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Rhetorical Agency in Algorithm-Centered Digital Activity: Methods for Tracing Agency in Online Research

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RHETORICAL AGENCY IN ALGORITHM-CENTERED DIGITAL ACTIVITY: METHODS FOR TRACING AGENCY IN ONLINE RESEARCH

by

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ABSTRACT

RHETORICAL AGENCY IN ALGORITHM-CENTERED DIGITAL ACTIVITY: METHODS FOR TRACING AGENCY IN ONLINE RESEARCH

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Contemporary scholars in rhetoric studies and technical communication have theorized rhetorical agency as engaging human and nonhuman actors in online spaces. One such space, where the work of scholarship, teaching, and technical communication practice intersect, is online research. In online research interfaces, scholars and students alike conduct research; scholars teach and students learn the online research process toward contributing knowledge; and technical communicators design and test meaningful user experiences in these interfaces.

However, the field offers few comprehensive methodologies for studying the emergence of rhetorical agency in online search environments, where the activities of technologies, humans, corporations, and environments coalesce. As a result, technical communicators, who both study the meaning-making activities of technologies and seek to explain those activities through technology-mediated practices, lack methods that would enable them to test the validity of emerging theoretical frameworks for understanding rhetorical agency in online activities like research.

This study implements modified usability tests and collects technical browser data to identify and trace the emergence of rhetorical agency among human, technological, environmental, and ideological actors during online research activity initiated using an online library search interface. In an IRB-approved case study, the study synchronizes user and technological activities centered around the web browser. Through detailed analysis of usability

testing recordings along with data collected in HTTP archive files, the study traces rhetorical agency to the millisecond as human, technological, environmental, and ideological activities converge in the research process.

The study reveals agency as emerging, shared among collective actors during online research. It provides the field accessible methods for tracing rhetorical agency in posthuman assemblages of human and nonhuman entities engaged in meaning-making activities. It concludes with the following implications:

1. Scholars should develop and test updated methodologies that address posthuman agency.
2. Rhetorical agency in online research should be re-examined for its assemblage and emergent qualities.
3. The "end user" of UX design should be recognized and treated as an assemblage.
4. The field should teach online search as a rhetorical activity.
5. Critical media literacies must widen their critique to include posthuman agency.

This dissertation is first and foremost dedicated to Deborah, Sydney, and Emily. Without your sacrifice, love, and support, I could not possibly have completed it. Thank you. You're my world.

It is also dedicated to my parents, Tom and Martha, who instilled in me early a love of learning and language.

It is also dedicated to the staff and administration at the University of Richmond School of Professional & Continuing Studies, who made possible the rather improbable task of completing a dissertation while working full time and teaching part time.

Finally, it is also dedicated to Aviva, whose 11th and 12th grade English classes inspired me to become an English teacher and, in doing so, to make a difference in the world.

ACKNOWLEDGEMENTS

This doctoral journey started with a suggestion from Dr. Erik Nielson, who encouraged me to apply—and reapply—to the ODU English doctoral program. My undergraduate and graduate mentors, Dr. Terryl Givens, Dr. Dona Hickey, and Dr. Joe Essid, reached back far into their memories to recommend me to the ODU English department. Without their intervention, I would not be here.

The idea for this dissertation emerged at the Southwest Popular/American Culture Association (SWPACA) annual meeting in 2015, where I met Dr. Marc Ouelette and Dr. Stephanie Vie. They joined Maury Elizabeth Brown, a frequent collaborator in those earlier days, in encouraging me to pursue the hair-brained scheme to study the rhetoric of algorithms. Dr. Shelley Rodrigo and Dr. Julia Romberger set me on the path of studying network activity, and Dr. Delores Phelps provided the tools and confidence to explore new theories and develop new methods.

The dissertation itself is deeply indebted to the guidance of my committee chair, Dr. Daniel Richards, who kept me encouraged and focused, provided timely and pragmatic feedback, and ensured that my scholarship was valued and recognized by the department and by the field. When he recommended that Dr. Emma Rose join my committee as outside reader, he recognized the invaluable insight on methods and practice she'd bring to the dissertation. She joined Dr. Romberger, whose expertise in networks and rhetoric was deeply influential, and Dr. David Metzger, whose instruction in modern rhetorical theory made me see the world anew, as my dissertation committee. I could not have asked for better. To all of you, thank you for guiding me along this journey that is only just beginning.

And finally, I could not have completed this project without the support of remarkable graduate colleagues in the ODU English PhD program. Your struggles and successes have encouraged me to keep going, especially at the most challenging times. You overcame adversity, and I followed. I tread in the footsteps of giants, and I am deeply honored to be a part of this community of scholars.

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CHAPTER 1

INTRODUCTION

Early in my doctoral studies, I was chatting via Facebook Messenger with a colleague attending a gaming a conference in Sweden. The conversation centered around composition, rhetoric, and games. My colleague reported that scholars in attendance were discussing the rhetoric of games as both *procedural*, along the lines of Ian Bogost's (2010) *procedural rhetoric*, and *algorithmic*. As a third party to a conversation happening several time zones ahead of me, I gleaned little else about what *algorithmic rhetoric* in gaming might entail other than considering algorithms as scripted activities engaged in game play, either as player or character. However, I was hooked on this idea of algorithms, like procedures, influencing the way players and characters might engage in a game, digital or analog. To what extent could algorithmic approaches to games limit or expand a player or character's potential for action? To what extent might digital algorithms in games affect the game play itself, exerting their own rhetorical influence on game play and outcomes? What rhetorical agency might digital algorithms have in games?

Around this time, DeepMind Technologies, a machine learning research firm later purchased by Google, released prepress research on arXiv demonstrating that an algorithm programmed for deep reinforcement learning paired with a neural network could learn to play Atari video games and win them at a rate better than human experts (Mnih, et al, 2013). While parts of the write-up were certainly written at a technical level well over my head, one particular passage stood out: "Our goal is to create a *single neural network agent* that is able to successfully learn to play as many of the games as possible" (p. 2, emphasis added). Intrigued by their use of the term *agent*, I read further and discovered that these DeepMind Technologies

researchers had programmed a machine learning algorithm to use high-sensory dimensional inputs (i.e., the location of pixels on a screen in an Atari game) to teach itself, using recalled pixel locations and corresponding scores stored in neural networks, how to successfully play seven Atari video games, earning points and besting high scores of expert human players on three of the games. This network agent played independently, relying only on its machine learning algorithm and its programmed goal to earn points and demonstrate gaming competency. These results were later confirmed, expanded to additional Atari videogames, and released in a letter in *Nature* (Mnih, et al., 2015).

For me, the use of the term *agent* to describe this programmed game-playing network revealed the potential that digital algorithms, or algorithm-centered processes, could indeed have rhetorical agency. While the rhetorical agency of algorithms might not represent *persuasion* in the traditional understanding of rhetoric as the use of available means of persuasion in attempts to influence behavior, there is little doubt in these research write-ups (Mnih, et al., 2013; Mnih, et al., 2015) that algorithmic processes identify specific pixel locations at particular timestamps that result in scoring points, then recall those past conditions during current gameplay and use those recalled states to improve performance in the form of earning more points. In short, algorithmic processes taught themselves to play and win.

If digital algorithms that incorporate machine learning processes and neural networks can learn to make decisions about what matters in simple digital games, could similar algorithms and networks in different contexts make decisions about what matters? And if algorithms are making decisions about what matters based on programmed machine learning processes, what role do human actors play when engaging those algorithmic processes in day-to-day life? If algorithms have agency, where does that agency reside? And how do human users exchange agency with

algorithms? Where are the boundaries of human and machine agency? What implications do these boundaries have for the field of technical communication, where (human) users have become the center of our communication and design processes?

It is these questions that guide my inquiry into a specific use case where humans and algorithms engage with one another: in online search, specifically in the online research activities in which students and professors engage daily. And given the place of user experience (UX) in technical communication research, I approach the problem through a technical communication lens toward addressing the question of user agency and identity in digital algorithm-mediated activities. For this study, I use the term *algorithm* to represent digital search algorithms, collections of encoded procedures that index web content, seek to understand users' queries in context, and match those queries in indexed content. I use the term *agency* as Miller (2007) describes it, an emergent (rather than pre-existent) meaning-making energy "rhetorically functional only through interaction" (p. 149) that emerges through the differential relations of human and nonhuman entities involved in online search activity.

1.1 THE PROBLEM

Old Dominion University (ODU), like many academic libraries (see Reilly, Lefferts, and Moyle, 2012; and Wray, 2013), seeks to provide an accessible way for students, faculty, and staff to search its digital and physical collections.[1] On the ODU Library webpage as of the writing of this passage, ease of access is provided by the prominent search box, Monarch OneSearch, on its main webpage (see Figure 1.1).

[1] See the ODU Library's "About" page for a list of its strategic goals. Goal 2 reads as follows: "**Ensure access to the full scholarly record for the University community**. Through the investment in focused local collections, especially in areas of ODU's intellectual strengths, and collaborations with other institutions, the Libraries will enrich the research environment for the Old Dominion University community and ensure the ongoing accessibility of the comprehensive scholarly record" (Old Dominion University, 2017a, emphasis original).

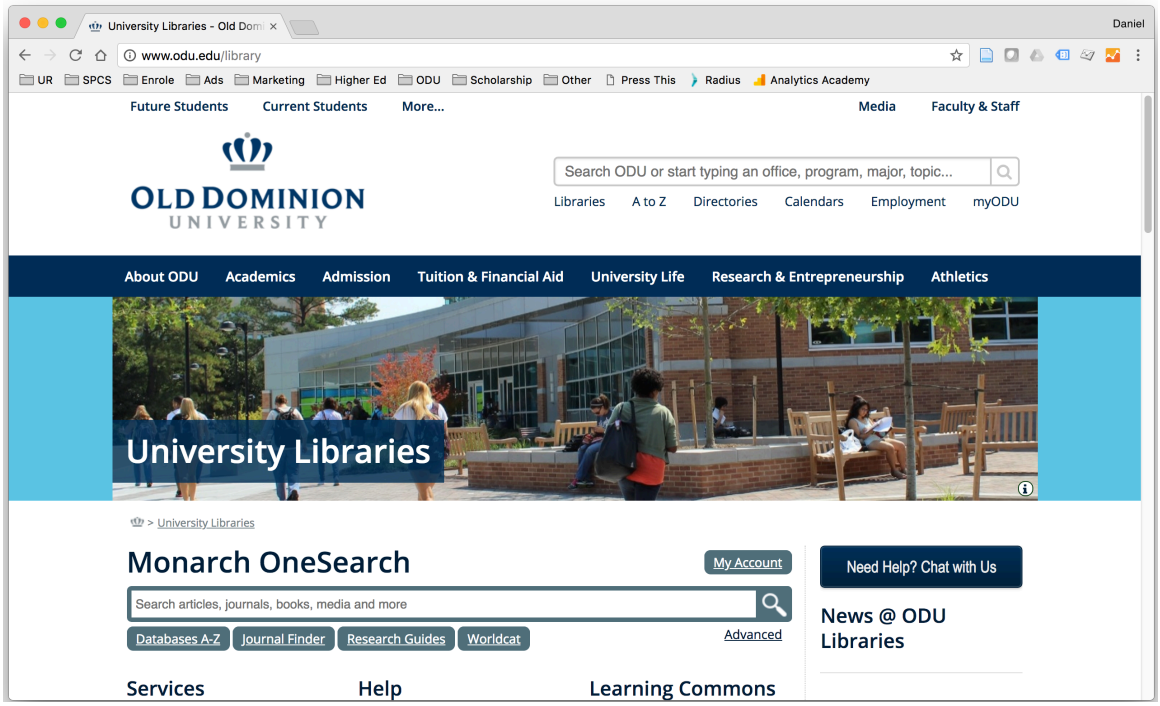

Figure 1.1. Prominent search box on the library's webpage. Old Dominion University. (2018a). *University Libraries*. Retrieved May 23, 2018, from https://www.odu.edu/library. Screenshot by author.

As the search box indicates, the search tool enables a researcher to search the library's collection of "articles, journals, books, media, and more" using this single search interface. A sample search, using the search phrase *rhetoric algorithms* without Boolean modifiers or quotes, yields a variety of results that open in a new browser tab: 2,851 peer-reviewed journal results, 7,654 full text online results, and four results available in the Library's physical collection (see Figure 1.2).

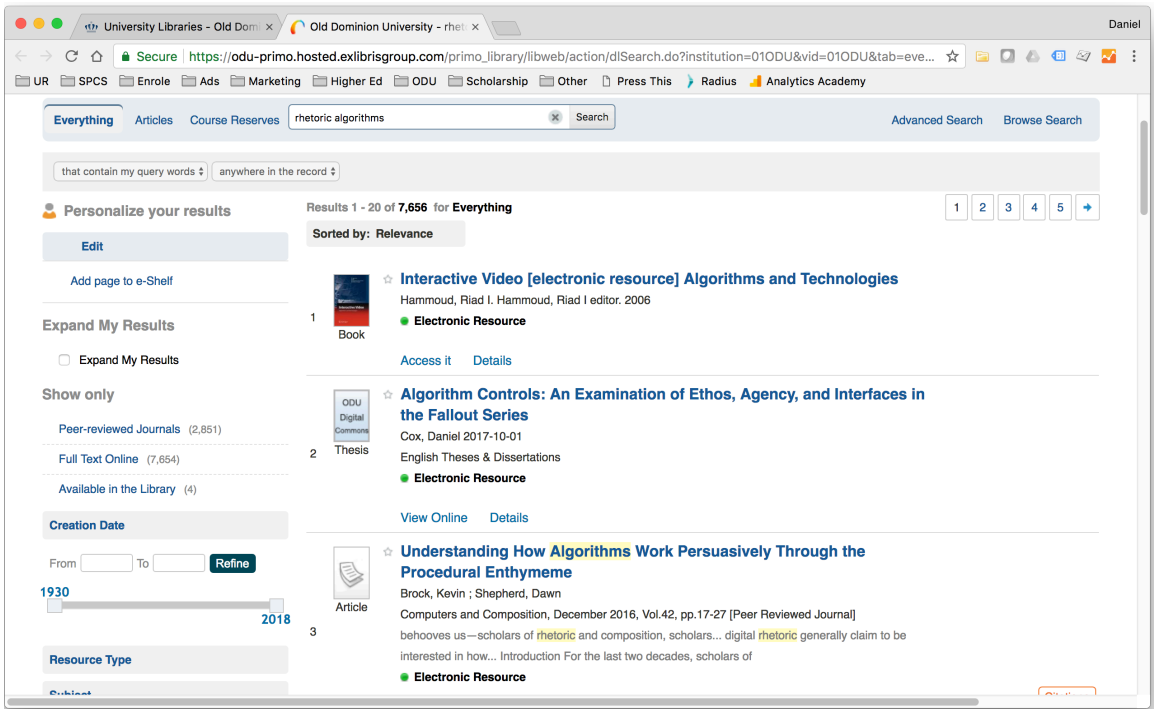

Figure 1.2. Library search results, opened in a new tab, for the search string *rhetoric algorithms*. Old Dominion University. (2018b). *Old Dominion University - rhetoric algorithms*. Retrieved May 23, 2018, from https://www.odu.edu/library. Screenshot by author.

A close inspection of the URL in Figure 1.2 reveals that the base URL has changed from www.odu.edu/library, shown as the URL in Figure 1.1, to a base URL (exlibrisgroup.com) that is not part of the ODU domain. The results page remains branded (not shown in Figure 1.2) as an ODU Libraries webpage and retains the general styling of the ODU site, but is clearly not hosted by ODU. This shift happens without notice as a result of conducting a search in the main search interface.

The activity of conducting a search using the library's accessible search interface reveals a symptom of the problem: Decisions made outside the awareness of the person conducting the search influence, direct, and limit potential results. The larger problem of which this is a symptom relates to the relationship between human and nonhuman actors engaged in search

processes. While a researcher who uses the library's prominent search interface is clearly conducting research using the tools provided, the search and its results represent the combined efforts of a human researcher and myriad human and nonhuman entities engaged in making the activity of online search possible. Online research as described above represents not merely the agency of a single researcher conducting online searches; rather, it is the combined efforts of human and nonhuman entities collaborating in unrecognized ways to achieve a result, the identification of a source that addresses some kind of research topic or question.

It is the unrecognized aspect of this collaboration that is most problematic. When researchers are unaware of the forces and entities with which they are collaborating to conduct research, whether "successful" or not (in the sense of finding sources that address a research topic or question), they cannot be sure they are fully in control of the research process. And, in fact, they are only partially controlling the process. As the example of the search results tab reveals, the influence of other entities collaborating with the researcher in research activities can be considerable and significant, but the influence goes largely unnoticed. In this case, the URL in the newly opened tab (shown in Figure 1.2) reveals that search results are not coming from the ODU library directly, but are instead coming from a largely unknown third party, exlibrisgroup.com.

A reasonable researcher might recognize what's happened and will trust that ODU had properly vetted this third party that is providing search results on pages from its domain. Yet no record of that vetting process appears on the ODU Library page. The ODU Privacy policy says this about "links to other websites" (although this was not so much a link as a hidden but required shift to another website): "The website may contain links to other public or private websites, whose privacy practices we do not control. ODU does not take responsibility for the

privacy practices of those websites or their content practices. You should check each website in order to understand its privacy policy" (Old Dominion University, 2018c). Following these instructions, no privacy policy can be found on the exlibrisgroup.com hosted results page. However, the "Help" link on the results page suggests that, despite shifting to a different domain, Monarch OneSearch "is the ODU Libraries' search tool" that "provides access to al [sic] of the Libraries' physical collections and some of our virtual collections by searching across our catalog and selected databases" (Monarch OneSearch Help, 2018). Ultimately, there is little information about why the search shifted from an odu.edu domain to the exlibrisgroup.com domain. However, the "Help" page provides a useful tip about search results that is accessible only after conducting a search and accessing the search results page: "Monarch OneSearch searches many of our databases, including ProQuest and Elsevier databases, however, **it does not include results from Ebsco** [sic] databases or others including **APA PsycNET**. For subject specific research we recommend going directly to a subject database via our Databases A-Z list or a Subject Guide" (Monarch OneSearch Help, 2018, emphasis original). The search interface and its search results page do not provide a clear explanation of what exlibrisgroup.com is or why the search results appear on a different domain than the search interface itself.

Further research—now requiring a Google search using the search string *exlibrisgroup*—reveals that Ex Libris Group is "an Israeli software company that develops integrated library systems and other library software" according to the Google Knowledge Panel (citing Wikipedia) that appears to the right of search results (see Figure 1.3).

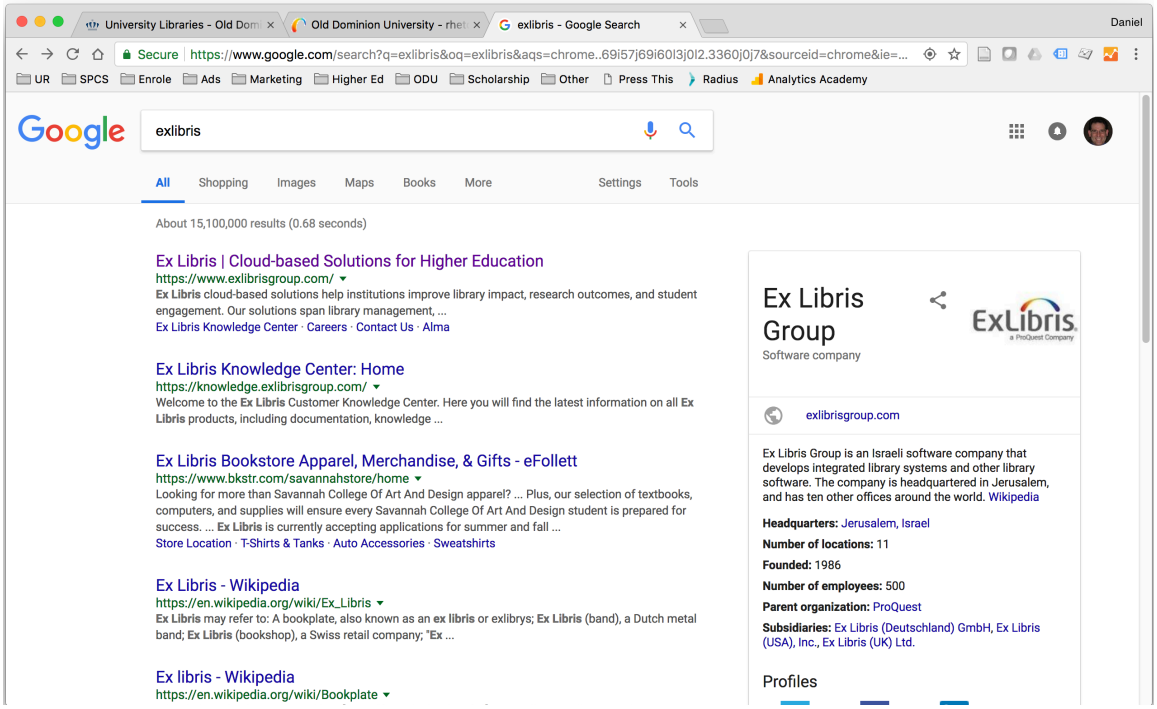

Figure 1.3: Results of search using search string *exlibris* on Google. The Google Knowledge Panel for Ex Libris Group appears to the right of search results, an automated suggestion matching my search term. Google. (n.d.a). *exlibris - Google search*. Retrieved May 23, 2018, from https://www.google.com/search?q=exlibris. Screenshot by author. Google and the Google logo are registered trademarks of Google LLC, used with permission.

