Presentation at the University of Colorado Law School (Mar. 4, 2015). In Mr. Dilenschneider's view, this is what differentiates Lexis Advance from Westlaw. As part of this philosophy, the algorithms have been adjusted so that the search returns the same number of results whether the researcher pre-filters the search results by limiting the search to a particular jurisdiction, or performs post-search filtering. Here were the search instructions for limiting a search to a specific court database in Lexis:

> Enter your search (e.g. agency follows clear congressional intent). Click the Filters arrow next to the search box.
> The top limiter is jurisdiction. Check federal district courts.
> Run the search (e.g. agency follows clear congressional intent) Scroll down on the left Jurisdiction and click on your circuit.
> Note that you have to know which circuit you are in (e.g.,the Sixth)
> Now you can see, under Court, the Eastern District Michigan.
> Click on that
> ALSO use the filters on the left to limit your searches to reported cases. (e.g. 338 cases)
>
> Please note that in Lexis, pre-filtering and post-filtering should give you the same number of cases (e.g. 338 cases). I haven't figured out another way to limit the search to a specific district court.

[80] LexisNexisLawSchools, *Understanding the Technology and Search Algorithm Behind Lexis Advance®*, YOUTUBE (Oct. 8, 2013), https://www.youtube.com/watch?v=bxJzfYLwXYQ&feature=youtu.be (discussed at 13:06 and following).

[81] *Id.*

terms in the document), prominence of the opinion, and how recent the opinion is.[82] Lexis Advance also states that changing word order or stop words will not alter the search results.[83]

When searching in a case database, Lexis Advance offers further filtering by court, date, publication status, practice area, attorney, law firm, most cited, keyword, and judge. Lexis does not offer any secondary sources when searching in a case database until the researcher clicks on a case; then the researcher can view a "Legal Issue Trail" that highlights important passages of the case being viewed, or the researcher can Shepardize the case and view secondary sources. [84]

C. Fastcase

Fastcase supports using a natural language algorithm.[85] According to Fastcase's promotional materials, "natural language searches are much less precise" than Boolean searches, "but they are good place to start if you are new to legal research, or if you are delving into a new area of the law." [86] Ed Walters, CEO of Fastcase, says that natural language is good if you are totally at sea, but only then.[87] The natural language algorithm returns cases with "the highest

---

[82] *See Lexis Advance Faculty FAQ*, LEXISNEXIS.COM, http://www.lexisnexis.com/documents/pdf/20111216091630_large.pdf [https://web.archive.org/web/20160620151641/http://www.lexisnexis.com/documents/pdf/20111216091630_large.pdf] (last visited Oct. 13, 2016) ("Lexis Advance uses a variety of proprietary methods in producing relevant results for our users; 'relevance' as we have defined it means that the document a user would expect to find in their results appears as one of the first five documents in a user's results set. To ensure this result, LexisAdvance includes, but does not limit, the following:
a. Automatic phrase recognition
b. Case name recognition…
d. Proximity search between the terms
e. Activity score boosting in the ranking algorithm (i.e. "landmarkness" of the case)").

[83] *Differences That Deliver*, *supra* note 80.

[84] For this **one** instance, there were no relevant further materials to be found either following the relevant Legal Research Trail or reviewing secondary sources in the Shepard's report,,

[85] *What Are Boolean Searches, Natural Language Searches and Citation Searches?*, FASTCASE.COM, http://www.fastcase.com/faq/ [https://perma.cc/K77N-HB9W] (last visited Oct. 13, 2016); E-mail from Ed Walters, Chief Exec. Officer, Fastcase, to author (May 4, 2015, 15:01 MST) (on file with the author).

[86] *Documentation and Downloads*, FASTCASE.COM, http://www.fastcase.com/documentations-and-downloads/ [https://perma.cc/7TW5-AXKG] (last visited Oct. 13, 2016).

[87] E-mail from Ed Walters, *supra* note 86.

relevance scores based on [the researcher's] overall mix of search terms." The results may include cases that do not have all of the search terms.[88] In Fastcase, the researcher chooses to use natural language searching. In Fastcase whether or not you filter before or after your search, the same number of results are returned. [89]

Once case search results appear, Fastcase supplements the results with Forecite, an algorithm that suggests relevant cases that do not include the words in the researcher's search, and results from Hein-on-Line's law reviews and journals database. Again, the relevance of the law review articles is related to the relevance of the search results.[90] Fastcase has announced that it will reveal what factors it weights in its ranking algorithm, and will allow researchers to adjust the weights to suit particular research strategies, which, of course, may change with the context of the problem being solved.[91]

D. Ravel

Ravel Law's Quick Start Guide describes how its search algorithm works when you enter keywords:

---

[88] Fastcase finds that "Lawyers, law professors, and law students will always get better results searching with Keyword (aka Boolean) searches." *Id.*

[89] Here are the instructions given to research assistants to limit results to a specific jurisdiction:

On the start page, click advanced case law search on the left, or the link at the top of the page.
Enter your search (e.g., agency follows clear congressional intent)
Leave the Keyword Search button on
Click on the Individual Jurisdictions radio button on the left, under Select Jurisdictions Select US District Courts, and click on your specific court (e.g., Michigan Eastern District) Make sure that the start date (under Search Options) is January and Before 1925
Make sure the Results are sorted by Relevance
Run the search
Filter out unpublished cases

Note that following this path leads to an exact number of results (e.g.,68 results); and filtering to the specific court after the search is done yields the same results (e.g. 68 cases).
versus filtering to the specific court after the search is done (e.g. over 927,000 cases).

[90] In this **one** instance, the secondary sources were helpful.

[91] E-mail from Ed Walters, Chief Exec. Officer, Fastcase, to author (Sept. 15, 2016, 14:24 MST) (on file with the author).

> When you enter a search, Ravel finds all cases that contain those keywords and then ranks them based on a combination of how those keywords appear in the case, and how important that case is more broadly. Ravel ranks the importance of each case by looking at the citation network – assessing how many and which other cases cite to a given case. [92]

Ravel therefore appears to be using term inclusion, term proximity, term frequency, and citation analysis to determine results, and then, on the main results page, providing a unique visualization tool to help lawyers find more relevant cases. Ravel's visualization shows the top 75 results based on your keywords.[93] The visualization map shows circles for cases; the larger the circle, the more important the case is in terms of the number of times it has been cited.[94] Of course, the relevance of the cases shown in the visualization is related to the relevance of the cases returned in the results set as a whole.[95] Once you click on a case in the list to read, additional help is provided in the form of "case analytics."[96]

---

[92] *Ravel Law Quick Start Guide*, RAVELLAW.COM, 16 https://d2xkkp20fm9wy8.cloudfront.net/downloads/Ravel_QuickStart_Guide.pdf [https://web.archive.org/save/_embed/https://d2xkkp20fm9wy8.cloudfront.net/downloads/Ravel_QuickStart_Guide.pdf] (last visited Oct. 13, 2016).

[93] *Id.* at 5. Ravel returns a list of cases on the right, ranked by relevance, and a visual map of the 75 most relevant cases shows on the left, which can be filtered by court and relevance).

[94] *Id.; see also* Ravel Law, *Overview of Ravel's Data Visualization,* VIMEO (May 11, 2015), https://vimeo.com/127559698 [https://perma.cc/GK5M-NXAH].

[95] Daniel Lewis, the CEO of Ravel, explains that "What we try to communicate about visualization is that it's tailored to the way that *lawyers* do research, which is about fitting together 20-30+ cases, which is a very different kind of research than doing a Google search." E-mail from Daniel Lewis, Chief Exec. Officer, Ravel Law, to author (Mar. 31, 2016, 15:18 MST) (on file with the author). For this **one** query, the visualization map was not that helpful without further refinement.