Visiting the Ex Libris Group website reveals that Ex Libris is a ProQuest company, which explains why EBSCO database results and APA PsycNET results do not appear in searches using Monarch OneSearch. ProQuest is a massive information technology company competing directly with EBSCO, a similarly massive information and technology company. Elsevier and ProQuest have completed several mutual sharing agreements that enable Elsevier titles to appear in ProQuest searches; I surmise that ProQuest has no such agreements at this point with EBSCO and APA. What's clear is that changing from the odu.edu domain to the exlibrisgroup.com domain when completing a Library search using its prominent search interface *limits, without obvious notice,* the possible results available to researchers.

Tracing the relationship between the odu.edu and exlibrisgroup.com domains is not intended to unduly criticize the ODU Library website. Personal experience on other university libraries suggests that this experience is more routine than exception. Rather, tracing this relationship is intended to demonstrate the heart of the problem: that agency resides not only in the search activity of researchers, but also in the programmed and algorithmic processes that enable those searches. In this instance, researchers who use a trusted interface for research like the ODU Library search interface enter into collaborative relations with programmed and algorithmic processes for knowledge research and building, relations they are largely unaware exist or could influence their research. This dissertation seeks to address this problem by revealing the programmed and algorithmic agents that collaborate with researchers to generate results, by tracing the collaborative relations that emerge during online research, and by identifying specific programmed and algorithmic processes with which researchers exchange agency throughout the research process. It does so using the methods of technical communication research influenced by Actor-Network Theory's (ANT) theoretical approach to agency (Latour, 2005).

1.2 ADDRESSING THE PROBLEM

The problem this dissertation seeks to address hinges, at least in part, on *trust* and *obscurity*. Researchers who use a trusted interface for research like an academic library's search interface are entering into unforeseen and unrecognized collaborative relations with algorithmic processes for knowledge research and building. The collaborative relations may be partially known by researchers—after all, few researchers are likely unaware that digital algorithms are involved in online search—but the algorithmic processes and their influences on research remain "black boxes," hidden from view. A 2017 Pew Research Center report states the problem as

follows:

> Because algorithms are generally invisible—even often referred to as "black box" constructs, as they are not evident in user interfaces and their code is usually not made public—most people who use them daily are in the dark about how they work and why they can be a threat. Some respondents said the public should be better educated about them. (Rainie & Anderson, 2017)

As this dissertation unfolds, the black box technical complexity of algorithmic processes emerges. This complexity obscures the influence that programmatic and algorithmic processes have on mundane research activities, such as the unseen programmed shift from one domain to another during the search process. Rainie and Anderson (2017) point out the ethical imperative that some respondents "said the public should be better educated" about algorithmic activity. The expectation to understand the complexity of algorithmic processes in research may be seen by many as laughable, given the complex mathematics that drive such algorithms. Yet the ethical imperative remains clear: Even if it's extremely difficult, such influences must be revealed, lest they contain within their programming nefarious intent or inhumane bias. Researchers, including students assigned research projects; scholars engaged in research; and the general public seeking online to find answers to questions; are similarly "in the dark" about the algorithmic processes that affect and influence their research process. Trust in the obscured is a dangerous precedent. This dissertation seeks to address this problem by revealing the complex relations involved in the algorithm-mediated process of online academic research. It uses the lens of technical communication to accomplish that tracing because this field, better than many others, seeks to make clear highly technical processes and concepts for its recipients.

Addressing the problem of trust in unseen algorithmic influence relies on being able to reveal to a public (in this case, the public of researchers, broadly conceived) the active influence of algorithmic processes in online research activities. Addressing problems involving technical

and human participants falls squarely in the realm of technical communication. Although David N. Dobrin (1983/2004) may reflect that his original definition of technical writing as "writing that accommodates technology to the user" (p. 118) was influenced by his "desire for economic security" (p. 107) at the time of its writing, that definition remains useful in understanding problems in technical communication. For the problem of algorithms as unseen influences on researcher activity, a clear need for accommodating technology to the user exists. Here "accommodate" takes the meaning of *make clear and visible* to the user; the goal of this dissertation is to demonstrate methods for accommodating to researchers the algorithm-centered processes encountered during online research.

In *Solving Problems in Technical Communication*, Johndan Johnson-Eilola and Stuart A. Selber (2013) position technical communication as a "problem-solving activity" (p. 3). I am positioning the problem of trust in unseen algorithmic influences during research processes as the kind of complex problem that Johnson-Eilola and Selber claim technical communication seeks to address. They describe such complex problems as "subjective phenomena open to analysis and interpretation, open to change over time and rarely solved permanently, and engaged by multiple actors in a social space" (p. 4). In the example of online library research, the process of conducting online research relies in large part on the researcher's information literacy and prior experiences with online search. Algorithmic processes change regularly, requiring continual adaptation on behalf of the researcher. And because online research activities are deeply mediated by technologies, procedures, environments, networks, and programmers (among others), many entities, human and nonhuman, are engaged.

Johnson-Eilola and Selber (2013) offer a useful approach to addressing problems that I'll incorporate into this dissertation. They offer a four-phase heuristic in their introduction to help

readers learn about the field of technical communication; I adapt this heuristic to the problem of trusting in unseen algorithmic processes during online research. They illustrate this heuristic as a recursive process, and rightly so; complex problems are subject to change over time, and the work of addressing such problems requires continual evaluation and adjustment. I've adapted this heuristic in Figure 1.4.

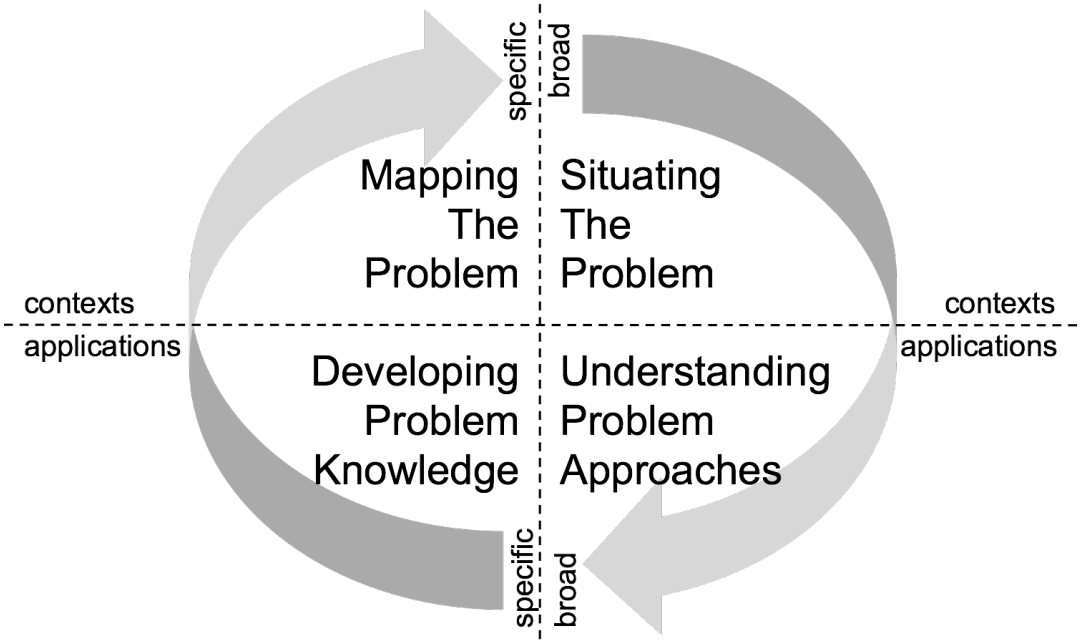

Figure 1.4. Four-phase heuristic for solving problems in technical communication. Adaption of Johnson-Eilola & Selber's (2013) four-phase heuristic, applied to the problem of algorithmic obscurity. Illustration by the author.

In this chapter, I'll **map the problem** by identifying the actors involved in algorithm-mediated online research. While indexing and search algorithms serve as the center of the list of actors, human, technological, network, and corporate actors will also be identified. In Chapter 2, I'll further **situate the problem** beyond the context of academic research, a common activity that

resides at the heart of modern research, into the realm of scholarship writ broad by situating this study among its theoretical and methodological influences. In Chapter 3, given the scope and context of the problem, I'll identify useful **theories and methods for approaching the problem**; some of these methods are commonly used in technical communication, but others will be new to the field. In Chapter 4, I'll **develop problem knowledge** by sharing the results of implementing these methods, then use those results to address the problem by proposing a heuristic for approaching the larger context of unseen algorithmic process across daily experience in Chapter 5.

1.3 BOUNDARIES OF STUDY

Mapping a problem in technical communication is no simple task. First and foremost, issues of bias inherent in mapping processes remain omnipresent. The approach I take to the complex problem of unseen algorithmic influence in research processes will likely differ from the approach another scholar will take, even within the field of technical communication. As Richard Selfe & Cynthia Selfe (2013) observe, "All maps… highlight certain things and not others, depending on the interests and goals of the mapmakers" (p. 20). In the case of mapping this particular problem, my approach relies on posthuman theories of agency. While these theories will be detailed elsewhere in the dissertation, posthuman approaches to material performativity (Barad, 2003), to political activity (Bennett, 2010), to ethics (Braidotti, 2013), and to literature (Hayles, 1999) influence the way I map the problem. My approach also relies heavily on Bruno Latour's (2005) Actor-Network Theory, which focuses attention on tracing social activity across networks. While the specific influences these theorists have on mapping will be discussed in greater detail later in the dissertation, their influence on mapping leads me to trace and describe, in minute detail, the activities of human and nonhuman entities engaged in

online research. Given the number of potential entities and processes involved in online research—consider the indexing activities of librarians, the physical environment where the search is completed, or the interior and exterior weather in a server farm where searches are processed and file are stored among wide-ranging possibilities—the first act of mapping is identifying the boundaries of study. The remainder of the introduction seeks to identify these boundaries and the potential influence exerted on library research activity.

1.4 ONLINE RESEARCH

A now-ubiquitous activity of scholarship is conducting research online. The array of online research databases available to academic researchers has radically changed what was only 25 or 30 years ago a largely paper- and book-based activity. While paper-based research followed algorithmic processes, digital algorithms that could conduct searches on demand remained the domain of science fiction. Introducing digital algorithms in search engines that could effectively identify and serve up citations and full-text sources made accessible the esoterica of academia. Now, when instructors assign a research topic or scholars initiate a theoretical research project, the first stop is not the *MLA International Bibliography* or a printed subject encyclopedia (although both remain relevant for advanced scholarship): instead, the first stop is an online search tool, often Google (despite best efforts to steer researchers toward librarian-recommended databases like EBSCO's *Academic Search Complete*). While our research methods remain algorithmic in that we and our students develop practices and workflows to conduct academic research, we also have offloaded much of the heavy lifting of searching across bibliographies for relevant sources to digital algorithmic processes that function in online databases.

When researchers search online, they engage a distributed, interconnected network of

digital assets intertwined with the experiences, ideologies, ethics, and practices of their originating individuals, organizations, products, and technologies. At the heart of these assets are digital algorithms, the work horses of online search. These algorithms receive input in the form of search queries, calculate matches between normalized queries and indexed results, and provide output in the form of a search results page, generally sorted by relevance. The manual labor of scanning hundreds or thousands of sources found via bound bibliographies and subject encyclopedias that was once the common experience of researchers has been outsourced to digital algorithmic processes that can scan millions of indexed data points in milliseconds. Outsourcing search to digital algorithms has radically altered the experience of research, making it a two-pronged, user-initiated process of:

1. developing query language that algorithms can process and match to indexed keywords; and
2. interpreting search results to determine which best meets the needs of the research project.

One result of this outsourcing and the subsequent changes to research activities is the introduction of automated, hidden algorithmic processes into research. The results of algorithmic responses to search are available to researchers, but the activity of the algorithm itself—the automated, iterative processes by which a search algorithm indexes data as potential results, collects and analyzes search queries, matches queries to indexed keywords, and returns relevance-sorted results to the researchers—is obscured and unavailable for scrutiny and analysis. Most often, algorithmic activities are unavailable because they are proprietary secrets at the heart of a brand.

Because algorithmic activities are largely obscured, sorting out the influence of

algorithmic activity during online search requires identifying entities and their actions. Identifying these entities and tracing their activities, in turn, requires careful attention to the conditions, environment, hardware, software, networks, and human actors involved in the search activity. Using the user-initiated, two-pronged process outlined above offers a starting point for identifying these conditions, environments, hardware, software, networks, and people, uncovering the additional entities involved in algorithmic activity of online search. In describing individual activities in this two-pronged process, I will use the example of searching the terms *rhetoric algorithms*, introduced in section 1.1, to illustrate the rhetorical agency engaged in each part of the process.

1.4.1 Developing Query Language that Algorithms can Process and Match to Indexed Keywords

Users initiate online search sessions by typing or vocalizing search terms. Those terms may be single words, phrases, sentences, or questions. Selecting terms for search is user-initiated, but the selection of terms is influenced by multiple experiential, material, and algorithmic forces. Users' familiarity with the subject will influence selection of more or less useful keywords. Users' prior experiences with a specific search engine will influence the form of the query, as some search tools may handle natural language queries (in the form of sentences and questions) better than others. Search engine interfaces like web browsers and mobile search applications may provide auto-complete suggestions as users enter query terms, suggestions that are generated by algorithms accessing prior successful search words and phrases. Mobile devices may automatically correct entries deemed mistyped, also based on algorithms accessing dictionaries of correct spellings and common misspellings, often optimized to device. Fingers can mistype terms, especially using mobile keyboards and keyboards that have an unfamiliar

look, feel, or layout. Vocalized search entries can be misunderstood or mis-entered by speech-to-text programs unfamiliar with individual pronunciations, accents, speech patterns, and emphases. And once search terms are entered into a web- or app-based search interface, the algorithmic activity that matches search queries to keywords and identifies matches is largely obscured from view. This activity can be broken down into several separate processes.

1.4.1.1 Transferring Data from Users' Devices to Search Engine Servers

In order for users' search queries to be processed, they must first be transmitted via Internet from search interface to search engine servers. This transfer process relies on networks and network protocols that convert text entries into packets[2] of digital bits[3] that can be transmitted as patterns of zeros and ones across wired and wireless networks from users' device to search engine server. Numerous protocols govern these transmissions, including textual encoding (e.g., UTF-8, ASCII); internet addressing (e.g., TCP/IP, DNS); packet transfer (e.g., IEEE 802.2 [ethernet], 802.11 [wireless LAN]); networking (e.g., WAN, LAN, SAN); web (e.g., HTTP, HTTPS, FTP); mark-up (e.g., HTML, XML); and more[4]. These protocols are seamlessly, and largely invisibly, involved in transmitting data from client to server and back again across fiber, copper, and wireless connections. Such transmissions can be influenced by adverse weather conditions, physical or virtual defects, electrical supplies, programming errors, network, hardware, and software hacks, incompatibility among protocols (e.g., UTF-8 vs. ASCII),

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[2] Technically, a packet represents a "protocol data unit" ("Network Packet," 2018) in the OSI model of computer networking. Practically, a packet represents "digitally encoded information in a communication network" (Verma, 2014) sent and/or received from a source to a destination directed by switching software.

[3] A bit is short for "binary digit" and is represented by either a zero or a one. A collection of bits is how information data is encoded (Mata-Toledo, 2014a).

[4] While this dissertation seeks to make accessible as much technology as possible, use of technical terminology is sometimes necessary. Here, the goal is to demonstrate the number of protocols involved in web-based activities like online search, not to define each protocol. Wikipedia offers a useful overview of the Internet Protocol Suite (https://en.wikipedia.org/wiki/Internet_protocol_suite), while the IEEE LAN/MAN Standards Committee provides a more technical listing of protocols involved in wired and wireless networking (http://www.ieee802.org/).

network traffic, and human intervention. “Slow” internet and network hacks represent the most visible and approachable of these influences, but unseen influences may also affect the transmission of data from point to point. In the example of the search string *rhetoric algorithms*, the text entry is encoded and packaged in one or more packets of data, transmitted via ethernet and/or wireless LAN through routers, switches, and network infrastructure to its destination server, where it is then decoded from its packets and re-encoded to textual format. Protocols governing each of the encoding, decoding, and transmission processes have stabilized as control rules over time (see Galloway, 2004), exerting unseen agency on the encoding, decoding, and transmission processes of network activity. Additionally, each protocol offers the potential, however slight or remote, for damaging, losing, or misdirecting the original query on its way from researcher’s search interface to server.

1.4.1.2 Natural Language Processing of Search Queries

Once the search query terms have been encoded, transmitted via networks, and recoded as text, natural language processors work to translate the text into machine-readable content that can be matched to indexed keywords and meta-data. Natural language processing (NLP), “a computer system that, after accepting as input sentences articulated in a natural language, analyzes the sentences, usually within a context, and shows ‘understanding’ of these sentences by performing some action” (Mata-Toleda, 2014b), enables the search engine’s matching algorithm to “read” and “understand” textual inputs in the form of words, phrases, sentences, and even questions. NLP requires considerable programmer intervention to parse text inputs into machine-readable inputs, often requiring non-essential terms (like articles, prepositions, modifiers, and pronouns) to be removed; variants to be normalized (like merging *approaches*, *approaching*, *approached*, and *approaching* into the single term *approach*); and definitions to be

determined based on most common usage in context with surrounding terms, if available (like considering *truck* to mean a type of vehicle rather than the activity of hauling by highway vehicle unless other query terms suggest the latter). NLP occurs algorithmically, without manual intervention, after a process of machine learning over time for accuracy. In the example of the search string *rhetoric algorithms*, NLP may be programmed to normalize *algorithms* to include *algorithmic*, *algorithm*, and misspelled variants; to normalize *rhetoric* to include *rhetorical*, *rhetor*, *rhetorics*, and misspelled variants; and to recognize the contextual unlikelihood of placing those two terms in a single phrase unless understood in a more meaningful, natural-language version in which one term could modify the other, as in the variant *algorithmic rhetoric*. Figure 1.2 reveals NLP at work, highlighting exact matches (*rhetoric* and *algorithms*) while including a variant (*algorithm*). Without NLP, only terms with exact string matches would be matched. Determining the extent to which NLP will accept variants (e.g., will *a;gorihmt* be accepted as a misspelled match for *algorithms*?) is among myriad rhetorical programming decisions that a programmer, or a machine-learning algorithm in conjunction with a programmer, will make in creating a NLP system.

1.4.1.3 Collecting and Indexing Web Content

Natural language processing seeks to understand queries and to match the intent of those queries, to the extent "understood" by the algorithm, to indexed web content. The process of collecting and indexing web content is another automated process completed by *webcrawlers*[5], or *spiderbots*, that crawl the web to identify new or updated pages; collect information from web

[5] "A **Web crawler**, sometimes called a **spider** or **spiderbot** and often shortened to **crawler**, is an Internet bot that systematically browses the World Wide Web, typically for the purpose of Web indexing (*web spidering*). Web search engines and some other sites use Web crawling or spidering software to update their web content or indices of others sites' web content. Web crawlers copy pages for processing by a search engine which indexes the downloaded pages so users can search more efficiently." ("Web Crawler," 2018, emphasis original). See also Google Console Help's "How Google Search Works" for details on this process as described by Google communicators (Google Console Help, 2018).

sites based on content, metadata (title, keywords, descriptions), incoming and outgoing links, and information architecture; and index that information in easily accessible, highly engineered and customized data structures that are quickly accessed during search. Not every website gets indexed, and not all pages are crawled on a website. Content that is protected by firewalls and paywalls cannot be indexed unless expressly allowed by the paywall or firewall owner. Indexing involves processing website content into data categories and values based on the structured content of the site. Once web content is indexed in massive structured data files, processed search terms are matched to indexed values found while searching the massive structured data files. For the search terms *algorithms* and *rhetoric* to be matched to indexed content, normalized and alternative versions of those terms would need to be matched to values found among the description and/or keyword metadata tags from a website, from the indexed content of a website, or from the data fields of a website's structured content. A website or research article with the words *algorithmic* and *rhetorical* in its title, subtitle, content, or metadata of the site would be considered (based on NLP) a match for the keyword search, and the particular page or pages on which those terms appeared would be returned as a match. The processes of indexing web content and matching that content to keywords are largely, if not entirely, automated, and are influenced by programming decisions made early in the development of spider bots, structured data collections, and natural language processing. In Figure 1.2, the results appearing on the page would appear only if the indexed content from the source matched the search terms *rhetoric algorithms*.

1.4.2 Interpreting Search Results to Determine which Best Meets the Needs of the Research Project

Once matches are made between search terms and indexed web content, those matches

are returned to the user in the form of the search engine results page (SERP). The SERP is a meticulously designed page that is intended to make the user's task of identifying matches that best meet the needs of a particular research task or project as easy and seamless as possible. Aspects of the SERP's design and structure influence, or have the potential to influence, a user's selection of one search result over another. Users review the limited content available on the SERP, and based on the information displayed, select a result to learn more about its match to the research project's parameters. Those parameters may only be implicitly understood, rather than documented or explicitly articulated, by the user, meaning judgments about search results that may be useful to the project could be, or could appear, arbitrary. Ultimately, the user's experience in reviewing search results helps the user determine whether the search query was effective in terms of matching relevant web content to the user's intent in submitting search queries. If few or no results are deemed particularly good matches to the requirements of the search project, the search may be deemed ineffective or irrelevant, and the search process re-initiated with additional knowledge of what didn't work (toward better understanding or identifying what might be more effective in the next search). Frequently the SERP includes the opportunity to hone, sharpen, filter, or narrow the original search; to revise the search by replacing, removing, or adding search terms; or to restart the search with entirely new terms (see left sidebar in Figure 1.2 for a selection of these options available on this SERP). Each of the elements incorporated into the SERP may influence the results eventually selected to include in the research project.

1.4.2.1 SERP Usability

Search engine providers invest considerable effort in designing SERPs that are considered easy to use for the purpose of identifying relevant results. Usability testing is

certainly an important aspect of this design process, although these tests and their results are not released to the public because they are integrally interconnected with the design of carefully protected search and matching algorithm engineering. Since search matches are based on keywords, the content from matching webpages that gets included on the SERP is severely excerpted and tends to highlight the original search terms. This can be seen in Figure 1.2, where exact matches of the search terms *rhetoric algorithms* are highlighted. A large quantity of information must be included on SERPs. For each webpage that is considered a match to the search terms, the following content is often included from the matching page:

- Webpage title
- Page URL
- Page content excerpt with matching search term(s) emphasized
- Brief summary of or blurb from the page, often author-generated from abstracts or summaries

Additional detail is included in Figure 1.5, showing specific design areas and iterated content areas included in the SERP design for the sample search of *rhetoric algorithms*.

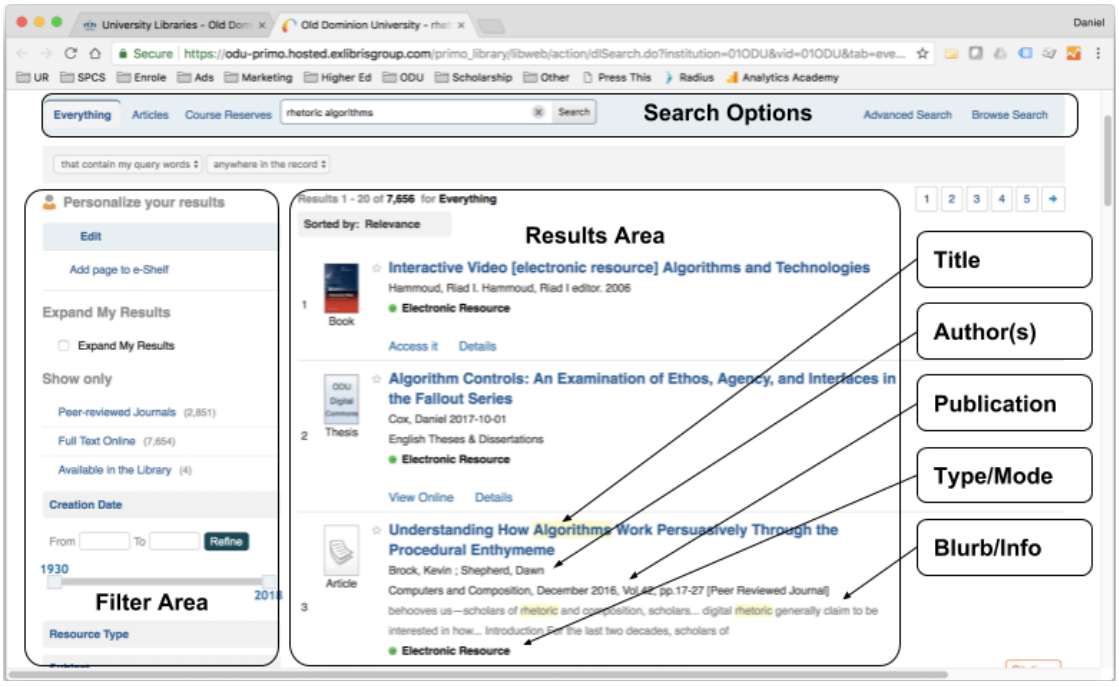

Figure 1.5. Design elements of search engine results page (SERP). Reveals specific content and design areas from the SERP sample. Old Dominion University. (2018b). *Old Dominion University - rhetoric algorithms*. Retrieved May 23, 2018, from https://odu-promo.hosted.exlibrisgroup.com. Screenshot by author. Boxes and annotations added by author.

Since the design must be repeated for every matching source, and since there may be hundreds, thousands, or tens of thousands of matching pages, designing the SERP for ultimate usability across a variety of devices and users requires careful negotiation and iterative design. These design elements necessarily exclude information from pages considered matches; such exclusions, along with the information that gets included based on programmed, algorithm-related processes, is likely to influence the user's selection of one source over another.

1.4.2.2 SERP Relevance Sorting

Search results displayed on SERPs are ordered by relevance, which is generally an algorithm-based determination of the quality of the match between a user's original search terms and the search results. The greater the quality of this match, the higher the resulting website gets

placed on the page. While many SERPs offer additional sorting options (like by publication date), relevance sorting is the gold standard and is used exclusively by Google on its SERPs. The results of relevance sorting on Google (and, to a lesser extent, on other search engines like Bing, Duck Duck Go, Yahoo, and others) are the primary focus of search engine optimization (SEO), the process by which web developers and marketers seek to influence the placement of their domain's webpages in search results. SEO relies on paying careful attention to the hundreds of signals Google's search algorithms appear to value and score highly in search matches, and on developing webpage designs and content that utilize algorithmic focus on these signals to be considered more relevant than other webpages for a given search term or set of terms. The higher a domain's webpage appears on a SERP for a given search term or search phrase (related to the content of the page or site), the more successful SEO efforts are considered. As a result, the work of SEO professionals, web developers, content managers, and web marketers, influences the content and order of results on SERP, which in turn necessarily influence the selections made by users. In worst case scenarios, the content, meta data, and structure of a webpage can misrepresent itself to Google's algorithms, which in turn result in higher placement of pages that may only appear to be relevant, but which are actually representing content that is not a clear match. Such activities are explicitly prohibited by search engine terms of use, and search engine providers aggressively work to prevent, curtail, and block such misrepresentation. Although Google is used as a the primary example, relevance sorting is either an option or a default in nearly all search engines. While specific algorithmic processes that determine relevance order are proprietary secrets of their respective corporate entities, the general processes by which search results are sorted by relevance remain likely influences on the results selected and not selected by users. For example, on the SERP for the search terms *rhetoric algorithms* shown in

Figure 1.2, relevance sorting is active. Relevance sorting, as determined by the search engine, ranks a 2006 interactive video and a 2017 ODU master's thesis as more relevant to the search than a 2016 peer-reviewed journal article that clearly highlights exact matches to the search terms (and, not coincidentally, that I cite later in this dissertation). There is no easy way to discover how relevance is ranked. These processes are programmed and managed by matching algorithms, and they directly influence the results seen atop SERPs. Relevance sorting changes over time: the same search on the same interface using the same browser conducted more recently (December 31, 2018) generated results in which the 2016 peer reviewed article appeared first in the listing, followed by the same 2006 interactive video (now labeled an electronic book), followed by three additional, recent peer reviewed articles. The 2017 ODU master's thesis appeared as the seventh entry. Clearly, programming changes resulted in somewhat "better" (for the purposes of my own study, at least) relevance sorting. Of vital importance is the fact that, at a given moment, there is no way to know how "accurate" relevance sorting may be for a specified search string.

1.4.2.3 SERP Advertising Results

Most freely available search engine providers sell advertisements to build or supplement revenue. Even those search providers that rely on subscriptions from academic or corporate entities may have portions of their web presence supported by advertising, especially when shifting from SERP to individual resources available through a different service or when accessing corporate links found on subscription SERPs, like *About Us* or *FAQs*. While subscription services remain subscriber supported, corporate owners may rely in part on ads to supplement subscription fees. SERPs for advertising supported or supplemented search providers like Google or Bing include advertisements in the form of paid search results. Businesses,

organizations, and individuals bid on keywords and keyword combinations that will place advertising for their programs, products, or services at the top or to the side of organic search results (search results that are generated strictly by matching algorithms uninfluenced by advertising matches). Paid search advertising is effective (and often expensive, depending on the popularity of the keywords on which advertisers bid) because users are pre-qualified by their search keywords. That is, the search terms entered by a researcher into a search interface are not only algorithmically matched to indexed results; they are also algorithmically matched to keyword combinations for which advertisers are bidding. When users' search terms match advertiser keywords, the highest bidder on those keywords takes top billing on the page—literally, the advertiser's promoted ad (which looks very much like a standard search result in most interfaces) appears at the top of the SERP, ahead of the organic results that resulted from matching search terms to indexed keywords. In addition, the SERP may have sidebar advertising placements or advertising placements found below the organic results. And the number of paid advertisements on a given SERP may require multiple scrolls to view organic results, especially when the SERP is viewed on a mobile device. Given the limited space on SERPs, the placement of multiple paid search ads in multiple placement areas on the page can easily influence a user's selection of relevant results for a research project. Thankfully, such intrusions seldom influence academic research, but search in free tools like Google will inevitably include paid advertisements on SERPs.

1.4.2.4 User Understanding of the Research Project

In addition to interface and algorithmic influence on selection of search results, the user's own understanding of the research project is likely to influence the selection of results. Poor or incomplete understanding of a research assignment's parameters may result in searches that

narrow or widen search parameters and search results within or outside the scope of the assignment. Similarly, poor or incomplete understanding of the kinds and content of sources that might be useful toward addressing the research assignment may also influence or affect the selection of search results—or may even result in discarding successful searches that likely provide relevant sources toward addressing the research project because the user is unable to determine the parameters of a successful search. Lack of clarity is part of any research project, of course, especially for novice researchers, but what's significant about such lack of clarity is the amplifying effect it has on search terms, keyword matching, and search results. Given the multiple ways research processes and search results are influenced by algorithmic activity and machine learning processes, any additional ambiguity or imprecision introduced into the search process may influence the user's selection of search results. For example, in using the search terms *rhetoric algorithms*, I may have opted for a much broader, and therefore less efficient, search. The closer I can construct a phrase, sentence, question, or query to the goal of answering my research question, the more likely I'll see relevant results. The phrases "rhetoric of algorithms" or "algorithmic rhetoric," or even the question "how are algorithms rhetorical?" might have generated more relevant results. However, given the intervention of NLP converting natural language to machine readable strings, and the intervention of relevance sorting, it's extremely difficult to know the extent to which my own understanding of my search project influences search results. It is this unknown element, the obscurity of the process, that also represents potential rhetorical agency in the research process.

1.4.3 Rhetorical Influence

At the heart of this project is the claim that influences on user search activities and selection of search results are rhetorical. The usual place to start defining what is meant by

rhetorical is with Aristotle, who defined rhetoric in *Ars Rhetorica* as "the faculty of observing in any given case the available means of persuasion…. [T]he power of observing the means of persuasion on almost any subject presented to us; and that is why we say that, in its technical character, it is not concerned with any special or definite class of subjects" (Aristotle, 350 BC, I, 2). Aristotle's willingness to apply rhetoric to "almost any subject presented to us" opens the door to understanding activities beyond oratory as means of persuasion, including search activities involving algorithmic selections and processes. In the examples presented earlier, a variety of human-centered and algorithm-centered processes and design strategies influence search activities, results, and selections. Using Aristotle's articulation of rhetoric as "observing… the available means of persuasion," it's possible to view these influences as potentially rhetorical. In the case of algorithmic matching of search keywords to indexed web content, the programmed and machine-learned processes that algorithms exert on keyword search terms, on indexing web content, and in matching terms to indexed content may be considered rhetorical because these processes engage educated guesses, in the form of relevance-ordered search results along with advertising-supported results on the SERP, as means of persuading users to select certain results over others. In this example, the rhetorical agent involved may not be immediately clear, but the intentional selection and ordering of search results on the SERP is a visual representation of a rhetorical process favoring one search result, or one set of search results, over other results that may be available. While algorithmic processes that enable online search are programmed by teams of engineers and mathematicians, the algorithms themselves are programmed to use machine learning to make more accurate search recommendations using auto-complete, to make more efficient and effective matches between search terms and indexed content, to more accurately index web content, and to present the most relevant results to the

user. In short, algorithmic processes adapt to users and, over time, improve accuracy and relevance to individual users. While programming computer and algorithmic code is certainly a rhetorical activity (see Beck, 2016), the code's ability to adapt to users represents use of means of persuasion—in this case, the means of indexing web content, of interpreting search terms, of matching search terms to indexed content, of identifying webpages that match interpreted search intent, and presenting those results in a relevance sorted list on the SERP. Exerting influence on research processes and results contributes to understanding algorithms as rhetorical. Algorithms make things matter in the world. They exert influence on matters of daily life, and in the case of academic research, algorithms and the processes surrounding them exert influence on the activity and results of research activities.

From this perspective emerge the following claims that must be demonstrated and proven before moving forward.

1.4.3.1 The Researcher's Search Literacy is Rhetorical

If literacy can be represented, as James Paul Gee (1989) asserts, as "control of secondary uses of language" (p. 23), search literacy can represent a researcher's functional understanding of the secondary use of language in online search—the way language is used for constructing machine-readable search strings, the way algorithms and machines process and index language-based content, and the way algorithms match language-based search strings to indexed data and present them in designed SERPs. The greater the level of literacy, the more successful the researcher's searches will be in terms of their applicability to answering a given research question. Research literacy results, in part, from repeated search experiences, often in the form of trial-and-error. In this sense, research literacy is based in an algorithmic processes: a repeated set of activities completed in sequence toward solving a problem. More importantly, however,

research literacy represents an influence on the effectiveness and efficiency of a research session.

Repeated experiences with a given search engine or online research tool provide researchers insight into the format and sequence of search terms that will result in more and less successful search result matches. Over time, such habituation and internalization of search processes results in a greater likelihood of matches between search terms entered and search results returned on the SERP. Search term effectiveness is influenced by auto-complete options suggested as researchers enter search terms in many online search tools; the interaction of user-entered terms and auto-complete suggestions results in selection of terms more likely (as recommended by the algorithmic auto-complete suggestions) to reflect closer matches between search terms and indexed content, which in turn are more likely to result in more useful and usable search results toward addressing the research question.

Similarly, repeated experiences with a search tool may also result in better, more efficient ability to narrow search results toward identifying the best possible results to address the research question. Experience with and exposure to a consistent SERP design, or consistent SERP designs across search tools, may reduce the time and effort required for the researcher to determine whether search results effectively address the research question, and whether a second page of results will be more likely to produce useful hits than revising the search using different search terms or applying different filters to the original results.

What's important is that a researcher's search literacy influences search processes by better, more quickly determining what matters, and what matters more, in search term selection and results review. Repeated experience with an online search tool may influence the user to exert less care in selecting search terms and more care in applying filters to search results, or may convince the researcher to take considerable care in selecting search terms and consider

most of the results to be likely relevant matches. In short, the researcher's functional understanding of the way a particular search tool works in practical terms affects the search process from tool selection to search term entry to search result review and selection. The influence of search literacy on the researcher's search activity may be considered rhetorical; its influence pervades the research process and suggests a strong rhetorical connection between prior experiences and current (or future) search activities. The researcher's literacy represents the available means of persuasion used by the researcher to more (or less) successfully complete a research task online.

1.4.3.2 The Search Engine's Interface is Rhetorical

The design of search engine interfaces and SERPs represents the product of careful research. User experience (UX) testing methods focus careful attention on the way webpages are designed for successful use. Given the considerable traffic that search interfaces attract, along with the importance of search results, careful design strategies are warranted. Whether it's McLuhan (1967/2003) or Selfe and Selfe (1994/2004), or any number of scholars between and after, who make the claim, it's worth repeating that the design of a medium influences the use and experience of the medium by a user. For example, in the case of Google's main search page (google.com; see Figure 1.6), the promotion of certain page elements, like the search box, over other page elements, like almost any other element (except the logo) on the page, serves a function that represents a rhetorical decision on the part of Google's web developers in line with the corporate ideologies and values of the brand.

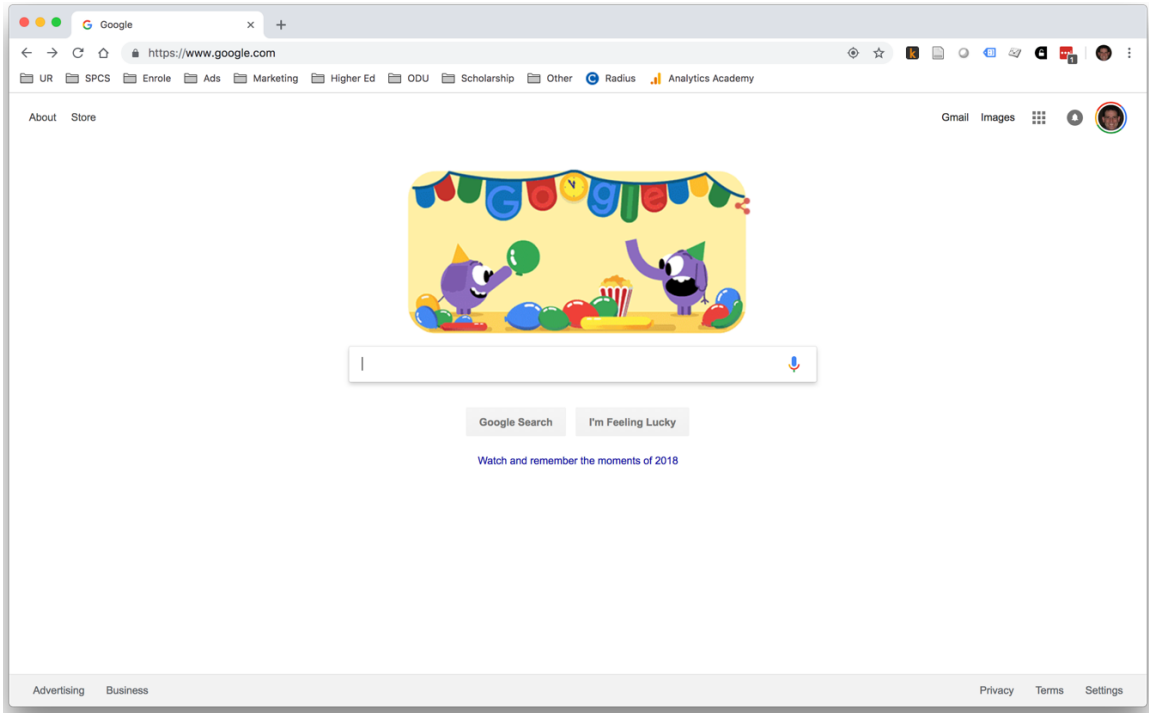

Figure 1.6. Main Google search page. Highlights two primary elements: the Google logo (in this case, replaced by a New Year's Eve Google Doodle) and the search box. Design is a rhetorical decision focused squarely on the user's purpose for visiting the page: to conduct a Google search. Google. (n.d.b). *Google*. Retrieved December 31, 2018, from https://www.google.com. Screenshot by author. Google and the Google logo are registered trademarks of Google LLC, used with permission.

User-centered design (UCD) principles guide development and design decisions; in the case of Google's search page, Google's design principals are found in the meta-description tag embedded in the design.google index page: "At Google we say, 'Focus on the user and all else will follow.' With this in mind, we seek to design experiences that inspire and enlighten our users" (Google Design, n.d.) This focus on the user results in a search interface that is entirely uncluttered, exceedingly easy to use (given basic search experience), and loads quickly. These design elements both reflect corporate ideology and influence the way users interact with the search page.