[96] *Ravel Law Quick Start Guide*, *supra* note 93, at 7. Ravel Law Case analytics show how pages within a case have been cited: the left column within a case shows how each page in an opinion has been cited by later cases and the citations are grouped when they discuss a similar principle of law. The more citations a page has, the more stars appear next to the page number. Ravel results are the same whether or not you filter before or after running the search. Here are the instructions given to research assistants to limit results:

> At the home page, enter your search (e.g., agency follows clear congressional intent)
> In Jurisdictions, start typing your court (e.g., Eastern District of Michigan)
> Do not collect unreported cases or Supreme Court cases.
>
> Note: The results are the same whether or not you pre-filter or post-filter (The results that show in the search bar when you limit jurisdiction first (e.g. 216 cases) are the same if you search first, (e.g. 26483 cases) and limit jurisdiction later, you still get the same results (e.g. 216 cases).

E. Casetext

Casetext's relevance algorithm is a function of keyword frequency, citation count, date, and jurisdiction.[97] The user interface lists the results by relevance, although the researcher can re-sort by date or citation count. There are tabs that lead the researcher to other texts, regardless of jurisdiction, and to organizations, communities, and posts. [98] Once the researcher opens a relevant case, Casetext provides "Summaries from Subsequent Cases" and "Key Passages from this Case." The summaries are parentheticals, showing how the case has been paraphrased by later judicial opinions. Key passages are extracted important language from the case, together with the number of times the extract has been cited by later courts.[99] You cannot pre-filter for jurisdiction in Casetext.[100]

F. Google Scholar

Google Scholar's case law database is meant to provide access to the law to the

[97] E-mail from Pablo Arredondo, Vice President, Legal Research, Casetext, to author (June 12, 2016, 17:33 MST) (on file with author).

[98] In this **one** query, the top post results were not relevant. The posts are crowd-sourced by lawyers, students, and librarians, and as such, are a form of heteromation, where the labor of a group is free and is used to enhance an automated experience. *See* Hamid Ekbia & Bonnie Nardi, *Heteromation and Its (Dis)contents: The Invisible Division of Labor Between Humans and Machines*, FIRST MONDAY, June 2, 2014, http://firstmonday.org/ojs/index.php/fm/article/view/5331 [https://perma.cc/EG2Z-P] (discussing an experiment using a free online community to solve folded protein puzzles, called FoldIt).

[99] Hannah Doherty, *Mastering Case Law in Just 5 Steps with Casetext Pro*, CASETEXT.COM (Mar. 23, 2016), https://casetext.com/orgs/casetext/posts/mastering-case-law-in-just-5-steps [https://perma.cc/Q6KY-VLLW]. Step 1 is understanding the law, which is supported by the summaries; step 2 is finding the important key passages, which is supported by the passages and a heatmap that shows how frequently other court opinion and articles cite to each case in the opinion. For a detailed discussion of the utility of parentheticals to understand the evolution of a case over time, *see* Pablo Arredondo, *Harvesting and Utilizing Explanatory Parentheticals*, 1 LEGAL INFO. REV. 31 (2016).

[100] Here are the search instructions given to research assistants to limit results by jurisdiction in Casetext:

> At the home page, enter your search (e.g., agency follows clear congressional intent).
> Under Jurisdictional Filters, open the plus sign, and select US District Courts, then select your court (e.g. Eastern District of Michigan)
> There is only post-filtering in Casetext. Filter out unreported cases.
> Filter out any Supreme Court cases.

general public.[101] According to its "about" page, "Google Scholar aims to rank documents the way researchers do, weighing the full text of each document, where it was published, who it was written by, as well as how often and how recently it has been cited in other scholarly literature."[102] A study was done of Google Scholar's ranking algorithm, and the authors believe that Google Scholar gives the most weight to citation counts.[103] The occurrence of a search term in the title is also important, but search term frequency in the full-text does not seem to impact the ranking.[104] Google Scholar does not search for synonyms.[105] When limiting a search by jurisdiction, the results are the same whether filtering before or after searching. [106]When entering a query into the search box for Google Scholar, the page with the results of the search is just a list of cases. A researcher has to look at an individual case to get any links to other resources, such as the "how cited" function, which will take the researcher to other cases and related documents.[107]

G. Cost

There is a wide variation in the cost of these six databases. Without discussing

---

[101] Dr. Anurag Acharya, Distinguished Engineer, Google, Presentation at AALL Annual Meeting & Conference: Searching Legal Opinions: The Google Scholar Approach (July 22, 2012).

[102] *About Google Scholar*, GOOGLE SCHOLAR, https://scholar.google.com/intl/en/scholar/about.html [https://perma.cc/UN94-R8TP] (last visited Oct. 13, 2016).

[103] Joeran Beel & Bela Gipp, *Google Scholar's Ranking Algorithm: An Introductory Overview*, *in* 1 PROCEEDINGS OF THE 12TH INTERNATIONAL CONFERENCE ON SCIENTOMETRICS AND INFORMETRICS (ISSI'09) 230, 230-232, 241 (Birger Larsen & Jacqueline Leta eds., 2009), http://docear.org/papers/Google%20Scholar's%20Ranking%20Algorithm%20--%20An%20Introductory%20Overview%20--%20preprint.pdf.

[104] *Id.*

[105] *Id.*

[106] Here were the search instructions given to the research assistants to limit results to a specific jurisdiction:

On the home page, enter your search (e.g. agency follows clear congressional intent)
Click on the case law radio button and then click on the "Select courts" link
Under the Sixth Circuit, click the ED Michigan box and then scroll up or down and click the DONE button (651 results)
The number of results is the same if you limit by court first, click DONE, and then go back and enter your search terms. Note that Google Scholar does not include unreported cases.

[107] For the results of the **one** query, there were no secondary sources in the first few pages of results that listed in "related documents."

actual cost, which can vary widely, it is safe to say the Westlaw and Lexis Advance are the most expensive options; Fastcase is a low-priced option; Ravel[108] is free or low-priced; Casetext[109] is free, although new additions to the database, like Cara, require payment; and Google Scholar is free.

IV. The Empirical Study

A. Methodology

One of the unique things about legal databases is that you can actually set up a sandbox of as nearly identical sets of information as it is possible to achieve. Normally when you are searching there is no way to determine what is in the database. By limiting searches to the subset of reported cases within a specific jurisdiction, and using the same search terms in each database, it is possible to compare search results in a nearly identical group of documents.[110] If,

[108] Ravel's case research, annotations, and search visualization are free. More advanced features require a paid account.

[109] Casetext's case search and annotations are free and other enhancements are currently free.

[110] The coverage in each of the databases studied is as follows:

- Casetext has published federal circuit and district court cases from 1925 to present. *Search Queries*, CASETEXT.COM, https://casetext.com/search-queries [https://perma.cc/KD8T-96SQ] (last visited July 30, 2015).
- Ravel has published circuit court cases from 1925 and published district court cases from 1933. *What Does Ravel's Case Coverage Include?*, RAVELLAW.COM. https://ravellaw.zendesk.com/hc/en-us/articles/212634578-What-does-Ravel-s-case-coverage-include- [https://perma.cc/JPG8-BRQS] (last visited June 9, 2015).
- Fastcase has published circuit court cases from 1924 and published district court cases from 1932. *Scope of Coverage*, FASTCASE.COM, http://www.fastcase.com/whatisfastcase/coverage/ [https://perma.cc/RP4Q-WSXU] (last visited July 30, 2015).
- Google Scholar has published circuit and district court opinions from 1923 to current. *Google Scholar Search Tips*, GOOGLE SCHOLAR, https://scholar.google.com/intl/en/scholar/help.html#coverage [https://perma.cc/G8CF-39WG] (last visited July 30, 2015).
- Lexis Advance has published circuit and district court cases from 1791 forward, as jurisdictions are added. *Lexis Advance Content Listing*, LEXIS.COM, 3-5 https://web.lexis.com/help/research/ContentListing.pdf [https://web.archive.org/save/_embed/https://web.lexis.com/help/research/ContentListing.pdf] (last visited Oct. 14, 2016).
- Westlaw Next has published circuit courts cases from 1891 to current. *U.S. Courts of Appeals Cases*, WESTLAW.COM, https://1.next.westlaw.com/Browse/Home/Cases/USCourtsofAppealsCases (click on information button) (last visited Oct. 14, 2016). Westlaw's coverage for district court cases is 1779 to current, as jurisdictions have been added. *Federal District Court Cases*, WESTLAW.COM, https://1.next.westlaw.com/Browse/Home/Cases/FederalDistrictCourtCases (click on information button) (last visited Oct. 14, 2016).

for example, a search is executed in a database of all of the reported cases from the Northern District of California, there should in theory be an identical set of documents regardless of which legal database the researcher is searching. In actuality, there is a very small margin of potential difference because each database may have a slightly different start date for coverage.[111]

The current study arose out of a single search prepared for a presentation on algorithms in 2013.[112] The same search entered into different databases produced starkly varied results. For the presentation, the author looked at a single keyword search – the right to receive information[113] – across four databases. The results follow:

[111] *Id.* All database providers have coverage for all federal cases since 1933, and since only two cases in the three thousand cases reviewed in the project were earlier than 1933, minor differences in the earliest years of coverage may be deemed a matter of little importance.