Design decisions and their rhetorical implications may be more visible on SERPs.

Continuing to use Google's SERPs as an example, it becomes clear upon loading most SERPs how important advertising and providing targeted information to searchers is to Google's corporate ideology (see Figure 1.7 showing a search for *computer programming*).

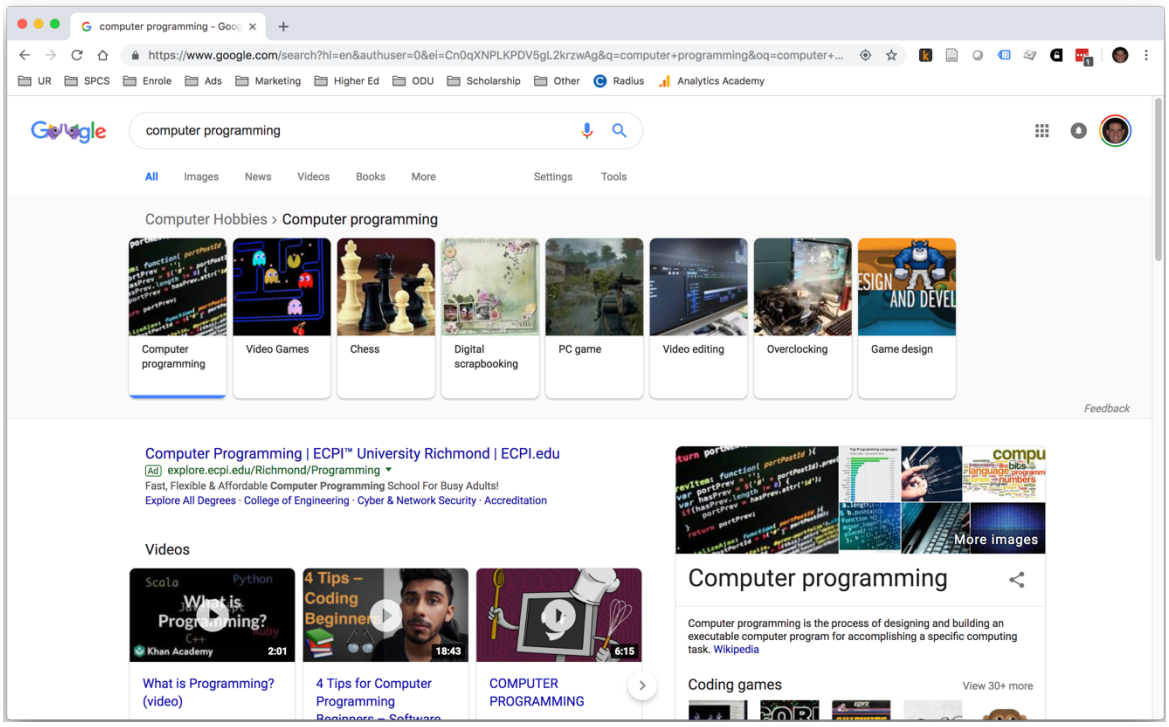

Figure 1.7. Sample Google SERP from the search *computer programming*. Reveals pre-packaged searches among "Computer Hobbies," the "Computer programming" knowledge graph, an ad for ECPI Richmond, and videos related to the search topic. Scrolling down the page (not shown) reveals an Answer Box, showing common questions and linked answers related to the search terms, and eventually reveals the first organic search result, the Wikipedia entry for "computer programming." Google. (n.d.c). *computer programming - Google search*. Retrieved December 31, 2018, from https://www.google.com/search?q=computer+programming. Screenshot by author. Google and the Google logo are registered trademarks of Google LLC, used with permission.

In this example, the SERP shows related computer hobbies aligned visually across the top of the page as pre-packaged searches; an ad for ECPI Richmond (likely selected based on my location when searching) appears atop other results, aligned with and designed akin to organic results;

and videos (shown) and an Answer Box (not shown) appear before the first organic search result. Additionally, a knowledge graph in the right sidebar on the page provides additional information on computer programming, algorithmically curated and displayed. Google's SERP design decisions nearly elide the differences among organic results, paid search results, and algorithm-curated content collections (like the Knowledge Graph, pre-packaged searches, and the Answer Box) related to the search. These design decisions, to which we've become inured and accustomed, represent considerable rhetorical influence on the activity of researchers who may be tempted to select sponsored links or other context collections ahead of organic search links because of ease and proximity to the top of the search results. Google SERPs somewhat diminish the role of the search input box, which shifts to the top left of the SERPs rather than appearing in the middle of the page. Google's logo also gets diminished, likely reflecting a focus away from the corporate image and function and toward the results, including paid results, that appear on the same page. Additional search options become more visible, like Images, News, Videos, and Books, and More. On some Google SERPs, the Knowledge Graph appears for a top search result, indicating an algorithm-recognized business entity that has been included as a destination for a search result (Google My Business, n.d.). The Knowledge Graph represents a clear promotion of the top search result over others in terms of importance and significance. While these decisions are user-centered and user-generated from billions of searches and results, they are also decisions that represent the rhetorical influence of algorithm-centered processes, curating content and shaping both results and the design of the SERP on which results appear.

1.4.3.3 The Programmed Activity and Machine Learning Functions of Algorithms are Rhetorical

Digital algorithms are programmed procedures that run iteratively to address problems. Search algorithms are collections of procedures that seek to match user-entered search terms with previously indexed web content. Algorithms are programmed to complete these activities with minimal user input: a single search term entered into a search engine's search box is adequate to initiate the algorithm's processes. Unpacking the programmed activity and machine learning procedures of search algorithms reveals several rhetorical aspects.

Estee Beck (2016) refers to the code of algorithms as "lingual structures" into which mathematician and programmer agency "is encoded and extended into their language acts, which include algorithms and programming languages." At the level of code, as lingual structures, algorithms are programmed as rhetorical entities that have the potential to encode "gender or race, ableism, class or Western values or organization and logic…. Computer algorithms and code operate by transmitting cultural values and beliefs of the programmers through the structure of code language to the execution of code" (Beck, 2016). As encoded programs, algorithms are necessarily rhetorical in the way they embed and transmit social and cultural values of their programmers and corporate employers.

In addition to their rhetoricity at the level of code, algorithms as collections of procedures that are performed on computers with user input also perform rhetorically. Bogost (2010) refers to this programmed performativity as *procedural rhetoric*, which he defines as "the art of persuasion through rule-based representations and interactions rather than the spoken word, writing, images, or moving pictures. This type of persuasion is tied to the core affordances of the computer: computers run processes, they execute calculations and rule-based symbolic manipulations" (p. ix). The procedures that algorithms execute in response to programmer

initiation and user input are persuasive: they enable or prefer some options—like auto-complete entries or "top" results—over others in obedience to their programmed functions. Search algorithms procedurally compare user-supplied search terms with indexed web content data and metadata in order to identify matches between search terms and web content. Other procedures then display the matched web content following style and content guidelines of the SERP interface, sorted with the procedurally calculated closest matches at the top of the list. Algorithmic procedures also "crawl" web content, automatically indexing and recording data and metadata for matching with search terms. The procedures that are programmed to index web content determine whether web content is accurate and relevant, properly coded and easily indexed, and write data entries into data tables whose content—indexed web data and metadata—can be compared with search entries toward identifying search matches. Procedural rhetoric manages both web indexing and search matching, revealing the persuasive influence that algorithms have on search processes and results.

Furthermore, advanced search algorithms are not only programmed to iteratively crawl and index websites, to suggest search terms as auto-complete suggestions based on prior search results, to match search terms to indexed content, and to sort results by relevance, with closer matches appearing at the top of search results. They are also programmed to recall user preferences and habits, to recognize user context, and to incorporate patterns that emerge from habits and context into search activity and results. Algorithms are programmed to learn user habits and patterns, and to use what's learned to suggest search terms contextually to users, to identify and highlight search results that are located nearby, to provide access to resources based on network, and to otherwise respond to user-initiated activity. Search engine trade groups like Search Engine Journal (http://searchenginejournal.com) and Search Engine Land

(http://searchengineland.com) track and report on the impact of machine learning's implementation in Google (and others, but Google and Facebook are the primary targets). Kevin Rowe (2018) of Search Engine Land identifies at least nine ways search engines use machine learning:

1. To detect patterns (in aggregated and individual searches)
2. To identify new ranking signals (criteria to make results more relevant)
3. To test, and sometimes reinforce, existing ranking signals
4. To customize results based on specific individual queries
5. To better understand photo content and subject in image search
6. To identify similarities in words in a single search query
7. To improve ad targeting quality for users
8. To identify synonyms
9. To help clarify user intent in search query (adapted from Rowe, 2018)

Such machine learning represents algorithms at their most persuasive and rhetorical, capable of acting beyond programmed functionality in response to individual user activity. In essence, algorithms are programmed to persuade themselves to change based on recognized user patterns and activities. At the levels of encoded programming, of procedurality, and of programmed self-persuasion, algorithms function persuasively in relation to users.

1.4.3.4 The Advertising on SERPs is Rhetorical

The process of purchasing ads to appear on SERPs is search engine marketing (SEM), and represents significant revenue streams for search engine companies like Alphabet and

Microsoft (corporate parents of Google and Bing, respectively)[6]. The process for purchasing and placing ads on SERPs is complex, representing at least two aspects of rhetorical influence: selection of and bidding on keywords most likely to result in ads being displayed, and matching of advertiser-purchased keywords with user-entered search terms and indexed web content to determine which ads appear in which order on a given SERP.

Potential advertisers develop text ads that link to landing pages, keyword groups that reflect the kinds of terms search users might use to find a particular topic, and target audiences whose searches will be examined for matches. Algorithmic procedures examine hundreds of data points to match the highest bidding and most relevant ad copy (based on keyword matches to search terms and indexed content) to the search terms and results returned on the SERP. Those ads appear on the SERP, generally identified as ads somewhere on the page, as text or display ads that look like organic search results but are in fact paid search results (see Figure 1.8).

[6] For example, Alphabet's 2nd quarter 2018 earnings report revealed that 86% of revenue came from search advertising during the period (Rodriguez, 2018). Microsoft's 2018 year-end earnings report revealed 6.3% (over $7b) of revenue came from search advertising (Nadella, 2018).

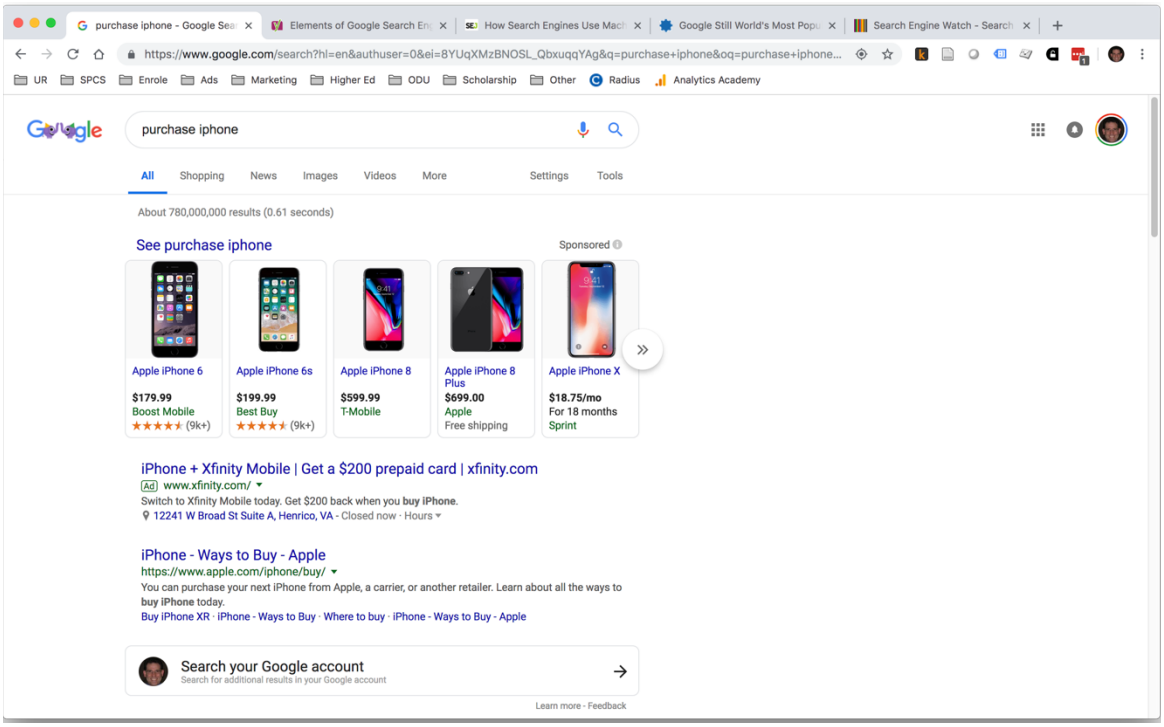

Figure 1.8. Ads on a Google SERP for the search terms *purchase iphone*. The word "sponsored" appears above the display ad for iPhones with no clear sponsor (selecting the "i" for information link reveals they are collected from Apple, AT&T, Sprint, T-Mobile & Boost Mobile). The small "Ad" square in front of the www.xfinity.com ad is the only design difference between an ad and an organic result. Machine learning has inserted an option on the SERP to search my own Google account for additional results, likely because I had recently purchased new phones online. Google. (n.d.d). *purchase iphone - Google search*. Retrieved December 31, 2018, from https://www.google.com/search?q=purchase+iphone. Screenshot by author. Google and the Google logo are registered trademarks of Google LLC, used with permission.

The text ads themselves represent rhetorical influence, seeking to persuade search users to click on the ad in order visit a website landing page. But the placement of the ads on the page is governed in part by the advertiser's bid for ad placement and by the positive and negative keywords identified by the advertiser as effective (or ineffective) in matching the advertised service or product and the algorithmically perceived intent of the user.

1.4.3.5 The Ideologies of Corporations and Teams is Rhetorical

The best-known digital search algorithms are owned and developed by massive global

technology companies including Google, Amazon, Facebook, and Microsoft. Their operations are distributed across the globe, as is their financial reach. These are massive publicly held corporations seeking to provide ongoing value to their shareholders. Profit motive influences the political and ideological approaches each company takes in developing digital search algorithms. In writing about the use of network technologies in the classroom, Tara Brabazon (2002) claims that, "when considered politically, technology, like any other formation, cannot be placed outside of ideology…. Nodes of power and resistance saturate the Internet" (p. 21). More specifically focused on computing algorithms and procedures, Bogost (2006) identifies procedurality as "fixed and unquestionable…, tied to authority, crafted from the top–down, and put in place to structure behavior and identify infringement. Procedures are sometimes related to ideology; they can cloud our ability to see other ways of thinking." The common characteristic both Brabazon and Bogost identify is that technology, networks, computers, and algorithms actively enact specific authority and power intertwined with the ideologies of corporate owners and creators. The clear relationship between algorithms and corporate ideologies has most recently been revealed in a number of stumbles experienced by Facebook and its CEO Mark Zuckerberg. Confirmed reports released in March 2018 that Facebook had enabled Cambridge Analytica to access and harvest "private information from the Facebook profiles of more than 50 million users without their permission" (Rosenberg, Confessore & Cadwalladr, 2018) revealed Facebook's corporate interest in profit over privacy. Revelations about Russian influence brokered through Facebook's advertising platform culminated in Zuckerberg's much-anticipated April 2018 testimony before Congress in which he was questioned on "the proliferation of so-called fake news on Facebook, Russian interference during the 2016 presidential election and censorship of conservative media" ("Mark Zuckerberg Testimony," 2018). Zuckerberg's testimony, and

subsequent revelations of continued Russian attempts to use Facebook to influence the 2018 mid-term elections, continue to reveal the distinct challenges of separating profit-centered ideology from the algorithms that regulate the design, content, payment, and placement of ads on the platform.

What makes corporate ideology rhetorical? Most prominently, it influences the programming and activity of algorithmic processes in online search. Consider again the example of the search terms *rhetoric algorithms*, this time shown in the Google SERP (see Figure 1.9).

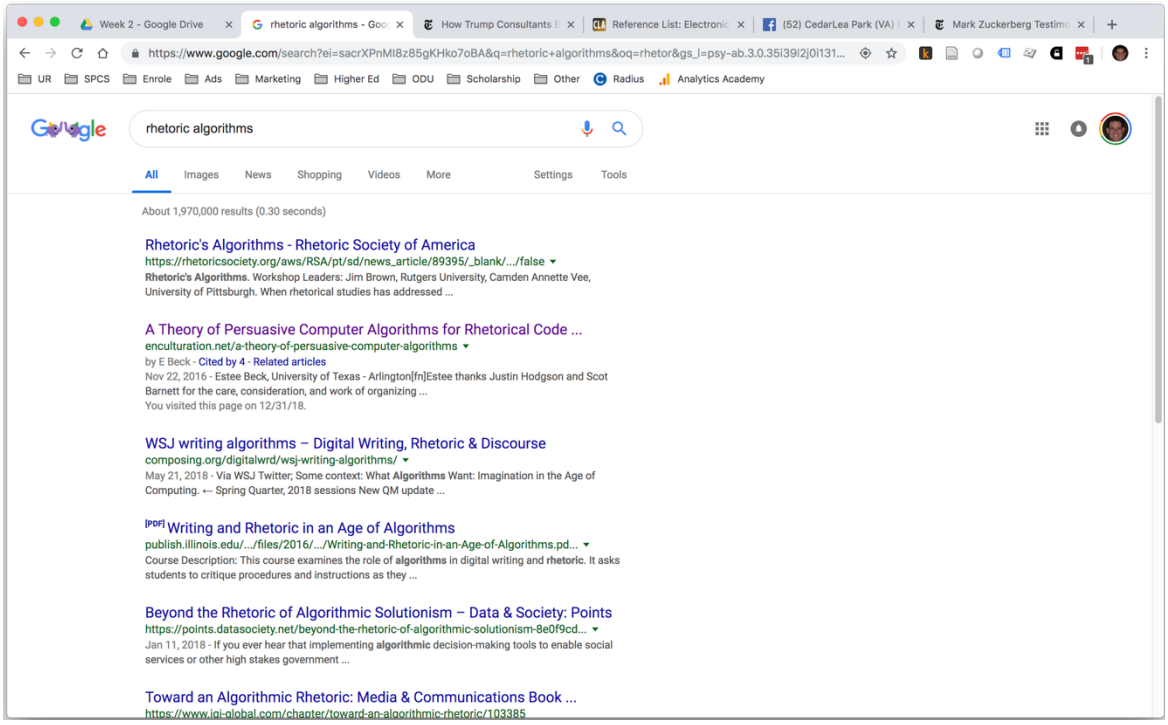

Figure 1.9. Google SERP for the search terms *rhetoric algorithms*. The SERP includes no ads or special algorithm-generated features (e.g., Knowledge Graph, Answer Box, videos), only organic results. Google. (n.d.e). *rhetoric algorithms - Google search*. Retrieved January 1, 2019, from https://www.google.com/search?q=rhetoric+algorithms. Screenshot by author. Google and the Google logo are registered trademarks of Google LLC, used with permission.

This SERP reveals neither ads nor special features, only organic results. On first blush this reveals little more than a lack of interest in a largely academic topic. Yet the contract between the SERP shown in Figure 1.9 and the SERPs from the search for *computer programming* shown in Figure 1.7 and the search for *purchase iphone* shown in Figure 1.8 could not be more striking. Topics close the heart of Google's profit-motivated corporate ideology, like *programming* and *technology*, appear programmed either to generate more robust, attractive, and lucrative SERPs or to respond to greater advertiser and user interest in this topic over academic topics like *rhetoric* and *algorithms*. Although algorithms are at the heart of Google's enterprise and could easily generate a much more complex SERP, the function of Google's algorithm is shrouded in corporate secrecy. Again, corporate ideologies appear to influence the way search results are generated and presented on SERPs. This influence is rhetorical, making some searches on some topics "matter" more than others.

1.4.3.6 The Technological Media of Device and Network are Rhetorical

The communication medium matters and exerts rhetorical influence. We can return to McLuhan's (1964/2003) maxim "the medium is the message" for support, or to a number of communication scholars who have made similar claims: Barton & Barton (2003) referring to visual design, Knievel (2006) more generally referring to technology and its relationship to humanism, Gailey (1993) and Bogost (2010) referring to video games, Chun (2011) and Beck (2016) to software. In the case of algorithm-centered processes like online research, medium in the form of browser, platform, and device shape the user's research activity. Consider the difference between typing a search query on a standard desktop or laptop keyboard and verbally asking a smart device to conduct a search. Typing bypasses the need for implementing voice-to-text technologies, while a verbal search request engages voice-to-text technologies to prepare

oral search queries for NLP on the server. These two different input methods result in vastly different search experiences. Similarly, conducting search on screen-based devices enables presentation of results in a spatially designed two-dimensional space; conducting search on a smart device without a screen requires entirely verbal presentation of search results, and likely a severe curtailing of both returned results and result details. In short, these two different media—screen-based desktop or laptop and voice-activated smart devices—exert significant, deliberate rhetorical influence on the nature, number, and type of results that can be presented. But it's not simply differences in screen-based and non-screen-based media that influence search results and SERP design: consider the difference between conducting a search on a desktop or laptop device, on a tablet device, and on a smartphone device. Each experience differs in terms of how search terms are entered and in terms of how results are displayed. While Figure 1.9 shows a laptop screen capture of a search for terms *rhetoric algorithms*, Figure 1.10 shows a tablet screen capture for the same terms on the same browser (Chrome), and Figure 1.11 shows a smartphone screen capture for the same terms on the same Chrome browser.

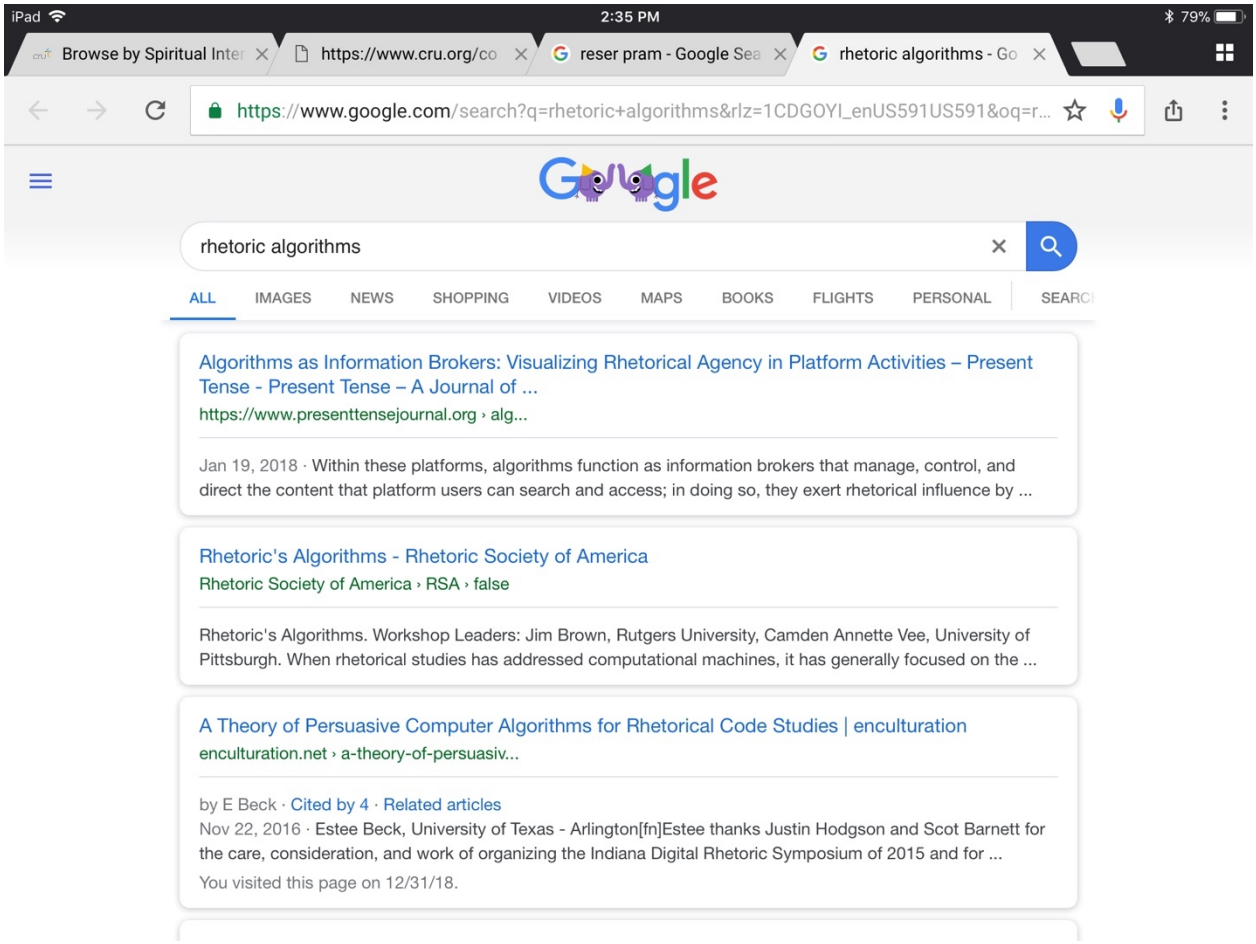

Figure 1.10. Tablet screen capture of Google SERP for *rhetoric algorithms*. Here, the results are centered and clearly distinguished from one another with rounded rectangles, likely making it easier to click with fingers rather than mouse pointer. Google. (n.d.f). *rhetoric algorithms - Google search*. Retrieved January 1, 2019, from https://www.google.com/search?q=rhetoric+algorithms. Screenshot by author. Google and the Google logo are registered trademarks of Google LLC, used with permission.

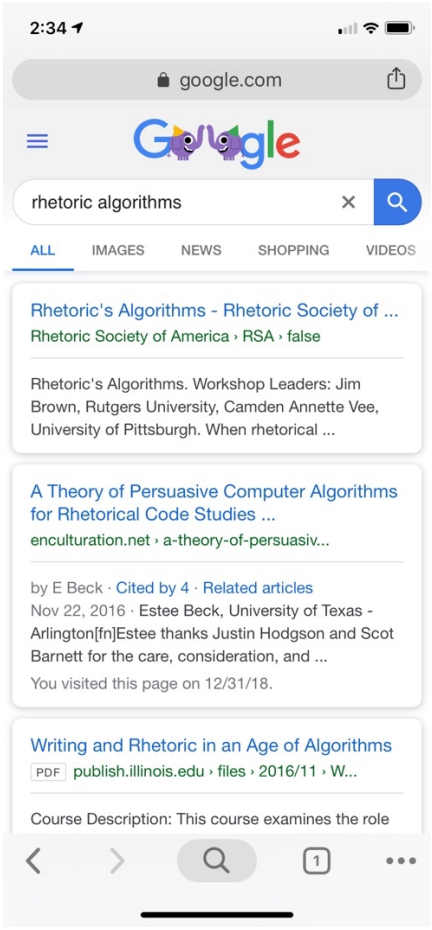

Figure 1.11. Smartphone screen capture of Google SERP for *rhetoric algorithms*. The interface is even simpler on smartphone, making it clear to the user that clicking anywhere in the rounded rectangle will result in visiting the source. Google. (n.d.g). *rhetoric algorithms - Google search*. Retrieved January 1, 2019, from https://www.google.com/search?q=rhetoric+algorithms. Screenshot by author. Google and the Google logo are registered trademarks of Google LLC, used with permission.

The different user experiences in laptop, tablet, and smartphone devices exert influence on the way a user interacts with results. The laptop version's lack of centered results suggests something might be missing; the right side of the screen appears to have too much white space relative to the rest of the page. The tablet version's centered results and even white space on both sides appears more complete, while the rounded rectangles around each result offer a clear target for finger-based selections. The smartphone's design fills the width of the vertical screen; the

rounded rectangles remain easy targets for finger-based selections, although the only area of each rectangle that can be "clicked" is on and around the blue text.

Perhaps more noticeable, however, is the fact that *different results appear on different devices*. Although I used the same Chrome browser on laptop, tablet, and smartphone; signed into my Google account on each device and browser; and connected to the same wireless network to connect to my Internet service provider (ISP), the first three results differ on each device. Table 1.1 reveals the differences.

Table 1.1

Top three search results for terms rhetoric algorithms *on laptop, table, and smartphone devices.*

Result	Laptop	Tablet	Smartphone
1	Rhetoric's Algorithms – Rhetoric Society of America	Algorithms as Information Brokers – Present Tense journal	Rhetoric's Algorithms – Rhetoric Society of America
2	A Theory of Persuasive Computer Algorithms – Enculturation journal	Rhetoric's Algorithms – Rhetoric Society of America	A Theory of Persuasive Computer Algorithms – Enculturation journal
3	WSJ Writing Algorithms – Composing.org	A Theory of Persuasive Computer Algorithms – Enculturation journal	Writing and Rhetoric in the Age of Algorithms – U. of Illinois course

The different SERP results by device shown in Table 1.1 reveal the influence that technology has on the research process. Of particular interest is that the top result on the tablet is my own *Present Tense* article. My tablet is the device on which I typically read and annotate digital scholarship. Clearly, some aspect of each device influences the selection and relevance sorting of results shown on the SERP. This clearly represents agency on the part of the technology in the

research process.

1.5 RESEARCH QUESTIONS

The influence that algorithmic activities may have on search processes and results, and by extension the potential ripple effects these results may have on research reports, is the subject of this study. By systematically tracing rhetorical agency through the research process from query to result, and by extension from the researcher's technical literacy and research environment to the researcher's selection of search results for inclusion in research reports, this study seeks to answer the following questions:

1. To what extent can search algorithms, and the platforms, networks, and systems that support them, be considered rhetorical?
2. In the process of conducting research using online search engines, when and where does rhetorical agency emerge and how can its activity be traced?
3. What practical applications do the results of this study offer to researchers, teachers, programmers, and designers?

CHAPTER 2

LITERATURE REVIEW

Adhering to my adaptation of Johnson-Eilola and Selbers' (2013) four-phase heuristic for problem solving in technical communication, this chapter seeks to situate the issue of agency in algorithmic processes within its theoretical and methodological situation. In doing so, this section addresses research question #1: "To what extent can search algorithms, and the platforms, networks, and systems that support them, be considered rhetorical?" Applied to the specific research scenario described in Chapter 1, the research question addresses the locus and origin of agency in online research processes. Should we consider the researcher the primary agent, to which algorithm-centered platforms respond as objects of the researcher-as-subject? This position raises the considerable challenge of the relationship between the researcher's search actions and the search results that appear. Results appearing on the SERP reveal little active agency on the part of the researcher in the selection and relevance ranking of these results. Similarly, assigning agency to algorithmic processes that seek out and index content, process search terms entered in the search interface, match search terms to indexed content, and provide relevance-sorted results on the SERP is problematic—only a researcher's use of the search interface initiates the algorithmic processes, suggesting dependencies among human and technological agents in determining the locus of agency.

The challenge of complexity in networked systems like those encompassing online research is considerable. As Andrew Mara and Byron Hawk (2010) emphasize, "Traditional humanist tools and heuristics for anticipating systemic complications—like audience analysis, user testing, and peer review—quickly become swamped when trying to account for the tendential forces of nonhuman actors and activities" (p. 2). This claim opens the authors'

introduction *to posthuman rhetorics* in technical communication as "a general category for theories and methodologies that situate acts and texts in the complex interplays among human intentions, organizational discourses, biological trajectories, and technological possibilities" (p. 3). Posthuman approaches to rhetoric complicate the locus of agency in technologies and technology-mediated communication. This complication resides at the heart of this project, which seeks to account for and trace rhetorical agency in online research activity.

The locus of rhetorical agency is important. As technical communicators learn the skills of communication in, with, and through technical systems, the agents for which they design and to which they are responsible must be clearly identified. If the researcher is the focus of technical communication, then the communication interfaces must be designed and their uses tested with the researcher in mind. If the algorithmic processes are the focus of technical communication, then the interfaces must be designed and their uses tested with the algorithmic processes in mind. And if the dependences among researcher and algorithm-centered processes are the primary locus of agency, then communication must be designed to address this interdependent locus of agency. As algorithm-centered processes gain ubiquity in daily life, the question of agency becomes ever more important for technical communicators to understand and address.

Studying the relationship of human researchers, rhetorical persuasion, and algorithmic processes in online search is the province of technical communication. The origins of the field are found at the intersection of classical rhetorical education, technical fields, and communication (see Connors, 1982/2004). Technical communicators address the ideological influence that technology and its systems may have on communication channels and, inherently, on their users. This focus on the relationship among humans, technologies, and ideologies is indebted to groundbreaking work by a range of scholars across several fields and decades. For

example, McLuhan's (1964/2003) work unveiled the influence of the medium in communication, important to the practice and study of usability and user experience. Selfe and Selfe (1994/2004), in the then-nascent field of computers and composition, applied McLuhan's work on the medium and Gregory Ulmer's (1989) work on electracy to reveal the ideological influence of computing platforms (hardware and software) on writers. Later posthuman approaches introduced by Donna Haraway (1990) and N. Katherine Hayles (1999) contributed deeper understanding of the shifting role of subject and object in literature and culture, revealing the potential for misapplication of human agency on nonhuman entities including technologies. Work in the social sciences by Latour (2005) extended understanding of social relations to represent the interconnected activity of human and nonhuman actors and actants in networks.

This area of study—at the intersection of the practice of technical communication; of mundane activity in networked public and private systems; and of algorithmic processes that serve as subject and object of their own activity in assemblage entities made up of users, digital technologies, online networks, and procedures—represents an under-studied area in technical communication. The online search interface, the literal and figurative spaces where humans and distributed, networked technologies meet to conduct research, is the location of this study. Technical communication is well suited to inform this study, for technical communicators study and contribute to user interfaces through usability testing, user-centered design, and focus on user experience (Barnum, 2011; Dayton and Barton, 2009; Johnson, 1998; Johnson, Salvo, and Zoetewey, 2007). User-centered design (UCD), user experience (UX) studies, and experience architecture (XA) have emerged as subfields of technical communication and rhetorical studies where careful study of human/technical interfaces results in designing intuitive, usable interfaces and products that communicate specific aspects of individual, corporate, and brand ideologies

(see Salvo, 2014). In addition, the field of technical communication tends to focus its activities beyond and outside the academy into technical fields and practices. This focus in recent years has extended beyond technical fields and into publics and spaces. For example, Jenny Edbauer (2005) extends the act of writing beyond fields and situations as "distributed across a range of processes and encounters: the event of using a keyboard, the encounter of a writing body within a space of dis/comfort, the events of writing in an apathetic/energetic/distant/close group" (p. 13). Selfe and Selfe (2013) extend technical communication beyond composing in technical fields and producing written documentation to being practiced "within digital environments and often within distributed networks" (loc. 810). And Beverly Sauer (2003) extends the locus of rhetorical activity well beyond technical specifications or scientific fields to the unwritten and undocumented (but communicated) sensory experiences of workers in dangerous conditions like mines. Learning and teaching in the field of technical communication focuses on relations among humans and nonhumans involved in composing practices and requires an active assertion of values and ethics into the experience. Russell Rutter (1991/2004) cites Quintilian to demonstrate the modern need for ethical approaches to composing in professional and business contexts: "the humanist tradition as it is embodied in various disciplines believes that Quintilian's ideal orator, a good person who can speak well, is likely to offer a perspective on human interaction and motivation that contributes usefully to the practical endeavors of business and industry" (p. 25). Jennifer Slack, David Miller & Jeffrey Doak (1993) focus directly on the technical communicator's role in articulating meaning as it relates to defining power differentials among various technical and human aspects of the task of communicating: "the articulation view allows us to move beyond a conception of communication as the polar contributions of sender and receiver to a conception of an ongoing process of articulation constituted in (and constituting) the

relations of meaning and power operating in the entire context within which messages move" (p. 25). Articulating the relations of meaning and power in context is inherently an ethical activity, one that ensures Rutter's "humanist tradition" contributes usefully to technical and scientific fields like computer science, algorithm development, and usability testing. Technical communication scholars of workplace functions and communications like Charles Bazerman (2004) and Clay Spinuzzi (2003) reveal interconnectivity among systems, genres, technologies, and users in their work, contributing to increased understanding of the influence that communication subjects, media, and methods have on messages.

2.1 ALGORITHMS

The kind of algorithm examined in this study is the digital online search algorithm, described above as the workhorse of the search engine. Generally speaking, an algorithm is "a prescribed set of well-defined rules or instructions for the solution of a problem, such as the performance of a calculation, in a finite number of steps" that is expressed as a program ("Algorithm," 2016). This definition would encompass a recipe used to make cookies, a set of procedures used to solve a mathematical problem, or a programmed set of processes used to provide online search results. Contemporary popular usage of the term typically refers to digital processes used in computing, especially online, that automate complex iterative problems like providing a limited set of results from a broad-based web search or suggesting products for purchase based on past purchases. Christopher Ingraham (2014) describes these as complex, iterative, automated algorithms: "the algorithm as we know it now is digital, and magnitudes more complex than the example of such simple instructions [as cookie recipes or driving instructions] would make it out to be… algorithms themselves now execute the very instructions and rules that make them algorithms in the first place" (p. 66). In the research scenario described

in Chapter 1, Google's explanation of "How Search Algorithms Work" offers clearer insight into the complexity and autonomy of algorithms at work in online search tools:

> You want the answer, not billions of webpages, so Google ranking systems sort through the hundreds of billions of webpages in our Search index to give you useful and relevant results in a fraction of a second.
>
> These ranking systems are made up of a series of algorithms that analyze what it is you are looking for and what information to return to you. And as we've evolved Search to make it more useful, we've refined our algorithms to assess your searches and the results in finer detail to make our services work better for you.
>
> Here are some of the ways Google uses Search algorithms to return useful information from the web:
>
> - Analyzing your words
> - Matching your search
> - Ranking useful pages
> - Considering context
> - Returning the best results (Google Search, n.d.)

Reading around the marketing language in the Google Search text, what's clear is that online search uses a series of algorithms working together to accomplish the task of matching and relevance-sorting results from a given search term or terms. It is these complex, regularly evolving algorithms developed by publishing companies like EBSCO that are at the heart of this rhetorical study.

Although digital algorithms are only recently being studied in composition, rhetoric, and technical communication fields, they are the subject of considerable scrutiny in fields like marketing, mathematics, and computer science. Such studies tend to focus on algorithm efficacy or efficiency: asking how well an algorithm achieves its programmed purpose or how efficiently it provides accurate results. Proving whether an algorithm is correct in terms of its results is difficult, except in the case of the simplest algorithms:

> In practice it is usually necessary to be content with **algorithm validation**. This process certifies, or verifies, that an algorithm will perform the calculation required of it. It

> involves testing the routine against a variety of instances of the problem and ensuring that it performs satisfactorily for these test cases. If the test set is chosen sufficiently well there can then be confidence in the algorithm. ("Algorithm," 2016, emphasis original)

Algorithm analysis is a branch of computer science study that analyzes "the performance characteristics of a given algorithm" ("Algorithm," 2016). These performance characteristics, rather than rhetorical agency or influence, are the focus of most studies of algorithms. Brad Miller and David Ranum (2011) succinctly identify the narrow focus of studies of algorithms in computer science: "One algorithm may use many fewer resources than another. One algorithm might take 10 times as long to return the result as the other. We would like to have some way to compare these two solutions. Even though they both work, one is perhaps 'better' than the other. We might suggest that one is more efficient or that one simply works faster or uses less memory." (sec. 1.6). Chung, Wedel, and Rust (2016), in a study of adaptive personalization (an algorithmic process of honing personalized results in social media links and posts), interrogate the appropriateness and match of algorithmic selections to preferences and differentiate between self-personalization and algorithmic personalization. In another study, Zhang, Gao, He, and Zhou (2016) describe a project in which a new algorithmic solution is proposed to address an existing issue in algorithmic processes, namely the matching of user product reviews with their usefulness and accuracy to other users within the user community. The tweaked algorithm proposed in the article achieves its creators' objectives by more accurately reflecting the product reviewer's intent in writing the review. In the *Nature* write-up of Google DeepMind's DQN algorithm (Mnih, et al., 2015), an algorithm specifically designed to play and win Atari video games, the researchers' focus is on programming the algorithm to learn on its own to play (and win) the games by focusing on pixel placement and score differences across millions of video frames. And in the *Nature* write-up of DeepMind's AlphaGo algorithm (Silver, et al., 2016), an

algorithm designed to play and win the board game Go, the researchers' focus is on designing training and learning protocols that enable programmed self-play to inform each move. In each case, the study of algorithms focuses specifically on developing accurate, reliable, efficient, and effective processes for users. Technical communication, with its background in rhetorical theory and its practice in user design, addresses algorithms differently. Rather than interrogating the efficacy or efficiency of algorithms, technical communication seeks to address their influence and effects on systems and users. It is this interest on the relationship among users, technology, and systems that places this study squarely in the field of technical communication. This project's technical communication focus on the rhetorical effects of algorithms, rather than a scientific or mathematical focus on algorithmic efficacy and efficiency, explains this chapter's attention to rhetorical rather than technical approaches to agency in algorithm-centered activities.