[112] Susan Nevelow Mart et al., Panel discussion at the Association of American Law Schools 2013 Annual Meeting: Understanding Search Engine Algorithms: Can We Effectively Teach Legal Research Without Them? (Jan. 6, 2013).

[113] The right to receive information is a small but well-defined concept in constitutional law. *See* Susan Nevelow Mart, *The Right to Receive Information*, 95 LAW LIBR. J. 175 (2003).

Table 1: 2013 Comparison *right to receive information*

Lexis Advance	Fastcase	WestlawNext	Google Scholar
Celotex v. Catrett	Alderson v. US	Bd. Of Education v. Pico	Virginia State Bd of Pharmacy
Anderson v. Liberty Lobby	Fuller v. Dep't of Navy	Virginia State Bd of Pharmacy	Stanley v. Georgia
Branzburg v. Comm'r	Aitken v. Comm'r of IRS	Stanley v. Georgia	Martin v. Struthers
Houchins v. KQED	Gal-Or v. US	Martin v. US EPA	Griswold v. Connecticut
US v. Polizzi	Warren Browne v. IRS	Neinast v. Bd. Of Trustees	Kleindienst v. Mandel
Kreimer v. Bd. Of Police	US v. Whitnery	Kreimer v. Bd. Of Police	Red Lion v. FCC
Virginia State Bd of Pharmacy	Doe v. City of Albuquerque	Doe v. City of Albuquerque	Bd. Of Education v. Pico
Santa Monica Pictures v. Comm'r	Texas Medical Providers v.	Sund v. City of Wichita Falls	Procunier v. Martinez
San Antonio Sch. v. Rodriquez	US v. Morriss	Cline v. Fox	Lamont v. Postmaster
Columbia Broadcasting System	US v. Holmes	Kleindienst v. Mandel	Pell v. Procunier

Cases marked in light gray were unique and relevant,[114] while cases that are not colored are unique and not relevant. Of the forty cases shown, 70 percent (28 cases) are unique, while 42 percent were both relevant and unique. Cases colored dark gray appear in more than one

[114] Relevance is a highly disputed term. Relevant for the purpose of the searches discussed in this Article means that, measured against a statement of relevance given for each search, the case would or most likely would be put in a review pile for more detailed review later; that is, the case has the potential to be helpful to a research project on this legal subject. The statement of relevance for this search was "You are looking for cases that discuss factual situations involving the right to receive information as a listener or recipient of information." For a more detailed discussion of relevance, *see infra* Part IV, Section C.2.

database; seven of the cases are in two results sets. One case is in three databases. No case is in all four databases.[115] There were three takeaways from this effort:

- There are irrelevant results in the top ten results for all four databases;
- Seventy percent (28/40) of the cases were unique to one database; and
- Of those unique cases, slightly over half (16/28) were both relevant and unique.

At least for this one search, every algorithm was offering unique and relevant cases not returned in the top ten results by the other databases. So every algorithm had something interesting to add to the legal construct a researcher attempts to create by the searches being entered into the database. Knowing that algorithms do not remain the same, and that results will vary over time, the identical search was run in the same four databases in 2016. The results follow:

[115] In 2013, 80% of the Lexis results were relevant by my standards. But only 10% of the Fastcase results were relevant. The natural language search information in Fastcase says if you type in words, "You will get cases that best match the words and phrases in the query," but many of the cases in the results did not have the phrase "right to receive information." The algorithm was not privileging proximity in a way that would return cases first that had those four words right next to each other.

Abstract

The results of using the search algorithms in Westlaw, Lexis Advance, Fastcase, Google Scholar, Ravel and Casetext are compared. Six groups of humans created six different algorithms, and the results are a testament to the variability of human problem-solving. That variability has implications both for researching and teaching research.

Table 2: 2016 Comparison *right to receive information*

Lexis Advance	Fastcase	WestlawNext	Google Scholar
Illinois v. Gates	Morris v. Equifax	Stanley v. Georgia	Stanley v. Georgia
Branzburg v. Hayes	Wis. Rt. To Life v. Barland	Bd. Of Education v. Pico	Virginia v. State Bd. Pharmacy
Virginia State Bd. Pharmacy	Hull v. IRS	Virginia v. State Bd. Pharmacy	Martin v. Struthers
Kreimer v. Bd. Of Police	Sorrell v. IMS Health, Inc.	Doe v. Governor of New Jersey	Griswold v. Connecticut
Bd. Of Education v. Pico	Wood v. Ryan	Martin v. US EPA	Kleindienst v. Mandel
Gregg v. Barrett	Essential Information v. USIA	Doe v. City of Albuquerque	Bd. Of Education v. Pico
Family Trust v. Wolnitzek	Information Resources v. US	Neinast v. Bd. Of Trustees	Red Lion v. FCC
Stanley v. Georgia	McKesson v. Bridge Medical	New York Times v. Sullivan	Procunier v. Martinez
Paris Adult Theater v. Slaton	Sense v. Shinseki	Kreimer v. Bd. Of Police	Pell v. Procunier
Kleindienst v. Mandel	Weaver v. USIA	Near v. State of Minnesota	Lamont v. Postmaster General

Lexis now has just one irrelevant result, but only three of the cases from 2013 show up here. Seven cases are new, even though all of the new cases existed in the database when the first search was performed.[116] Fastcase now has two relevant results, but all ten results are new, and only two of those new results were not available in the database when the first search was

[116] None of the new cases are more recent than 2013, when the first search was performed.

done.[117] Westlaw now has two irrelevant cases and three of the cases are new.[118] All of Google Scholar's cases are the same, but the order in which they were returned changed. The Google Scholar algorithm seems to have been worked on the least. This chart illustrates very clearly that search results change over time by more than the mere addition of new cases to the database. The percentages of unique cases - 67 percent (27/40) remained about the same over time, while the percentage of cases that were both relevant and unique went up slightly – 66 percent (18/27). But the results from just one search, while provocative, are not statistically significant.

The study was expanded to include fifty different searches. Many of the searches were taken from the author's previous study of digests and citators,[119] and new searches were generated by the author's random reviews of current law review articles for legal concepts that might make a good search. Each search had to turn up at least ten results in each of the six legal databases, so that the coders could compare the top ten results from each database. Not every search worked in every database and not every jurisdiction returned sufficient results in some of the databases.[120] It is possible that focusing on cases with a robust search history, as was done for this study, introduces some bias of its own, but this was unavoidable.[121]

---

[117] Of those ten new results, two are dated 2014, after the first search was performed.

[118] One of the three new cases was decided in 2015, after the first search was performed.

[119] Susan Nevelow Mart, *The Case for Curation: The Relevance of Digest and Citator Results in Westlaw and Lexis*, 32 LEGAL REFERENCE SERVICES Q. 13 (2013).

[120] Research assistants were asked to run the searches and find the number of results in each database prior entering any data into the spreadsheet or reading cases to determine relevancy. To make the comparison of results consistent, each search had to return at least ten results in the chosen jurisdiction.

[120] If the original query did not return at least ten results in each of the six legal databases, first the search was tried in other, larger jurisdictions. If that did not work, a new variation of the query was crafted. If the query did not work in any jurisdiction, the query was discarded, and a new query crafted. Of the fifty queries originally created, the jurisdictional case database was changed fifteen times, three search queries were revised, and two queries were discarded.

[121] The statistical analysis performed on the fifty queries in six different legal databases for the top ten queries (3000 cases) is descriptive statistics. *See Analysis: Descriptive Statistics*, RES. METHODS KNOWLEDGE BASE, http://www.socialresearchmethods.net/kb/statdesc.php [https://perma.cc/WJ7B-6U22] (last visited Oct. 17, 2016). Regarding the selection of cases, *see also* Mark A. Hall & Ronald F. Wright, *Systematic Content Analysis of Judicial Opinions*, 96 CALIF. L. REV. 63, 105 (2008) ("The goal in selecting cases is not a perfect match between sample frame and research conclusions, but only a reasonable connection between the two. Inevitable imperfections

The searches were all simple keyword searches, and each was crafted to include multiple words and at least one legal phrase or legal concept, and to work in each legal database.[122] Because not all databases seem to recognize legal phrases with the same consistency, this may have introduced some bias in favor of algorithms that recognize more legal phrases without quotes. But researchers intuitively expect that cases that have the words next to each other will, because of proximity, be returned in the top results. Algorithms that do not privilege proximity to the extent that a case with the four words from the search right next to each other are returned before results with those same four words scattered through the text are not meeting researchers' expectations.[123] starting searches. For an actual research problem, of course, if the results from the first search were disappointing, the researcher would refine the search, adding or changing words and word order, or trying different resources. One hopes no researcher would stop with one search, or one resource.

Here are three of the actual searches that were used in the study:

special relationship constitutional duty protect public from crime (N.D. Cal.)

job performance racial classification constitutional (D. D. C.)

administrative search 4th amendment warrant requirement (S.D.N. Y.)[124]

in case selection methods often will not seriously threaten the entire validity of the study's findings. It usually suffices to acknowledge limitations fairly briefly.").

[122] For example, just adding quotes around a phrase will improve most searches. However, at the time the study was designed, one could not add quotes in Westlaw without adding adv: and that is not a first step most researchers take. Since the searches had to be identical in each database, a search without quotation marks worked in all databases.

[123] This expectation is based on years of discussions the author has had with legal research students about searching. This expectation may not be correct, but then researchers need to know that. This is another instance where algorithmic accountability would be useful.

[124] The text of all fifty searches is available (a permanent URL will be provided to a document in an institutional repository once the article has a citation) as Appendix B.

Where the search was "special relationship constitutional duty protect public from crime," the student coder was told: You are looking for cases where, despite the fact that state officials normally have no constitutional duty to protect the public at large from crime; the duty is (or is not) imposed by virtue of a special relationship between state officials and a particular member of the public (you are looking for the factual contours of a special relationship).

For the search "job performance racial classification constitutional," the coder was told: You are looking for cases that discuss situations where job performance is or is not related to race (parameters of acceptable racial classifications for work).

And for the search "administrative search 4th amendment warrant requirement," the coder was told: You are looking for cases about administrative searches and whether or not the search does or does not require a 4th amendment warrant.

These instructions set the stage for relevance determinations. If a case could be helpful to the legal construct in the statement of relevance in any way, it would be coded as very likely or likely relevant enough to go into the pile for later, more thorough review. Cases that seemed not be to be relevant were either very likely or likely to go into the discard files; these were the cases that would not need to be reviewed later on. This expansive view of relevance was meant to insure that cases that might work by analogy would be included as relevant. While this is certainly a subjective view of relevance, it is the way lawyers actually do a quick review of cases, mentally sorting results into helpful or not helpful to my issue. Stuart Sutton saw this as the creation of mental models of an area of law and as a basic determination lawyers make; in his view, "A relevant case is one that plays some cognitive role in the structuring of an argument." [125] Even though the study has tried to define relevance in the most expansive way, human coding of

[125] Stuart A. Sutton, *The Role of Attorney Mental Models of Law in Case Relevance Determinations: An Exploratory Analysis*, 45 J. AM. SOC'Y FOR INFO. SCI. 186, 187 (1994).

relevance has its own biases. Additionally, percentage of relevant documents may not be the best measure of relevance. For example, if the top ten results from one database have only two relevant cases, but those two are the most relevant in that area of the law, that might be a better result for the research than a search that returns eight relevant documents, but misses those top two most relevant cases. To determine relevance at that level of granularity requires subject expertise in each specific legal domain related to each search, which was not possible for this study.

The decision to limit the review to the top ten results was based on several factors. One factor was the sheer amount of time it takes to review cases. Fifty queries in six legal databases and ten results per database is three thousand cases to review. The ten result limit also fits in with actual user studies of the primacy of the top ten results in searchers' behavior: the default page view on Google, for example, is ten results and studies have found that researchers who are used to online searching will usually stop reading after the top ten results[126] and try

[126] Jessica Lee, *No. 1 Position in Google Gets 33% of Search Traffic [Study]*, SEARCH ENGINE WATCH (June 13, 2013), https://searchenginewatch.com/sew/study/2276184/no-1-position-in-google-gets-33-of-search-traffic-study [https://perma.cc/A6TC-L7SF] (showing that page 1 results (top 10) received 92 percent of all traffic); Daniel E. Rose & Danny Levinson, *Understanding User Goals in Web Search, in* PROCEEDINGS OF THE 13th INTERNATIONAL CONFERENCE ON WORLD WIDE WEB 13 (2004), http://dl.acm.org/citation.cfm?id=988675 (documenting a decrease in willingness to look at more than one page of search results). In academic research, researchers are noticing "horizontal information skimming . . . where people view just one or two pages from an academic site and then "bounce" out . . ." Ian Rowlands et al., *The Google Generation: The Information Behaviour of the Researcher of the Future*, 60 ASLIB PROC. 290, 294 (2008), http://www.emeraldinsight.com/doi/pdfplus/10.1108/00012530810887953. *But see* Gerard de Melo & Katja Hose, *Searching the Web of Data, in* PROCEEDINGS OF THE 35TH EUROPEAN CONFERENCE ON ADVANCES IN INFORMATION RETRIEVAL 869, 869 (Pavel Serdyukov et al., eds., 2013), http://dl.acm.org/citation.cfm?id=2458300 (positing that searchers don't want "ten blue links," they want "actionable information").

another search[127] or another legal resource.[128] One would expect in any event that the goal for each legal database provider would be to present the most potentially relevant results in the top ten, and Lexis Advance explicitly defines "relevance" as a "document a user would expect to find in their results appears as one of the first five documents in a user's results set." [129]

.

B. Hypotheses

There were three hypotheses for the study. The study was framed in the usual way, by stating a null hypothesis, and then testing to see if it was proved or disproved. [130] One null hypothesis was that, because the search algorithm for each legal database was trying to achieve the same result in the same pool of information by finding relevant cases, each algorithm would find the same cases. Another null hypothesis was that, because the algorithms all rank relevance, and the goal is to return relevant cases, the top ten cases would all be relevant. The last null hypothesis was that the coders would not agree on relevance. To test the last hypothesis first, in addition to the ten queries each coder reviewed across all six legal databases, each of the five coders reviewed five of the same queries, chosen with a random number generator. Using

[127] In fact, a recent study showed that researchers using online databases to solve an ill-structured legal research problem used multiple searches; one researcher entered ten search strings in seven minutes in an attempt to get to a case on a legal principal she thought of. Stefan H. Krieger & Katrina Fischer Kuh, *Accessing Law: An Empirical Study Exploring the Influence of Legal Research Medium*¸ 16 VAND. J. ENT. & TECH. L. 757, 775, 778 (2014).

[128] On the principle of least effort in information theory, *see* Marcia J. Bates, *An Introduction to Metatheories, Theories, and Models, in* THEORIES OF INFORMATION BEHAVIOR 1, 4 (Karen E. Fisher et al., eds., 2005). For an example of the principle of least effort at work, *see* Scott A. Moss, *Bad Briefs, Bad Law, Bad Markets: Documenting the Poor Quality of Plaintiffs' Briefs, Its Impact on the Law, and the Market Failure It Reflects*, 63 EMORY L. J. 59 (2013).

[129] *Lexis Advance Faculty FAQ*, *supra* note 83.