2.2 RHETORIC

There are a number of ways to understand and describe rhetoric. Classical approaches may be applicable, but the application of classical rhetorical theories and principles to questions of agency in modern technologies can become torturous. After all, when Aristotle defined rhetoric as "the faculty of observing in any given case the available means of persuasion" (Rhetoric, I, 2), it's a sure thing he never envisioned rhetoric applied to digital computer algorithms. With this in mind, I turn to Kenneth Burke's more contemporary, technology-aware (if not digital algorithm-centered) understanding of rhetoric to describe the ways algorithmic processes may be considered *rhetorical*.

In *A Rhetoric of Motives*, Burke (1969b) describes rhetoric as built around *identification* and *consubstantiality*. *Identification* refers to the intersection of interests among colleagues and the way in which colleagues may identify with each other even when their interests do not

intersect, but one or more of the colleagues involved consider or believe their interests to be intersected (p. 20). *Consubstantiality* refers to the activity of identity: "to identify A with B is to make A 'consubstantial' with B"—the two colleagues are "both joined and separate" (p. 21) in the way a child is consubstantial with a parent, and a parent consubstantial with a child. In Burke's illustration, the activity of identification among colleagues, and the reality of consubstantiality, result in rhetoric. The mixed confusion of identity and its opposite, division, represents the concern of rhetoric, "the state of Babel after the Fall" (p. 23): "Put identification and division ambiguously together, so that you can't know for certain just where one ends and the other begins, and you have the characteristic invitation to rhetoric" (p. 25). Burke's recognition that rhetoric emerges from the confused state of competing identity and division among entities offers useful insight into the research activity illustrated in Chapter 1. Although the illustration from Chapter 1 doesn't include "colleagues" as Burke exemplifies, the research activity includes a researcher engaging a web interface along with the algorithmic search process and sorting results found on the SERP. While this pair represents a deeply oversimplified description of the actors engaged in the research activity, these two entities demonstrate consubstantiality among two entities: the researcher, who is identified with the motives of the algorithm-centered process of search (to provide results); and the technological and algorithmic processes that present relevance-ordered results to the search terms provided, which are identified with the motives of the researcher (to find information). The researcher and the algorithmic processes engaged in the research activity are consubstantial with one another, and this consubstantiality represents, as Burke puts it, an invitation to rhetoric.

Of concern in this extension of Burke's description of rhetoric to algorithm-centered research activity is his focus on human actors. Burke (1969b) regularly refers to individuals

rather than nonhuman entities in his references to rhetoric: consider his use of "colleagues" in the illustration described above, or his description of the basic function of rhetoric: "the use of words by human agents to form attitudes or to induce actions in other human agents…" (p. 41). These represent unambiguously human-centered approaches to rhetoric. Yet Burke opens the door to representing rhetorical agency among a broader range of agents than humans alone. First, he posits the existence of extrinsic motivations with which human agents may identify: "The fact that an activity is capable of reduction to intrinsic, autonomous principles does not argue that it is free from identification with other orders of motivation extrinsic to it…. The human agent, *qua* human agent, is not motivated solely by the principles of a specialized activity…" (p. 27). Burke appears to suggest that human agents can and will identify (and therefore be consubstantial) with extrinsic motivations, which could include nonhuman actors and agents like algorithmic processes. Further in this chapter, Burke recognizes that agency extrinsic to the human agent has influence upon rhetorical motives: "There is a wide range of ways whereby the rhetorical motive, through the resources of identification, can operate without conscious direction by any particular agent" (p. 35). This focus on operation of rhetorical motives beyond the human agent represents a depiction of rhetoric that is open to the influences of nonhuman agents in rhetorical activity.

Burke's (1969a) "dramatistic pentad," described in *A Grammar of Motives*, reinforces the potential that nonhuman entities contribute to rhetorical motives. By breaking rhetorical motives into act, scene, agent, agency, and purpose, Burke proposes a view of rhetoric that centers neither on rhetor nor on situation, but on the combination of factors that contribute to and produce invitations to rhetoric. As a reminder, Burke (1969a) described the five terms of dramatism as follows:

- *Act* "names what took place, in thought or deed";

- *Scene* is the "background of the act, the situation in which it occurred";
- An *Agent* represents "what person or kind of person performed the act";
- *Agency* represents the "means or instruments" by which an agent acted; and
- *Purpose* presents the reason the agenct acted (p. xv).

Once again, Burke focuses directly on an agent as a human entity. However, given Burke's (1969b) recognition in *A Rhetoric of Motives* that a rhetorical motive can be influenced through the process of identification, there seems room that *agency*, if not *agents*, has the potential to exert influence on motives. Agency is not limited in Burke's pentad to human agents. Since agency must be exerted within a scene, and since Burke appears to recognize that agency may be exerted through identification beyond the human agent in the pentad, agency may be said to emerge through identification from the interaction of human and nonhuman entities enacting thoughts or deeds in a given scene for a given purpose. This conclusion helps understand the way agency emerges when human agents engage algorithmic entities (like search algorithms) in online research interfaces. The elements of Burke's pentad work together through identification to generate, produce, or reveal rhetorical agency.

At this point, returning to the research activity described in Chapter 1 and applying Burke's pentad will prove instructive.

1. The *scene* represents the physical and virtual research situation, and extends to the corporations that create and own search algorithms, the institutions that engage those corporations, and the ideological values inherent in algorithmic programming:
    a. A location like a classroom, lab, dorm room, or library where the search is conducted;

   b. An internet-connected device like a laptop computer, tablet, or smartphone that includes a modern web browser;
   c. The library webpage where the search interface can be used;
   d. The physical and virtual servers where programmed algorithms run;
   e. The corporations and institutions that own and deploy algorithms; and
   f. The values and biases of the programmers who create algorithmic procedures.

2. The *act* represents the activity of conducting a search:
   a. Receiving a research assignment and developing a research question or plan;
   b. Entering search terms appropriate for addressing that research plan;
   c. Reviewing results on the SERP; and
   d. Selecting results that will best help answer the research question.
3. The *agent* is the person conducting research, including:
   a. Level of prior research experience;
   b. Level of prior experience searching in the library interface; and
   c. Research and technical literacy.
4. *Agency* is the method by which search happens:
   a. Algorithmic processes that crawl existing online content and index that content in proprietary data structures;
   b. Search terms entered by the agent, often influenced by auto-completion suggestions in the search bar;
   c. Natural language processing that "reads" and "understands" the search terms entered by the agent; and

    d. Matching algorithms that match search terms to indexed content toward providing the most relevant search results.

5. The *purpose* is to address the terms of the research assignment:
    a. Toward developing a research-based response;
    b. Toward meeting the requirements of the assignment; and
    c. Toward presenting research in as ethical and honest a format as possible.

The goal of this research project is to trace agency as it emerges during research processes. Burke's pentad suggests rhetorical agency represents the means by which a human agent engages in a specific act within a scene for a stated purpose. However, even the simplified approach described in the previous listing suggests that agency resides in algorithmic processes that are identified with human agents, but are not actions of human agents. Rather, it is the interactivity of human agents within a scene that generates agency. Agency does not emerge as a result of the individual activity of a subject, be it human agent or nonhuman entity. Rather, it emerges through what Karen Barad (2003) terms "intra-action" among entities, where relations among subjects and objects are separated, constituting "*a reworking of the traditional notion of causality*" (p. 815, emphasis original). In other words, the scene of shared agency in online research represents the locus of interactivity where subjects and objects remain in indefinite, but continually shifting, relations among themselves, solidified momentarily for review in the SERP.

This conclusion about the origin of agency in research activity is startling for its willingness to ascribe agency to algorithms. Yet the effects of this conclusion are available to be experienced daily. Algorithmic processes suggest the best way to drive from an origin to a destination, recommend the next TV show to watch on a streaming service or next product to purchase on an ecommerce site, tell us the name of a song we're listening to but can't quite

place, and (of course) recommend a list of sources that will address a specific research question. None of these processes is available without the human agent, but neither do these processes require action beyond human agent initiation to make recommendations. Combined with the initiating activity of a human agent, these algorithmic processes make recommendations and decisions that are rhetorical, but that cannot be traced directly. Algorithmic rhetorical activity occurs in black-boxed environments whose processes should be traceable to rhetoric scholars, but are not. This project recognizes the rhetoricity of algorithmic processes and seeks to trace agency as its emerges among human and nonhuman interaction during online research activity.

Understanding technology, and especially algorithm-centered technological processes, in rhetorical terms is clearly an important next step toward tracing rhetorical agency through a technology-centered process like online research. For this approach, we can turn to Robert R. Johnson (1998) and his ground-breaking *User-Centered Technology: A Rhetorical Theory for Computers and Other Mundane Artifacts*. In this text, Johnson constructs user-centered rhetoric in technological settings as a complex of activities centered around users engaged with technologies. In examining the history of user-centered research, Johnson specifically probes the nonmaterial aspects of technologies engaged in user-centered activities like online research: "user-centered research has dedicated itself almost entirely to probing the interactions that humans have with technological artifacts (usually computers), and therefore it is limited to the conception of technology as a material artifact. My interest in technology encompasses the discursive, or nonmaterial, aspects of technology and technological use" (p.14). These discursive or nonmaterial aspects of technology, understood more clearly as technology-in-use, represent the focus of this study. Algorithmic processes engaged throughout research activity certainly require a researcher (in Burke's terms, an *agent*; in Johnson's terms, a *user*) to initiate the search

process, but once initiated, the combined activities of users and discursive activities of online algorithms represents rhetorical agency, the means by which an act (in Burke's terms) happens. Johnson describes the rhetorical agency of technology-in-use as "The User-Centered Rhetorical Complex of Technology" (see Figure 2.1).

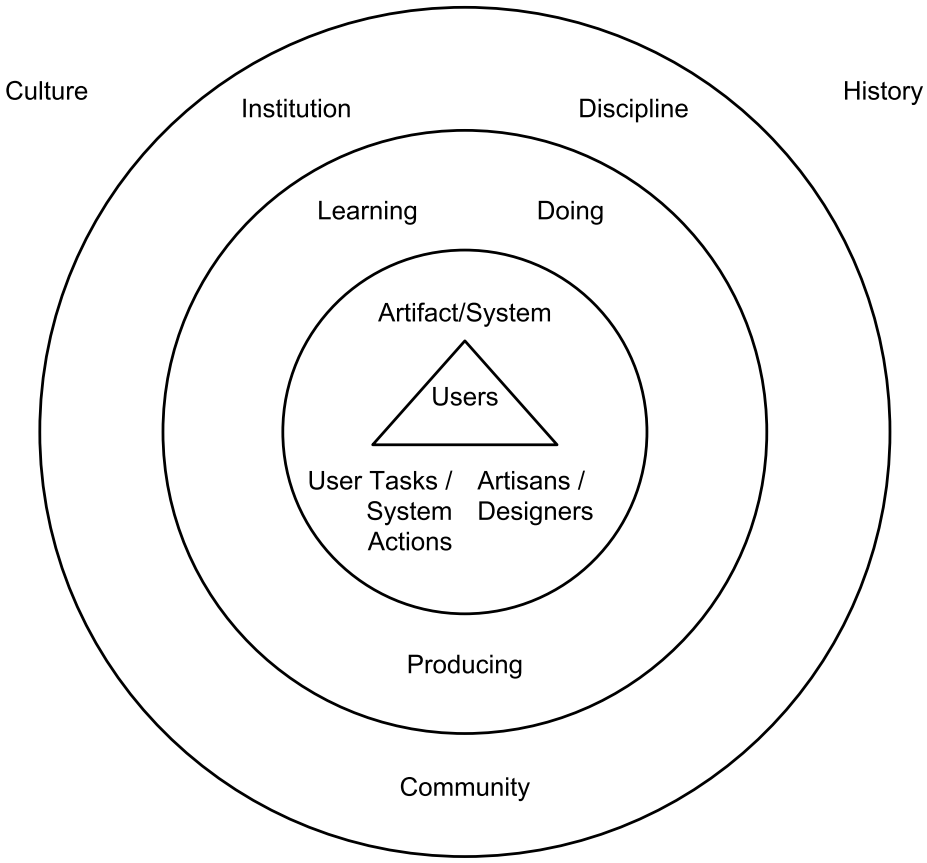

Figure 2.1. Depiction of Johnson's (1998) user-centered rhetorical complex of technology (adapted from p. 39). Illustration by author.

The significance of the rhetorical complex of technology is a recognition that, while users may represent the end (user) of technology, the rhetorical activity of technology use engages a

complex of nonmaterial entities, many of which may be algorithm-centered processes. Johnson reminds us that technology can function as a tool to be controlled or used, but it can also "be controlling." Johnson continues,

> There is the powerfulness that resides within the tools and systems we either use or are a part of. Technology is, like rhetoric and fire, a paradox of power and powerfulness. Technology may be the defining paradox of our culture: a paradox that, like virtually all paradoxes, we can neither escape nor ignore. (p. 111)

This project seeks to trace the origins of this controlling powerfulness, the agency that emerges during the interactions of human agents with algorithm-centered nonmaterial processes through technological tools.

Cheryl Geisler (2009) addresses a brief history of contemporary approaches to rhetorical agency that offer useful insight into the issue this project seeks to address. The question of what rhetorical agency is, and who or what can have agency, dominates Geisler's approach. She reports that "scholars seem to be moving us toward a richer understanding of rhetorical agency by examining how rhetors without taken-for-granted access do, nevertheless, manage to exercise agency" (p. 11). This perspective on rhetorical agency, where rhetors find themselves in situations that do not match traditional conceptions of rhetorical situations, certainly opens the door to some aspects of rhetorical agency being situated outside the traditional rhetor, who would be the user in online research activities. Geisler continues to broaden the scope of agency by describing the "fragmentation of agency" (p. 11) in work related to media and its dispersal across distributed networks. Here she describes agency as the "interplay of audience and media in constructing and being constructed" through images depicted in those media. While this perspective relates to image-based media like photographs, iconography, and film, Geisler's perspective recognizes that agency is constructed less through the activity of a traditional rhetor and more through the interactivity of the media and its viewer, a perspective that offers clear

insight into the locus and origin of rhetoric in online research activity being shared and emergent from interactivity. Her focus on the influence of technology and material conditions on rhetorical agency reveals considerable latitude toward studying rhetorical agency in the future.

> As we have already seen, some of the more interesting research has been looking at the way that material conditions shape rhetorical action—the rhetor's body (Brouwer), the place of rhetorical performance (Blitefield). Interesting questions arise in this regard in connection with technology. Under the impact of digital technologies, we have the ability to be in virtual places beyond our physical reach—how does this affect agency (Gunn)? And in studying the increasing complex impact of popular media, scholars have been hard pressed to find adequate accounts of agency for mediated experiences like iconic photographs (Lucaites) or the Willie Horton story (Wells). (Geisler, 2009, p. 14)[7]

Geisler points to "interesting questions" that technology raises in understanding agency. Her perspective appears limited to more traditional popular media (pop art, photography, film) and websites that offer users opportunities to experience a different time and place through multiply mediated experiences, precursors to more immersive experiences now available like augmented and virtual realities. Even with these limits, however, Geisler appears open to the rhetorical work that technologies perform as rhetorical agents. Missing from Geisler's work is a method by which to identify and trace rhetorical agency in media, in technologies, or in distributed media networks.

Carolyn Miller (2007) carries the interest in rhetorical agency in technological systems to automated assessment systems for writing and speaking. She closes her abstract with this startling claim: "Unwillingness to attribute agency to automated assessment systems makes them rhetorically ineffective and morally problematic" (p. 137). Miller clearly recognizes that automated systems seem to have some level of rhetorical agency, but given the lack of traditional rhetor as the subject of a rhetorical situation, she struggles to place this agency within a Burkean

[7] Parenthetical references to authors are included in Geisler's text and are not cited in this project.

framework for symbolic action: "automated assessment systems create a situation in which Burkean symbolic action directly confronts nonsymbolic motion in the form of the machine" (p. 140). Miller's perspectives on Burkean symbolic action reveals its lack of flexibility when confronted with machinic motion rather than symbolic action, a lack hinted at in my earlier attempt to apply Burke's dramatistic principles to algorithm-centered processes.

Miller's (2007) approach places the automated assessment system in the position of the audience in the rhetorical situation, placing the rhetor in the position of writer or speaker. She argues that agency does not reside solely in the rhetor, whose written or spoken performance is being assessed, but in the relationship between the rhetor and the audience, which in this case is providing feedback to the rhetor on work submitted to the assessment system. She concludes that agency in such situations can be defined as "the *kinetic energy* of rhetorical performance…. In invoking the distinction that physics makes between potential and kinetic energy, I'm comparing agency not to the energy of a stone sitting at the top of the cliff but rather to the energy it has as it falls, the energy of motion" (p. 147). This approach to agency focuses attention on the rhetorical performance, meaning that rhetorical agency inheres not in a rhetor or an audience, but in the performance of rhetorical activity. Here we recognize an approach in which rhetorical agency emerges as a "property of the rhetorical event" (p. 137) rather than as a property of rhetors or audiences. Combined with Geisler's approach to rhetorical agency as open to technologies and media, approaches to rhetorical agency can begin to expand beyond a traditional rhetor subject toward agency that resides in interaction among rhetors and technologies.

If rhetorical agency as kinetic energy can be seen as the property of a rhetorical event, it's not so great a leap to suggest that rhetorical agency should be present in online research

activities. User, technology, network, and information combine in the rhetorical event of finding research materials to support or address a research question. Agency resides neither in the user's search activity nor the algorithm's matching and sorting activity, but in the interaction of these assembled agents. This provides a clear picture of rhetorical agency, but offers no way to test the theory. How do we demonstrate that agency has emerged? What methods can we apply to this rhetorical event to trace the emergence of agency?

The work of identifying and tracing agency in technological and digital procedures is happening. Scholars are at work considering how to theorize, describe, and trace the rhetoric of digital algorithms and their assembled activities and actors. For example, in a chapter titled "Toward an Algorithmic Rhetoric" that seeks to introduce algorithms as rhetorical, Ingraham (2014) identifies several approaches to rhetoric offered by rhetoricians and rhetorical theorists that might reasonably, if not perfectly, be applied to algorithms. These theorists include Aristotle, Burke (1969b), Wayne Booth (1974), and Lloyd Bitzer (1968) among others. After reviewing various theories, Ingraham claims that "algorithms are rhetorical by nearly any notion of rhetoric available in the literature" (p. 67). He then summarizes theorists' contributions to an understanding of rhetoric; Table 2.1 presents Ingraham's list of definitions of rhetoric in a matrix as they apply to algorithms.

Table 2.1

Ingraham's (2014) list of notions of rhetoric applicable to algorithms, organized as a matrix.

Source	Conception of Rhetoric Applicable to Algorithms
Aristotle (2006, p. 37)	"An ability, in each particular case, to see the available means of persuasion."
Burke (1997, p. 43)	"The use of language as a symbolic means of inducing cooperation in beings that by nature respond to symbols."
Booth (1974, p. xiii)	"The art of discovering warrantable beliefs and improving those beliefs in shared discourse."
Hauser (1999, p. 14)	"The symbolic inducement of social cooperation."
Weaver (1985, p. 211)	"An art of emphasis embodying an order of desire."
Bitzer (1968, p. 4)	"A mode of altering reality, not by the direct application of energy to objects, but by the creation of discourse which changes reality through the mediation of thought and action."
Farrell (2008, p. 470)	"The art, the fine and useful art, of making things matter."

Note: Adapted from Ingraham, 2014, pp. 67-68. Unless elsewhere referenced, Ingraham's sources are not cited in this project.

Ingraham summarizes their various contributions to a broad understanding of rhetoric as follows: "[W]e can at least say broadly that rhetoric concerns the exertion of influence" (p. 68). Applied to algorithms, Ingraham offers this approach: "At a technical level, algorithms function by making certain rules matter in certain ways, and the influence of these choices results in making other things matter in the world" (p. 68). It is this understanding of algorithmic activity as exerting influence that, at least in part, makes algorithms rhetorical. Ingraham's summary recalls Burke's recognition that agency may involve nonhuman identifications and Johnson's recognition that user-centered technologies exert rhetoric through a complex of relations: algorithms contribute to making things matter in the world. They exert influence on matters of daily life, and in the case of academic research, algorithms exert influence on the process and

results of research activities. However, this approach does not provide a method or methodology for tracing rhetorical activity as it emerges from algorithm-centered activity.