[130] Regarding the null hypothesis, *see* CHARLES WHEELAN, NAKED STATISTICS: STRIPPING THE DREAD FROM THE DATA 148-150 (2013). (To put the issue of null hypotheses in a simple legal context, in a criminal trial, the null hypothesis is that the defendant is presumed innocent; to reject the null hypothesis, the jury must find that the defendant is guilty "beyond a reasonable doubt.)

standard tests, the coders had moderate concordance. [131] More than moderate concordance can probably not be expected of legal reviewers, as ranking relevance is a highly subjective task even when constrained by the parameters set out for the coders in this study. [132]

The importance and immutability of the relevance rankings in this study must not be overstated. The relevance determinations were subjective, were constrained by the state of each algorithm at the exact time the research was performed, and were further limited by the precise legal problem posed by the statement of relevance for each query. Different researchers, using the same search terms, could be trying to solve a slightly different legal problem, and could reach much different determinations of relevance. What can be concluded, from the data the study used, is that at the time the queries were run, with the human, algorithmic, and legal constraints that then existed, the relevance rankings of the raters give an accurate although subjective snapshot of relevance for the six databases.

In addition to a relevance ranking for each case, the coders also noted the name of the cases returned, the jurisdiction that was being searched, the date of the case, the number of results returned by the search for each database, and the number of databases that case citation was found in (ranging from unique and only in one database to found in all six databases). The determinations that were made from this raw data are discussed in the next section.

---

[131] The tests used were Kippendorf's alpha and an intraclass correlation**,** There was moderate concordance for all five raters based on Kippendorf's alpha (.50) and an intraclass correlation of .55. The data sets for the concordance studies are available at (URL will be provided to a document in an institutional repository once the article has a citation).

[132] *See also* Jeffrey T. Luftig, *Statistical Analysis of the Data, Susan Nevelow Mart Study of Search Functions in Lexis and Westlaw*, https://dspace.library.colostate.edu/handle/10974/12902?show=full [https://web.archive.org/save/_embed/https://dspace.library.colostate.edu/bitstream/handle/10974/12902/StatisticalAnalysisDataUploadVersion.pdf?sequence=6&isAllowed=y] (last visited Oct. 17, 2016), for a positive concordance finding for coders making legal document relevance determinations, where the concordance results were similar to the findings in this study.

While each search within a jurisdiction had to return at least ten results to qualify for the study, the range of cases returned by query in each of the databases was large. As an example, the range of the number of cases returned in the results for Query 1, using the same search terms in the same jurisdictional case database was: 123, 909, 1730, 1197, 677, 25.[133]

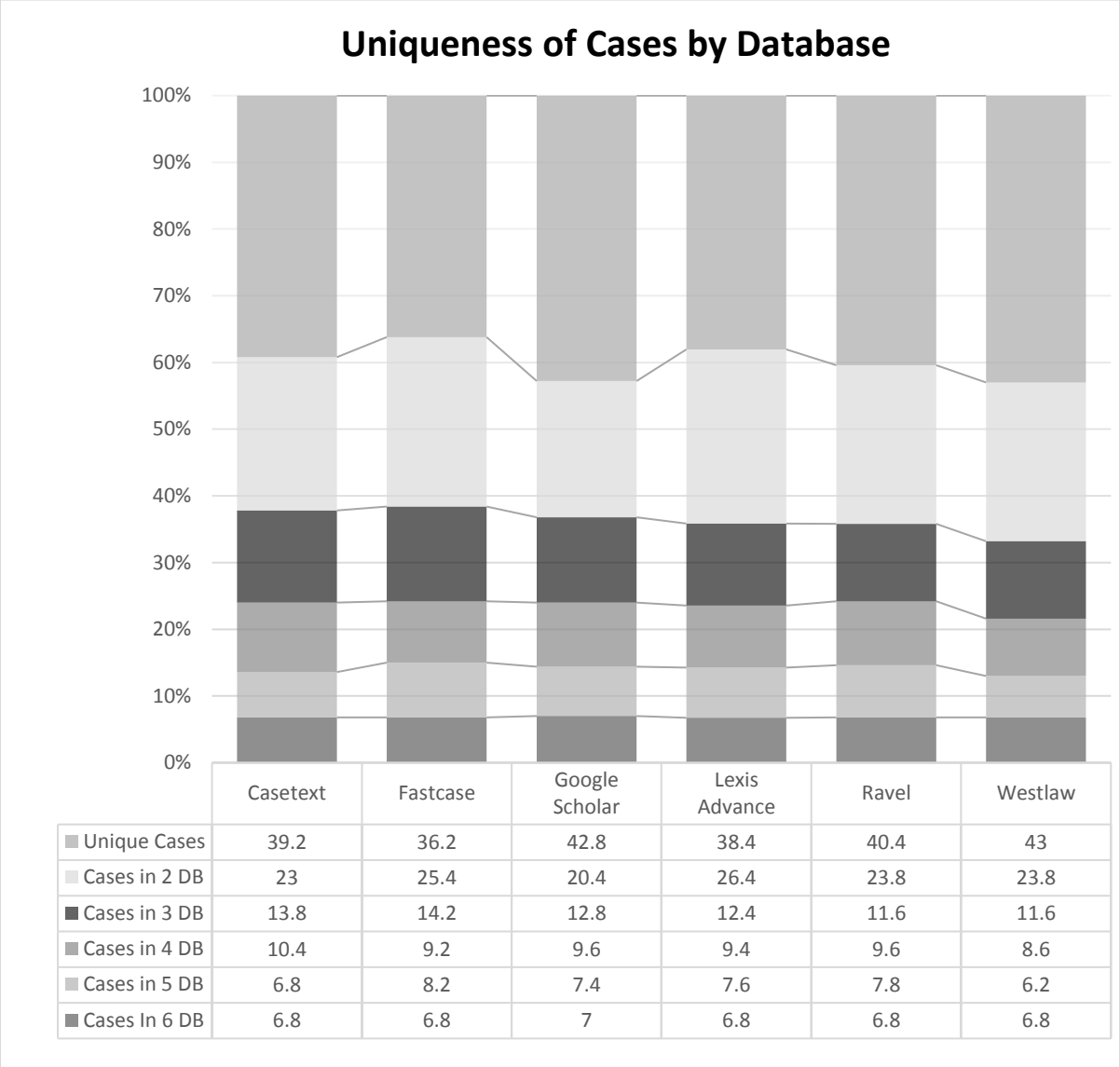
C. Results

1. Uniqueness Of Cases

In the study of one query, when the search was performed, there was very little overlap[134] in cases in the results for the four databases tested.[135] The first null hypothesis was that when there was a large number of searches, that result would not hold true. Because the search algorithm for each legal database was trying to achieve the same result in the same pool of information by finding relevant cases, the algorithms would find the same cases. As the chart below illustrates, the null hypothesis was disproved by the study, and each algorithm returns an average of 40 percent unique cases in its search results.

[133] *See infra* Chart XX for a full representation of the data on the number of cases returned.
[134] Overlap in this comparison is the occurrence of a specific case in two or more databases.
[135] *See supra* p. XX.

Chart 1: The Uniqueness of Cases in Each Database



	Casetext	Fastcase	Google Scholar	Lexis Advance	Ravel	Westlaw
Unique Cases	39.2	36.2	42.8	38.4	40.4	43
Cases in 2 DB	23	25.4	20.4	26.4	23.8	23.8
Cases in 3 DB	13.8	14.2	12.8	12.4	11.6	11.6
Cases in 4 DB	10.4	9.2	9.6	9.4	9.6	8.6
Cases in 5 DB	6.8	8.2	7.4	7.6	7.8	6.2
Cases In 6 DB	6.8	6.8	7	6.8	6.8	6.8

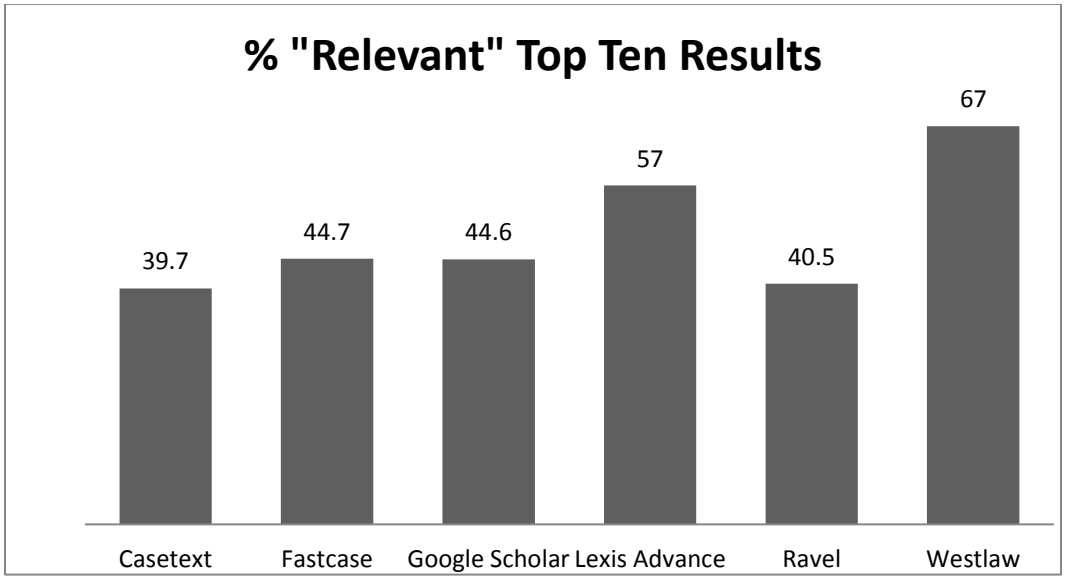
The percentage of cases in each category is very consistent across all of the searches. An average of 25 percent of the cases are only in two databases. An average of 15 percent of the cases appeared in three databases, while an average of 9 ½ percent of the cases appeared in four databases. Slightly less than seven percent of the cases appear in five databases and in six databases. So each group of human engineers is solving the search problem in very different ways and illustrating that each algorithm has something interesting to say about what a

searcher is looking for, but not the same interesting things. A fair percentage of cases from each database provider will give a researcher a unique set of cases to look at.

2. Relevance

The next null hypothesis was that, because the algorithms all rank relevance, and the goal of each algorithm is to return relevant cases, the top ten cases would all be relevant. That hypothesis was disproved. The following chart illustrates how many of the results found in the top ten results for each database were relevant by the standards set out in Section IV.[136] Recall that the standard for relevance was subjective, but expansive. There were more relevant results for the venerable legal database providers Lexis and Westlaw, at 57 percent relevance for Lexis Advance and 67 percent for Westlaw; the newcomers Casetext, Fastcase, Google Scholar, and Ravel were clustered together near 40 percent relevance.

Chart 2: The "Relevance" of the Top Ten Cases in Each Database



[136] Refer back to correct page cite

If you take a look at only the top five results, the number of cases Lexis Advance posits should all be relevant,[137] the percentages of cases that are relevant increased slightly for every database, but no one achieved 100 percent relevance for those cases:

Table 3: "Relevance" of the Top Ten and Top Five Cases Compared

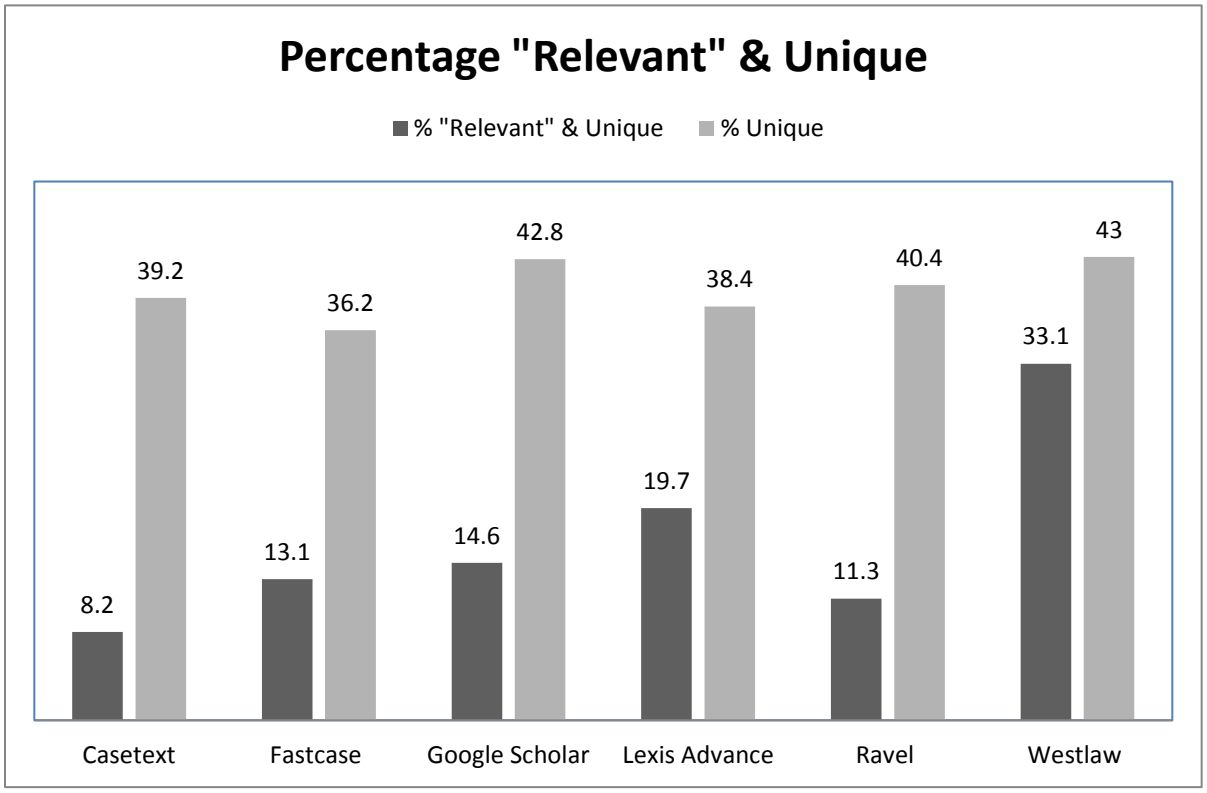
Database	**Top Ten**	**Top Five**
Casetext	39.7	45.0
Fastcase	44.7	49.2
Google Scholar	44.6	46
Lexis Advance	57	64.4
Ravel	40.5	43.8
Westlaw	67	77.6

3. Relevant and Unique

As Chart 2 illustrates, each database has an average of 40 percent unique cases in the top ten results, and there is not a lot of overlap in the remaining cases. That means that each database is providing a significant number of unique results. One question a researcher might want to know is: of those unique results that each database is providing, how many are relevant?

[137] *Lexis Advance Faculty FAQ*, *supra* note 83.

Chart 3: Percentage of Cases That Are Relevant & Unique, by Database



The chart shows that Westlaw returns the most relevant results in the unique category. Although there is a diminishing payoff for the remainder of the databases, each unique relevant case is one more opportunity to find a "relevant case …. that plays some cognitive role in the structuring of an argument."[138] The idea that every database has an individual world view of cases, classifications systems, and commentary that it is mining for relevant cases, and that therefore each database's algorithms has unique, relevant cases that may contribute to solving a legal problem that is not fully resolved by searching in only one database is not a concept that is easy to communicate to novice researchers. The best way for researchers to internalize the concepts is to figure it out on their own, and Appendix A provides a sample problem for students to illustrate