2.3 TRACING AGENCY

Work is emerging in the fields of composition, rhetoric, and technical communication that addresses the influence of algorithms on users. Ingraham (2014) is not alone in recognizing that algorithms are rhetorical. Nathan Johnson (2012) focuses on information architecture and infrastructures in web-based tools as rhetorical features that organize, classify, and prioritize content. Regarding the rhetorical activity of algorithms, Johnson writes that "[s]earch algorithms designed by Google limit the intellectual world of novice searchers" (p. 2). As information to be indexed and matched to search terms becomes increasingly vast and complex, the infrastructural approaches to organizing and indexing this content for quick algorithm and user accessibility have increased in complexity. The result, according to Johnson (2012), is a need for scholars to "start looking at infrastructure, rather than through it. Investigating the rhetoric of classifications, standards, protocols, and algorithms is an important part of understanding modern rhetorics" (p. 2). While Johnson offers three approaches to rhetorical intervention in information infrastructure—*genealogies*, *rhetorical ethnography*, and *protocological hacking* (p. 2)—specific methods for completing these studies, or understanding how these studies address the influence of algorithms on users, are lacking.

Kevin Brock (2014) compares the algorithm, as a set of instructions or procedures for solving a problem, to the rhetorical *enthymeme* as heuristic for possible rhetorical response: "The enthymeme, while serving as the basis for heuristic invention, also works at the local level as a rhetorically oriented algorithmic procedure through which a rhetor determines the most probable success for persuading an audience to action." Brock and Dawn Shepherd (2016) push this

understanding of algorithms as rhetorically persuasive in their focus on the warrants hidden in the proprietary activities of algorithms working in ads displayed on Google's search results pages:

> The expected event—discovery of information about a given topic of interest, thanks to the implicit argument that Google serves users with avenues toward the knowledge that they seek—mutates into an unexpected one, as the procedural enthymeme reveals a different conclusion than the one suggested by its premises: the genesis of a consumer who is persuaded by the Google interface… that emphasizes links to the websites of one or more of Google's advertising partners. (p. 23)

Both studies identify ways that algorithms may influence or affect the researcher or user, especially focused on the rhetorical arguments implicit in search interfaces and SERPs. However, both approaches—search algorithm as rhetorical enthymeme and SERP interface as site of rhetorical persuasion—lack an approach to algorithms that provides methods for tracing agency as it emerges in the interaction of users and technologies in action. Such tracing of agency in the search setting (referring back to Burke's pentad) is the goal of this study.

Shifting focus from the persuasive activity of the Google interface to the influence of encoding algorithms themselves, Beck (2016) looks to the "lingual structures" of algorithms, the symbolic linguistic systems used for coding, to identify rhetorically persuasive aspects of algorithms: "computer algorithms are persuasive because of their performative nature and the cultural values and beliefs embedded/encoded in their lingual structures." Beck's work points to a sometimes-overlooked characteristic of algorithms as programmed procedures composed using symbolic coding languages: the programming and testing work of digital algorithm programmers, researchers, and developers is inherently rhetorical as they work to program algorithms that index content and match results to search terms. The field of critical code studies offers insight into the rhetorical work of programs (see Berry, 2011, and Cummings, 2006), focused both on the function and influence of the code itself and on the rhetorical process of

authoring code. Berry (2011), Cummings (2006), Johnson (2012), Brock (2014), Brock and Shepherd (2016), and Beck (2016) all recognize that the activities of digital algorithms exert rhetorical persuasion on users who encounter them in computer-mediated life experience. However, none offers clear methods for identifying and tracing rhetorical agency as it emerges in the search setting. More specifically, the field lacks a clear methodological approach to describing, locating, or tracing agency in algorithm-centered activities like online research.

The effects of algorithms, the influences they exert in the world to "make some things matter more than others" (Ingraham, 2014, p. 76), have expanded into many experiences in the digitally mediated world, including social media newsfeeds, online search functions and results, artificial intelligence (AI) appliances like personal assistants (Amazon Echo and Alexa) and home automation controllers (Google Home), digital advertising platforms, and dating applications. Digital algorithms, especially iterative automated algorithms programmed to create and execute their own rules, are rarely encountered directly by human users. Instead, they are executed deep within distributed networks and computing platforms and mediated through interfaces. As a result, the influence algorithms exert is seldom seen or recognized as influential or persuasive by human users. Furthermore, the activities of algorithms are mediated by networks and technologies that may also be influenced or persuaded, in the sense of executing one set of rules or instructions over another, at the level of code (Beck, 2016), network flows (Rainie & Wellman, 2012), or even affect (e.g., overheating in a wired system that results in traffic being automatically and/or manually blocked, throttled, or otherwise affected).

Such obscurity in algorithm-centered processes, identified as the heart of the problem this study seeks to address, requires a comprehensive methodological approach for tracing rhetorical agency as it emerges at the intersection of human, technological, ideological, and environmental

activity. Aspects of this agency are being traced in piecemeal fashion. For example, Beck (2015) traces the rhetorical activity of algorithms involved in building digital identities. Browsing and purchasing habits are tracked with beacons and tracking pixels, and those habits and purchases are collected to form a hidden identity in the form of a digital profile situated on a networked server that is used for the purpose of matching advertised products and product offers to profile preferences. Beck (2015) reveals the existence of this invisible digital identity and seeks to make students (and their teachers) aware of "how companies use their personal data for online behavior advertising, and what actions students can take to limit the farming of computer files of their surfing habits" (p. 126). Beck theorizes an object-oriented rhetoric (OOR) as a framework needed to recognize the rhetorical influence of algorithmic processes that exist in digital surveillance and identify creation:

> OOR helps position us to acknowledge ways computer algorithms, the very ones that track us online, persuade us to click on advertisements or respond to certain elements in social media spaces beyond just seeing algorithms as subordinate to a human position, but as equal in existence, and therefore warranting further exploration into computer code. (p. 136)

Here the importance of algorithmic influence on human and nonhuman entities is revealed through their ontological position in relation to one another during digital identity creation and manipulation.

John Cheney-Lippold (2011) argues that creation of aggregated (rather than Beck's individualized) digital identities has a powerful effect on the way companies market products to target audiences based on broad categories like gender. The influence of algorithmic processes that enable aggregation and categorization of huge datasets filled with the browsing patterns of millions of people provides what Cheney-Lippold calls a "soft biopolitics" that can, in turn, have influence on biopolitical decisions made by corporations and states:

> Through what I term cybernetic categorization, categories' meaning can be realigned according to the code and algorithmic models built to target content to particular consumers. The process of identification, at least in the online world, becomes mediated by what I term soft biopolitics, as user identities become tethered to a set of movable, statistically-defined categorizations that then can have influence in biopolitical decisions by states and corporations. (p. 176)

Cheney-Lippold's soft biopolitics, by which algorithmic categorization is mediated, recognizes the influence algorithms have on identity formation and on the actions corporations and states may take as a result of defining these categories. In both Beck and Cheney-Lippold's research, algorithms are involved in the rhetorical process of identity formation. They both demonstrate ways that algorithms are involved in identity creation, but each lacks a clear, accessible methodology for tracing when and where in browsing activity such identities are built, maintained, and manipulated.

Additionally, algorithms are involved in the activity and flow of information used by human and nonhuman users alike. These activities, or flows of information, never end, at least not in a digital sense on networks. They can be traced. The example of a computer connected to a wired ethernet hub offers a distinct picture of this activity: whether a human user is logged into the computer or not, the network is sending information, in the form of packets filled with data, through the network and into the network card of the computer. The computer is responding in kind, sending information about its location in the network and its status across those same wires (illustrated in Figure 2.2).

Figure 2.2. Network activity across wired connection between computer through hub to internet and back.

An observer can often view a representation of that activity in blinking lights on the network port of a computer connected to a wired network via ethernet cable (see Figure 2.3).

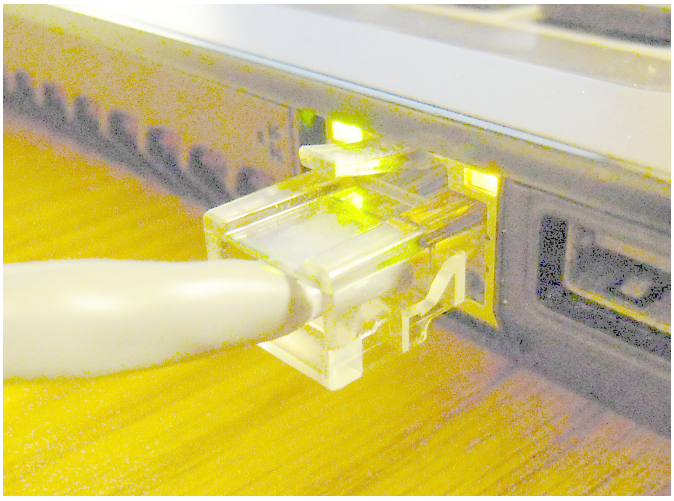

Figure 2.3. Network port on a laptop computer, with green light on left showing networking connection status and orange light on right showing network activity. WikiMedia Commons. (2013). *Ethernet Connection.jpg*, retrieved September 2, 2017, from https://commons.wikimedia.org/wiki/File:Ethernet_Connection.jpg. Creative Commons licensed BY-SA 3.0.

This activity exists as long as the network is powered and the computer is turned on, regardless of additional human intervention. Algorithms are in place to mediate this flow of electrons organized into packets of data through physical and virtual networks. Jim Brown (2015)

addresses this algorithmic influence on network flows using Derrida's "'non-dialectizable antinomy' between what he [Derrida] calls the Law of hospitality and the laws of hospitality" (loc. 563). The Law of hospitality is absolute connectivity; in a digital network, the Law of hospitality allows all connections, then uses (or implements) various laws of hospitality to limit and analyze these connections.

These various laws of hospitality represent what Brown calls ethical programs, and these ethical programs include algorithmic procedures that limit, direct, analyze, and categorize incoming and outgoing traffic in a network: "the Law of hospitality in a networked society is connectivity, and the laws of hospitality are written in response to this unrelenting fact of connectivity" (loc. 574). Johnson (1998), writing some years earlier about the value of user-centered design, recognized that technology design evokes an emergent rhetorical agency through activity:

> In a user-centered approach to technology, users are active participants in the design, development, implementation, and maintenance of the technology. This is not meant to imply that users are the sole or dominant forces in technology development. Rather, they are allowed to take part in a *negotiated process of technology design, development, and use* that has only rarely been practiced. (p. 32, emphasis original).

This negotiated process of design, development, and use presages the rhetorical activity that emerges in the interplay between Law and laws of hospitality. Algorithms are integrally engaged in the rhetorical activity of networked systems, participating in programmed and learned ethical activities to restrict, control, and otherwise influence other participants in distributed networks—including, potentially, human users. Brown's description of the relationship between the Law of Hospitality and the laws of hospitality offers useful metaphors for tracing the flow and control of data through networks. However, it does not provide specific methods for identifying and tracing agency in such relations.

This literature review has sought to trace rhetorical approaches to algorithm-centered activity using Burke's dramatistic pentad as a framework. From there, it identified contemporary rhetorical approaches, cited by Geisler and presented by Johnson and Miller, that contribute to understanding rhetorical agency beyond the human subject portrayed by Burke. Actor-Network Theory (see Chapter 3) provides an additional theoretical lens for describing the agency that emerges in activity of multiple actors in a networked relationship. When agency is described as assembled in specific activity, like that in algorithm-centered processes including online search, technical communication and rhetorical studies scholars are proposing theoretical approaches to describing the way users are affected, influenced, and even manipulated in such assemblages and network flows. However, little technical communication scholarship dives into the question of where agency emerges in such assemblages, nor seeks to trace that agency as it emerges and distributes among human and nonhuman agents. As technical communicators both describe the work of algorithm-centered technological activity and use tools that distribute agency among assemblages to do the work of describing these technologies and their role in assembling agency, methods for identifying and tracing agency as it emerges in assembled actors are needed. The next chapter proposes methodology and methods for doing this important work.

CHAPTER 3

METHODOLOGY

After mapping the situation of this dissertation to identify the variety of actors engaged in online library research, then positioning the dissertation in the field of technical communication, this section applies the dissertation's theoretical underpinnings to specific examples of online library research. The goal of the study is to trace the activity of human, technological, environmental, and ideological actors identified in Chapter 1 in order to describe, in rhetorical terms, the agency that emerges from network assemblages. As noted in Chapter 2, the study's methodology stems from Latour's (2005) Actor-Network Theory (ANT). The goal of this chapter is to explain and defend the methodological approach taken and to detail the methods implemented to address the research questions. It presents specific methods that address the project's second research question: "In the process of conducting research using online search engines, when and where does rhetorical agency emerge and how can its activity be traced?"

3.1 THEORETICAL INFLUENCES

Algorithm-mediated processes are hardly the common realm of technical communication or its parent field of rhetorical studies. As a result, this study requires applying methodologies that are outside the common realm of those fields.

3.1.1 Actor-Network Theory

While Bruno Latour's work has regularly been applied to rhetorical studies (see the recent "Forum: Bruno Latour on Rhetoric" (Walsh, et al., 2017) in *Rhetoric Society Quarterly* for descriptions of Latour's influence on the field from the pens of such theorists as Nathaniel Rivers, Laurie Gries, Thomas Rickert, and Carolyn Miller), it's important to remind readers that ANT represents a methodology for redefining sociology, not as a methodology for tracing

rhetorical agency. Latour (2005) describe his project in *Reassembling the Social* as "redefining sociology not as the 'science of the social' but as the *tracing of associations*" and describing the term social as "not a thing among other things…, but *a type of connection* between things that are themselves social" (p. 5, emphasis original). Latour most assuredly is not presenting a methodological approach to studying the rhetorical activity of humans and technologies in networks. However, ANT provides an approach for identifying actors, defined by Latour as "*any thing* that does modify a state of affairs by making a difference" (p. 71, emphasis original) and tracing their activity (Latour and rhetoricians might both use the term "agency" here to represent these difference-making actions) in relation to other actors in a network. In the case of online library research, those actors include human, technological, environmental, and ideological actors as outlined in Chapter 1.

Latour's (2005) work seeks to isolate and flatten the activity of network actors toward understanding the relations among nodes in networks. The work of isolating actors and flattening networking activity enables tracing social relations among actors, which Latour agrees can be human or nonhuman entities, in order to reveal the social as action and study its emergence. In rhetorical terms, Latour focuses on the agency, or agentive activities, of individual actors toward the emergence of the social in order to demonstrate that social activity represents actors working in differential relation to each other. In writing that "an actor-network is traced whenever, in the course of a study, the decision is made to replace actors of whatever size by local *and* connected sites instead of ranking them into micro and macro" (p. 179, emphasis original), Latour recognizes that both actor and network are essential to the study:

> The first part (the actor) reveals the narrow space in which all of the grandiose ingredients of the world begin to be hatched; the second part (the network) may explain through which vehicles, which traces, which trails, which types of information, the world

> is being brought *inside* those places and then, after having been transformed there, are being pumped back *out* of its narrow walls. (p. 180, emphasis original)

Actor-network represents a combined entity of actor and network that interacts with other actors and networks whose interaction can be traced and studied toward uncovering the sociology of the social. However, and importantly, although an "actor-network" represents tracing the activity of "local and connected sites" rather than individual actors, they do not quite represent the assemblage of agencies that this dissertation seeks to identify and trace. Assemblage agency represents an ecological dependence among constituent entities for activity to emerge; in Latour's terms, the actor-network is centered around an indivisible rhetorical actor in networked relations with other actors and networks rather than a network of individual agents engaged in collaborative activity. In online research activity, agency is theorized to emerge in collaborative ecological interactivity consisting of human and nonhuman actors, not to emerge through actor-networks centered around human and nonhuman actors. More directly, actor-networks consist of networked connectivities around actors; assemblage agency consists of actors in collaboration whose activity cannot be isolated to individual actor-networks or actors. This dissertation seeks to demonstrate that agency in online research cannot be divisible among actors; it can only be understood in collaborative ecological terms.

3.1.2 Indivisible Unity of Assemblage Agency

The collection of assembled human and technological actors whose activity is indivisible among its constituent parts is how this dissertation represents online research conducted by students. *Indivisibility* reflects the nature of agency in online library research. It is this hypothesis—that agency emerges through assemblage activity rather than through actor-networks or individual entities at work in online library research—that this dissertation seeks to prove or demonstrate. Jane Bennett's (2010) work, although it represents a political approach to

the effects of agency, provides the language and approach needed to understand agency as it emerges in online library research. She terms the assemblage agent an "ontologically heterogeneous" (combining human and nonhuman entities) public that coalesces "around a problem":

> If human culture is inextricably enmeshed with vibrant, nonhuman agencies, and if human intentionality can be agentic only if accompanied by a vast entourage of nonhumans, then it seems that the appropriate unit of analysis for democratic theory is neither the individual human nor an exclusively human collective but the (ontologically heterogeneous) "public" coalescing around a problem. (loc. 2200)

Bennett's focus on human intentionality being "inextricably enmeshed with vibrant, nonhuman agencies" is precisely the approach this dissertation takes in describing emergent assemblage agency. As she writes, such agency is "ontologically heterogenous," meaning its constituent entities may be traceable, but its agentive effects must be treated as an indivisible unity of agency. Bennett theorizes systems and their constituent actors as assemblages of agentive matter, ecologies that are capable of self-actualized agency. For Bennett, regardless of how carefully one traces the activity of the individual actors in an assemblage, no agency can be attributed to a single entity in the assemblage. Agency emerges only through the interactivity of the assemblage, which itself organizes and devolves as required by its constituent systems.

3.1.3 Unit of Analysis

Given the methodological underpinnings of this dissertation, Bennett's approach to a "unit of analysis"—in this case, of rhetorical theory rather than democratic theory—provides useful language for developing a study that unpacks the black box of algorithmic processes in online research. In both cases, the assemblage is the unit of analysis; she refers to this assemblage as a public that coalesces around a problem, while this dissertation refers to unit of analysis as the human and nonhuman assemblages that coalesce around online research activity.

The object of study for this dissertation is an instance of online research. The goal of the study outlined in this dissertation is to demonstrate and visualize where possible the assemblage agency that emerges as a result of the research activity. Here the terms "mapping" and "tracing" become useful distinguishers. The theoretical underpinnings of this study assert that agency emerges in assemblage activity, that agency maps its own progress. The methodological underpinnings of this study assert that assemblage agency may be traced during its emergence and reconstructed as a model of the self-mapped agency that emerges. Assemblage agency is an ontological approach whose activity can be traced, but not mapped. Its progress has already been mapped by its emergence; the role of the researcher is to trace that emergence. Using the assemblage as its unit of analysis, this study seeks to trace agency as it emerges during online research activity.

3.1.4 Rationale for Theoretical Influence Beyond Technical Communication

Latour's focus on the study of the social as networked activity and Bennett's focus on the nature of political intentionality as a result of intertwined, indivisible human and nonhuman agentive activity have been deeply influential in recent technical communication scholarship. In the past ten years, since 2009, Latour's (2005) *Reassembling the Social: An Introduction to Actor-Network-Theory* has been cited in 264 sources that also include the phrase "technical communication," according to *Google Scholar*. Similarly, since its publication, Bennett's (2009) *Vibrant Matter: A Political Ecology of Things* has been cited in 62 sources that also include the

phrase "technical communication."[8] I choose to employ both as methodological frameworks because they offer a way to solve a challenging problem: how do technical communication scholars and practitioners teach their students and employees to recognize the influence that algorithms have on mundane decisions? Given the black box in which algorithms act, technical communicators can extrapolate algorithmic activity from inputs and outputs. We can't observe that activity. We can't see or study, in most cases, the code that generates programmed responses to inputs. Yet algorithm mediated experiences are pervasive in daily life, and especially in the work of technical communicators. Our tools, often project management or productivity platforms, are digital and rely on algorithms; our methods, often involving computers and video, are digital and rely on algorithms; and our research, generally involving online search, is digital and relies on algorithms.

3.2 DESIGN RATIONALE

This study situates online research around a web browser where searches are conducted using an academic library's search interface. Rather than seeking to replicate this study across multiple research sites, this study examines in careful detail the online research practices of a small group of participants using the same search interface. Rather than seeking to isolate independent and dependent variables as would a quantitative study, this study multiplies variables to replicate, to the extent possible, real-life conditions of online research while enabling in-person researcher observations. The study seeks to identify and trace assemblage agency

[8] These results may be replicated to view current results on Google Scholar (scholar.google.com) by searching for the author/title pair, selecting the link to citations of the text, selecting the "Search within results" option and entering the search phrase "technical communication" (including quotation marks), limiting the citation timeframe to 2009 onward, and viewing the number of results. This represents the number of citations of the author/text combination indexed by Google Scholar that also include the term "technical communication." In this search, "technical communication" is serving as approximate proxy for scholarship in the field of technical communication. These results are hardly scientific, but they do provide a useful gauge for understanding the prevalence of Latour and Bennett citations in published contemporary technical communication scholarship.

emerging during the research session, and its theoretical framework positions the human participant as one among several entities in an assemblage of human, technological, environmental, and ideological entities whose activities coalesce as agency. The result of assemblage agency is represented in this study by identifying at least one resource that could be used in an assigned research-based project.