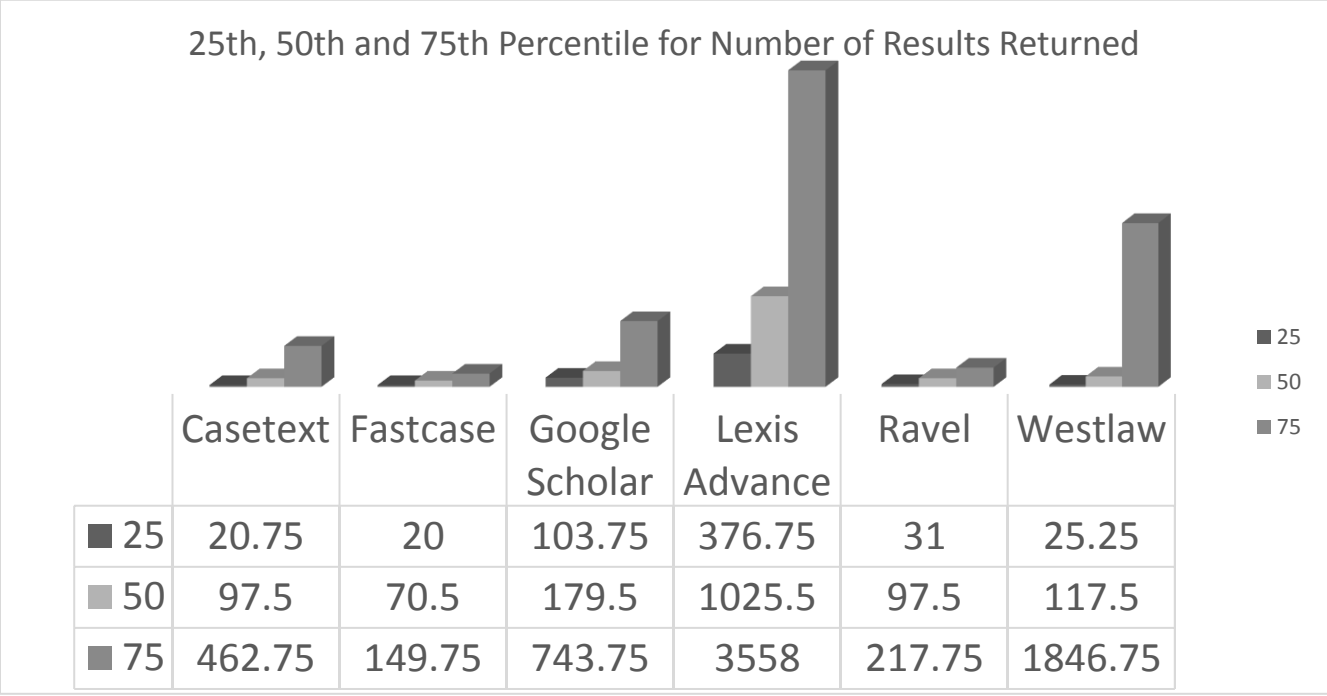
[138] Sutton, *supra* note 126, at 187.

the work of algorithms in legal databases.

4. Number of Results Returned by a Query

The study also looked for any statistical correlation between the number of results returned and relevance. For each query in a specific database, the number of results is the same, but since the relevance rank given to each of the top ten cases may not be the same, an average of the relevance rankings across the top ten results was used to see if relevance changed as the number of results changed. The number of cases returned by each database is reported below at the 25th, 50th and 75th percentile:

Chart 4: Number of Results Returned by Each Search, by Percentile



	Casetext	Fastcase	Google Scholar	Lexis Advance	Ravel	Westlaw
25	20.75	20	103.75	376.75	31	25.25
50	97.5	70.5	179.5	1025.5	97.5	117.5
75	462.75	149.75	743.75	3558	217.75	1846.75

Lexis Advance returns the highest number of cases, which is interesting when compared to the average relevance rating across most databases. In the chart below, the average relevance of the

top ten results stays fairly constant even when the number of results increases. For Lexis Advance, average relevance actually increases as the number of results increases.|

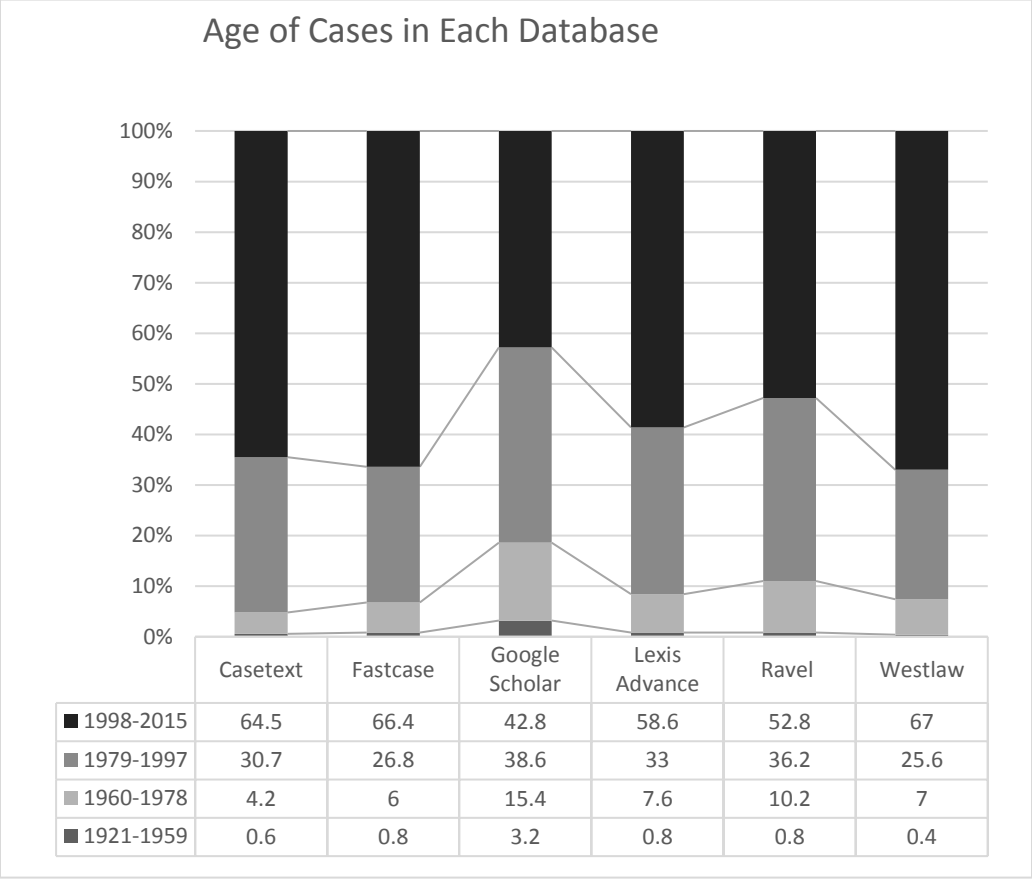
Table 4: Average Relevance Rating Within Number of Results Returned

# Cases	Casetext	Fastcase	Google Scholar	Lexis Advance	Ravel	Westlaw
>100	2.2316	2.3896	2.3091	2.6	2.4692	3.1455
100-499	2.4	2.4583	2.45	2.55	2.1289	2.8857
500-999	1.95	1.9967	2.6429	2.4	1.72	3.2
1000-1999	2.04		1.86	2.8727	2.1	3.0167
>2000	1.425	2.05	2.16	2.96	1.3500	2.65

5. Age of Cases

For the age of cases returned in each database, the following results show that Google Scholar returns the highest percentage of older cases, while Westlaw, Fastcase, and Casetext return the highest number of newer results.

Chart 5: Age of Cases in Each Database



	Casetext	Fastcase	Google Scholar	Lexis Advance	Ravel	Westlaw
1998-2015	64.5	66.4	42.8	58.6	52.8	67
1979-1997	30.7	26.8	38.6	33	36.2	25.6
1960-1978	4.2	6	15.4	7.6	10.2	7
1921-1959	0.6	0.8	3.2	0.8	0.8	0.4

Age of cases did not correlate in any statistically significant way with relevance.

6. **Discussion**

There is no way to account for the higher percentages for Lexis and Westlaw and the clustering effect for the newer database providers, beyond speculation. As speculation, it may be that the much greater investment in classification (as in Key Numbers and concomitant legal phrase recognition), mining of secondary sources, and leveraging machine learning from user search history gives Westlaw the greatest edge, as its largely human-generated classification system is the oldest.[139] In an earlier comparison of the classification

[139] The West Key Number System began in the 1890s. Ross E. Davies, *How West Law Was Made: The Company, Its Products, and Its Promotions*, 6 CHARLESTON L. REV. 231, 234-235 (2012).

systems in Westlaw and Lexis, the human-curated system in Westlaw had an advantage over Lexis's largely algorithmically-generated classification system, that despite changes in each company's algorithms and interfaces, still seems to make a difference.[140] Lexis's results are the second most relevant, and this may be because Lexis's algorithms utilize a topical classification system that it has been refining with machine learning since 1999,[141] a large collection of secondary sources, and, as the first online legal database, the longest repository of user history.[142] As Frank Pasquale has noted, having a large user base that contributes to the search algorithm with every search means that the "incumbents with large numbers of users enjoy substantial advantages over smaller entrants."[143] It is therefore not that surprising that the legal database providers with the largest user base and the longest search history to mine exhibit one kind of advantage over the newcomers. In terms of the general relevance of top ten results, there is an advantage to using the older providers' algorithms.

[140] Mart, *supra* note 120, at 13, 16, 25-29, 59. In the study, comparing the results of Key Number searches (Key Numbers are largely human-generated) with Lexis Topics searches (Topics are largely computer-generated), Westlaw's results were 61.7 percent relevant, while the Lexis Topic results were 38.3 percent relevant. *Id.*

[141] *Id.* at 16.

[142] Lexis became publicly available in 1973. For an interesting history of online access to legal opinions, *See* Gary D. Spivey, *Remembering James M. Flavin: The Origins (and Unintended Consequences) of Online Legal Research,* N.Y. ST. B. ASS'N. J., Feb. 2008, at 11, 18.

[143] Frank Pasquale, *Dominant Search Engines: An Essential Cultural & Political Facility, in* THE NEXT DIGITAL DECADE: ESSAYS ON THE FUTURE OF THE INTERNET 401, 411-412 (Berin Szoka & Adam Marcus eds., 2010).

In addition, the West classification system and the Lexis classification system reflect a nineteenth century world-view.[144] The classification systems are, of course, not identical,[145] and Westlaw and Lexis each have a unique set of secondary sources for their algorithms to mine. The classification differences and the differing set of secondary sources voices that contribute to search results leads to two possible kinds of viewpoint discrimination. The first kind of viewpoint discrimination is one librarians have long dealt with in acquiring treatises and secondary sources for library collections. Budgets allowing, librarians want more than one authorial viewpoint in their collection, because a treatise is only *one* author's view of the law; it is not the law. Since the different authorial viewpoints provided by the very different list of secondary sources in Westlaw and Lexis Advance are baked into their respective search results, it is not surprising that the results from Lexis Advance and Westlaw are different. Every database has about 40 percent relevant cases. Of those, Westlaw has 33 percent relevant and unique cases in the search results while Lexis Advance has 20 percent.[146] It is possible that those different relevant results reflect the different classification systems and secondary sources. So long as researchers have to deal with databases that import viewpoints into their algorithms, it seems to be a positive that each offers results based on differing classification and authorial viewpoints.

---

[144] The asserted hegemony of the West worldview is thoroughly discussed in Robert C. Berring, *Legal Research and the Universe of Thinkable Thoughts*, 2 J. APP. PRAC. & PROCESS 305 (2000), http://scholarship.law.berkeley.edu/facpubs/694/. *But see* Joseph A. Custer, *The Universe of Thinkable Thoughts Versus the Facts of Empirical Research*, 102 LAW LIBR. J. 251 (2010). Of course many lawyers did not use legal publications that incorporated the West classification system. But to the extent that the Langdellian method of teaching law recreates a similar classification decade after decade, generations of law students have parsed out the levels of classification in, for example, the formation of a contract in ways very similar to the West system. *Compare* CLAUDE D. ROHWER & ANTHONY M. SKROCKI, CONTRACTS IN A NUTSHELL ix-xxvii (7th ed. 2010), *with* WEST'S ANALYSIS OF AMERICAN LAW: GUIDE TO THE AMERICAN DIGEST SYSTEM 370-382 (2015). Although the exact outlines differ, the subject matter is broken down into similar patterns of essentials for formation, interpretation, performance, and defenses or breach. So is the Topic outline for Contracts in Lexis, where Topics to look at include formation, condition, performance, interpretation, breach and defenses. Whether the world view is based on the West classification system itself or the Langdellian world-view that older classification systems reflect, newer legal research databases may be freer of the whatever limitations that world view imposes.

[145] Mart, *supra* note 120, at 18-21.

[146] *See supra* Chart 3.

The second kind of viewpoint discrimination is one we don't think about that much, and that is the 19th century world view of the legal system explicitly embedded in Westlaw's Key Numbers and in Lexis's Topics. These classification systems, while not identical, follow a pattern that will be familiar to everyone who has taken contracts in law school, and that is firmly based in the Langdellian view of the world, where the subject matter is broken down into similar patterns of essentials for formation, interpretation, performance, defenses, and breach.[147] This view is a form of filtering, for better or worse, and the newer legal research databases may be freer of the whatever limitations that world view imposes. So researchers looking for an alternative to that Langdellian point of view may gravitate towards the newer database providers. The newer entrants into the legal markets may be offering, in their 40% of cases that are unique, something outside the range of that old world view, and with the value added results that users see on the results page,[148] they may be offering new forms of serendipity in search. Researchers looking for an alternative may gravitate towards database providers that offer search results from different world-views of the legal universe.

V. Conclusion

There are a few specific findings that can be stated about the legal databases in the study. For results that return the largest number of more recent cases, researchers should turn to Casetext, Fastcase, and Westlaw. The highest percentage of relevant cases, as defined in this study, can be found in Lexis Advance and Westlaw. Google Scholar has the most older cases in its results. And Lexis Advance returns searches with the most results. More generally, the study shows that every algorithm starts with a different set of biases and assumptions. Even for

[147] *See* discussion *supra* note 145.

[148] See *supra* p. XX for a discussion of the value added features each database provider presents to the researcher once a search has been executed.

returning results from searches in a specific case database, every algorithm draws on a different set of sources and processes, whether those sources and processes are classification systems, secondary sources, citation networks, internal case analyses, mined user search history, or machine learning deployed in the unique environment each legal database provider offers. These algorithmic variations in "world view" lead to substantial variations in the unique and relevant results each database provides. The knowledge of this variability expands the opportunities for researchers to find relevant cases that can play "some cognitive role in the structuring of an argument."[149]

Legal information literacy requires lawyers to be "self-reliant in their investigations" of the law.[150] Legal research professors hope to teach their students to achieve the metacognitive skills required to be self-reliant. Black-boxing the research process is not helping educators or students achieve this goal. Algorithmic accountability will help researchers understand the best way to manipulate the input into the black box, and be more certain of the strengths and weaknesses of the output. Asking for that kind of accountability can be successful. It was successful for doctors using Watson in oncology departments,[151] and, in response to requests, some database providers have made some of their assumptions much clearer.[152] This article is, in part, a call for each of us to request more accountability from database providers. It is as true now as it was in 1963, when Reed Lawler wrote about *What Computers Can Do*, that, "If you ask the wrong question, you will get the wrong answer."[153] We need more detailed information

[149] *Mental Models*, *supra* note 126, at 187.

[150] Dennis Kim-Prieto, *The Road Not Yet Taken: How Law Student Information Literacy Standards Address Identified Issues in Legal Research Education and Training*, 103 LAW LIBR. J. 605, 606 (2011) (citing *Proceedings: First Session*, 1 AM. LIBR. J. 123–24 (1876) (comments of Otis H. Robinson)).

[151] *See* Friedman, *supra* note 55.

[152] LexisNexisLawSchools, *supra* note 81.

[153] Reed C. Lawler, *What Computers Can Do: Analysis and Prediction of Judicial Decisions*¸ 49 A.B.A. J. 337, 338 (1963). Mr. Lawler was a "pioneer investigator in the application of computer technology and modern logic to the law." *Id.* at 337. Lawler believed that only those "trained in the law have the skill for asking good legal

in order to ask the right questions. The answers will allow legal researchers to be the engaged humans they need to be when working with computer algorithms.

questions. The computer scientist's job is to translate the question into machine language." *Id.* at 338. The human/machine teamwork Mr. Lawler foresaw continues to evolve.