This study employs an ontological rather than epistemological approach to rhetorical agency. Chapter 1 addresses the influence that algorithms and algorithm-centered processes may have on users and search results in a mundane activity like online research, while Chapter 2 seeks to frame this influence as rhetorical. This influence emerges in the relations of human, technological, environmental, and ideological actors assembled in the moments of online research. Given this influence, this study seeks to identify how, when, where, and why agentive assemblages emerge through algorithmic mediation. This study outlines forces and sources of algorithmic influence in online research, pays careful attention to the entities assembled as agency, then examines the results to identify and trace assemblage agency produced during the research activity.

Engaging usability testing software provides a useful, if not perfect, means for collecting the activity of assemblage agency across technological, ideological, environmental, and human networks. The TryMyUI.com platform records all on-screen screen activity during the testing session, and it also records sounds, both ambient environmental sounds of the testing space (like people walking and talking in adjacent hallways or elevators arriving on the floor) and audio from participants' think-aloud narratives.[9] Audio and video are available in timestamped .MOV video files. Timestamps enable chronological correlation of participant, narrative, aural, visual,

[9] Audio is captured through the user's laptop microphone; one of the requirements of participation was having a laptop computer with functioning microphone.

hardware, software, network, search, and interface activities. Such correlation is vital to demonstrating the formation and activity of assemblages as agents during research activity. The platform also provides participants an opportunity to respond to open-ended survey questions at the conclusion of the usability test; these responses provide insight into participant comfort and experience with the online research interface specifically and with online search more generally. These responses also hint at, if not providing conclusive evidence of, the role information literacy plays in online research agency.

The methods of this dissertation seek to identify the human, technological, ideological, and environmental actors that combine as assemblage agency during online research; to trace that emergent agency across networks; and to demonstrate that agency in digital algorithm-mediated activity like online research should be understood as emergent and indivisibly assemblage-based. While usability testing is the primary method used to capture network activity for analysis, the methodology calls to focus not on whether the research interface is *usable* in the traditional sense of UX testing, but on how the process of conducting research online enacts agency, emergent in assemblages formed during research activity. As a result, the method employed is a modified usability test. Modifications are described in detail below, but the primary modification relates to the *positionality* of the researcher in relation to participants and the study itself. My methodology called for a modified usability test that focused not on whether the search interface was easy to use (i.e., its "usability" in the traditional sense), but on how the interface was used by the participant. As a result, my role as a researcher in this usability test was more engaged. While I remained a nonparticipant observer as it relates to the research task participants worked to complete, I interacted with participants to provide instruction on setting up the usability test software, on capturing and saving HTTP archive files generated by the

research session, and on working through the sometimes challenging experience of the search interface itself. This interactivity is reflected in the research session transcripts (available as Appendices G and J).

The study at the heart of the dissertation was split into two parts: a **pilot** involving two participants to test and hone methods followed by a **focus group** involving three participants to collect data for analysis. This study uses the term "focus group" more loosely than Creswell's (2015) definition of a focus group interview, "the process of collecting data through interviews with a group of people, typically four to six" (p. 217). In this case, the purpose of the focus group was to collect data in the same way as the pilot, but in a group setting rather than an individual setting. Rather than interviewing participants to collect qualitative data, I envisioned the focus group enabling me to collect data from multiple participants in a single setting; not necessarily because "interaction among interviewees will likely yield the best information" (Cresswell, 2015, p. 217), but rather because data from multiple individual browsers could be collected in a single testing session. Similar to a convenience sample, this was a convenience method. Because interaction among participants would be captured by audio recording in the usability testing software, and because the goal of the study was to capture participants in a somewhat realistic setting—like a study group or a crowded library where people might chat with each other about assignments or work together on research—testing a group of participants in a single session, like a focus group, seemed the right move. It was also a way to ensure we made available to all members of a class selected for the study, and not just a select few, an opportunity to earn extra credit. And because the unit of analysis in this project was assemblages, I considered including other participants among assemblage actors a usable approach to the study.

As will be revealed in the sections that follow, the two parts of the study merged into a case study of two participants completing nearly identical usability tests. The results of the case study are presented in two segments and reveal strikingly similar results.

3.3 PARTICIPANT RECRUITMENT

In order to trace assemblage agency, this project engaged a small group of student participants in an IRB-approved[10] online usability test that recorded user, browser, and network activities. The project provided participants a discrete research task and recorded, using ethnographic observation and participant video, each participant's research practices, technological mediation, and interaction with interfaces, processes, and environments. Participants were recruited to use their own laptop computers to connect to the Old Dominion University (ODU) wireless network (MonarchODU) and to conduct the research process using the operating system of their choice and the Chrome web browser using the ODU Library's main "OneSearch" interface. The study was conducted in a partially controlled environment, but participants used their own browsers and laptops to capture the widest range of activities within the timeframe of the research activity and the constraints of the testing environment.

The study's stated goal of tracing agency as assembled among human and nonhuman actors required a small number of participants who would, in combination with the technologies, environments, and ideologies engaged in online research, generate data for analysis. I enlisted the aid of a professor in the Old Dominion University English department teaching a technical communication class to help recruit a convenience sample (Cresswell, 2015, p. 144) of students in the course to participate in the usability test. Because user experience and usability testing is a core component of technical communication, the professor offered extra credit to students who

[10] IRBNet ID 1107778-1 "Toward Algorithmic Literacies: Rhetorical Agency Surrounding Algorithms in Online Digital Research," Old Dominion University, approved November 5, 2017.

participated in a usability testing session. Two different opportunities to participate were offered: a pilot study for two participants in January 2018, and a full study for a focus group in April 2018. To make the opportunity equally available to all class students, two students were recruited for the pilot study, but all other students in the class were invited to participate in one of four focus groups. By the end of the semester when the focus groups were scheduled, only three additional students chose to participate, despite the offer of extra credit at the end of the semester. As a result, only one focus group of three students was used to run the focus group of the usability test. Ultimately, this participation rate affected the study in several significant ways, including the decision to consider this study as two case studies—one for the pilot test and one for the focus group—rather than a focus group.

This decision to shift from a focus group framework to a case study framework was made after the study was conducted and the results were analyzed. This unorthodox approach brings with it methodological concerns about data analysis, concerns that I hope to put to rest as I detail results of both case studies and discuss the methodological lessons learned from both pilot study and focus group. Given the variable and emergent contexts in which participants encountered digital algorithms during online research, it's essential that methodologies be flexible, malleable, even modular and capable of adding or removing modules, in order to be applied to an emergent object like assemblage agency. Patricia Sullivan and James Porter (1997) encourage an approach that identifies methodologies and methods that are appropriate to the object of study in its situation and context; I have taken their guidance to heart in developing this study and reporting its results. Additionally, given the posthuman nature of agency that emerges in online research, it's important that any methodology employed represent a posthuman approach. Francesca Ferrando (2012) calls for posthumanist methodology to "be dynamic and shifting, engaging in

pluralistic epistemological accounts, not in order to comply with external requirements of political correctness, but to pursue less partial and more extensive perspectives, in tune with a posthuman future which will radically challenge human comprehension" (p. 16). I place this study squarely in the realm of the posthuman and apply a posthumanistic approach to studying emergent assemblage agency.

3.4 TECHNICAL DATA COLLECTION DECISIONS

In both pilot study and focus group, three types of methods were used to collect data and trace rhetorical agency. *Qualitative data* were collected and analyzed to focus attention on the human actors (literacy, experience, and activity) and environmental actors (testing conditions and ambient sensory data). *Quantitative data* were collected and analyzed to focus attention on the technological actors (software and hardware) and network activity involved in the research activity. And *web design and development strategies* were applied in an attempt to identify and "reverse engineer" ideological actors (algorithmic programming, development, deployment, and design) engaged during research activity. These data collections were categorized and chronologically synchronized. The study used the results of this synchronization and analysis to identify and trace the assemblage rhetorical agency that emerged during the time of the research process.

3.4.1 Ethnographic Methods

To collect ethnographic data, I observed participants and collected descriptive fields notes as a participant observer during the testing session (but a nonparticipant observer related to the research task), focusing on actions taken by participants in relation to their working environment, their personal computers, and their browsing and search habits. I also generated reflective field notes following observation sessions. To supplement this collection of data, during the research

activity, I used usability testing software to collect cursor, keyboard, and mouse activity, along with a video record of research activities, and engaged participants in speak-aloud protocol to collect their own narratives of research activity. Table 3.1 provides a list of methods, data collected, significance to the study, and correlation to research questions.

Table 3.1

Ethnographic data methods and rationales.

Study Method	Data Collected	What It Tells Me	Why It's Important	RQ Correlation
Observation Notes	Ways of engaging in research activity	Computer use & research habits	Ways of use represent agentive activities	2) Identify agent(s); Trace agency
Usability Test	Realtime search practices	Timestamps, chronology of search, interactivity with algorithms	Provides human side of human/algorithm agency, allowing extrapolation	1) Algorithmic influence 2) Identify agent(s); Trace agency
Post-Test Survey	Reflection on search approaches	Prior search experience and approaches	Prior schemas and typologies indicate negotiated agency	2) Identify agent(s); Trace agency
Think-Aloud Protocol	First-person narrative of activity	User perception of activity and problem solving	User's narrative offers view of perceived agency	2) Identify agent(s)

Table 3.1 identifies the primary sources of quantitative data: researcher-written observation notes from the testing sessions; recorded results of the research process from the usability test platform; the post-test survey written responses; and the speak-aloud narratives provided by participants themselves. Analyzing these data for themes helps identify participant attitudes toward the research activity, an important aspect of the assemblage agency that emerges during

the research session. Positioning these data on a common timeline is a starting point to understanding how human and environmental actors contribute to assemblage agency.

3.4.2 Technical Methods

In addition to ethnographic data, I also collected a number of technical data points. Using Beck's (2015) methods for uncovering surveillant assemblage identity, I sought to collect a list of advertising cookies, beacons, and trackers active during the research session using the Ghostery (www.ghostery.com) and the Digital Advertising Alliance's WebChoices Consumer Choice Tool for Web (www.aboutads.info/choices). These tools, while designed to provide consumers choices about the way their online behavior is tracked and used for advertising, also provide researchers information that connects hidden online identity trackers to their corporate owners and users (see Figure 3.1 for a sample Ghostery summary report on a recent visit to the DAA's WebChoices page). Careful attention to privacy and use policies applicable to the search tools and software used during research allows connecting those policies to the identity collection and formation that occurs during the browsing session.

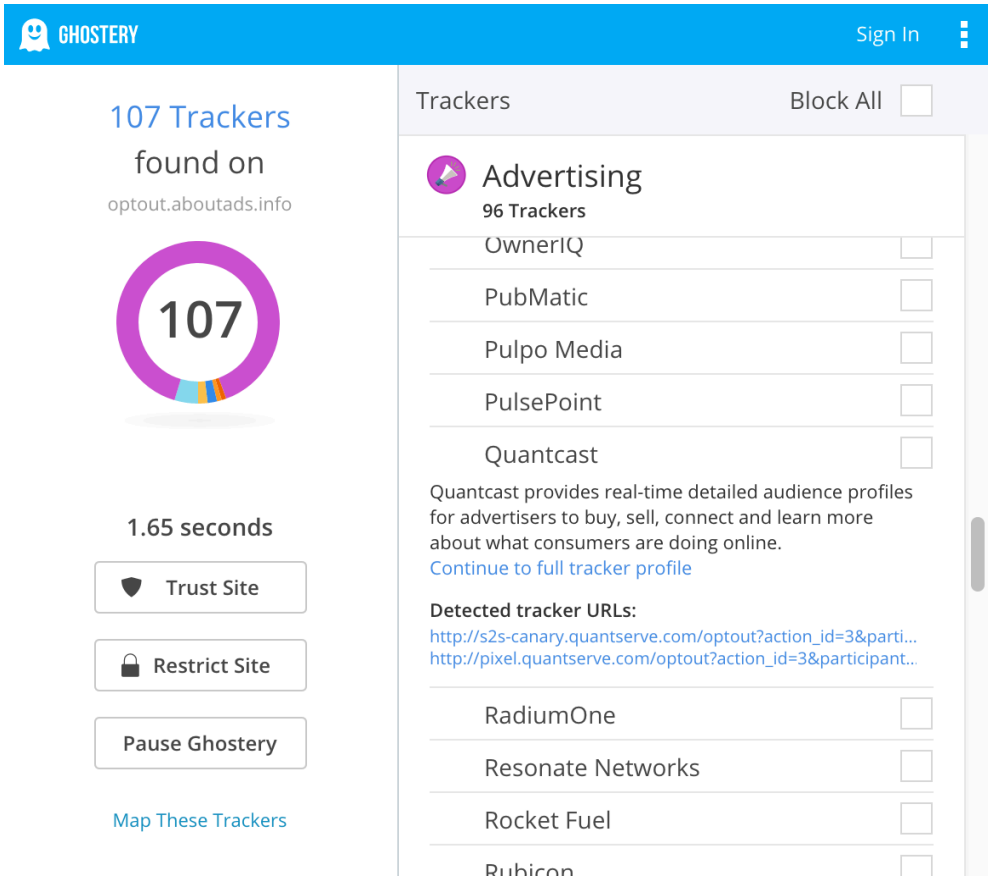

Figure 3.1. Sample tracker report generated by the ad-blocking tool Ghostery. Demonstrates a way researchers can use Ghostery to identify installed trackers and trace them back to their corporate creators and policies. Ghostery. (n.d.). *Report on optout.aboutads.info*, run as Google Chrome extension on September 2, 2017. Screenshot by author.

I also collected and reviewed computer cookies, small text-based files used for storing browser conditions and browsing habits, that are written during the research session and accessed by the browser and search tools in order to determine what information is collected and passed on to other tools and servers. I used participants' browser developer tools to collect this data; Figure 3.2 illustrates how cookies engaged while using a library search tool may be viewed using Chrome Developer Tools.

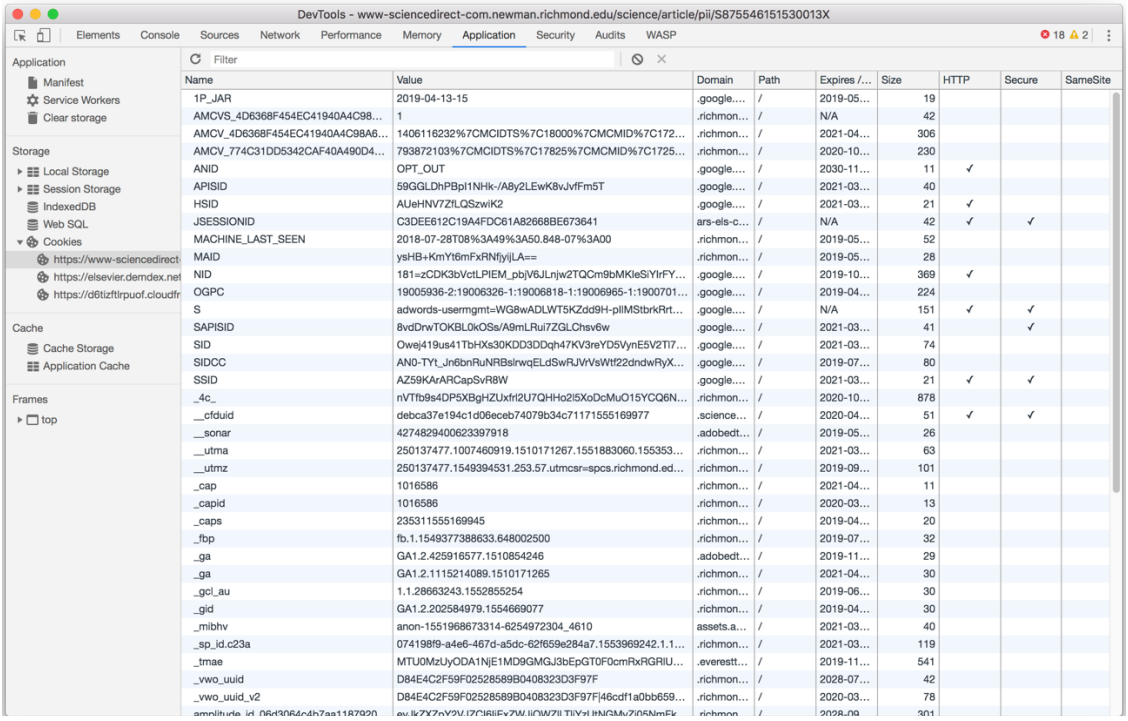

Figure 3.2. Sample Chrome Developer Tools report on Cookies engaged during a recent search using an academic library's article search tool. Google. (n.d.g). *DevTools*, inspecting http://www-sciencedirect-com.newman.richmond.edu/science/article/pii/S8755461530013X on April 13, 2019. Google and the Google logo are registered trademarks of Google LLC, used with permission. Screenshot by author.

I also measured average network speed and conditions during the research process. I used the Speedtest tool (www.speedtest.net) on my own laptop to measure download and upload speeds of my network connection from the same location and using the same wireless network access points as participants. I took measurements as each search session began and ended, and at least once (and more than once if possible) during the search session, then averaged these results and compared them to national and regional results provided using Ookla's Speedtest tool (see Figure 3.3 for sample results).

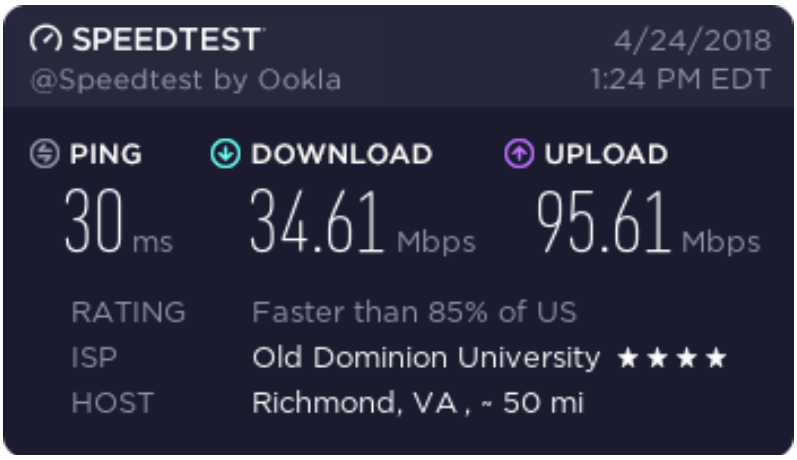

Figure 3.3. Sample network speed test results from Speedtest by Ookla. Shows average upload and download speeds at a particular time (1:24 p.m.) and place (Old Dominion University) connecting to a particular network hub (Richmond, VA). Ookla. (n.d.). *Speedtest from Old Dominion University to Richmond, VA*, Run April 24, 2018, at https://www.speedtest.com. Used with permission from Ookla, LLC – Copyright 2018. All Rights Reserved. Screenshot by author.

These data points were attached and related to the timeline of the research process in order to identify relations and influence among assemblage machines. Table 3.2 provides a list of technical study methods, data collected, importance to the study, and correlation to research questions.

Table 3.2

Technical study methods and rationales.

Study Method	Data Collected	What It Tells Me	Why It's Important	RQ Correlation
Surveillant Assemblage Identity Construction	List of web beacons and trackers encoded in all pages/sites visited	Ways algorithms are collecting, accessing, and sharing data	Algorithms place users in identity buckets for providing results	1) Algorithmic influence 2) Identify agent(s)
Corpus/Textual Analysis	Privacy and usage policies of hardware, software, sites, pages, trackers & beacons identified	Policies and ideological positions embedded in algorithm development and processes	Tracing ideological influence provides evidence of potential and implicit political, social & economic influence on users	1) Algorithmic influence 2) Trace agency
Text/Code Analysis	Cookie data written/accessed during browser session	Browsing & search histories accessed and used in algorithmic processes	Shows ways the algorithm could be influenced by user activity online	1) Algorithmic influence 2) Trace agency
Speedtest.net	Network speed and conditions sampled during the browsing session	Average network speed, the potential to extrapolate to network conditions	Network speed, latency, and TCP/IP conditions may influence search	1) Algorithmic influence 2) Trace agency

3.4.3 Reverse Engineering Design and Content Decisions

With these data collections, I applied search engine optimization (SEO) methods to the tools and sites used during the research session to reverse engineer and describe the relationship between search engine input and results pages, their designs, and the algorithmic processes that influence and affect those designs. Similarly, I applied known methods of natural language processing and coding to reverse engineer and describe the programming decisions made by programmers and software engineers to develop indexing tools, database searches, and keyword matching protocols and procedures. Research into published work on algorithm development and revision from computer science, mathematics, data analytics, and big data were reviewed to identify strategies and tactics that algorithm programmers, designers, and engineers implement to

program and test algorithms. These descriptions are in turn applied to the research processes to connect the visible, known activities collected ethnographically and technically with the invisible, unknown, black-boxed activities of the search algorithms, software, and servers themselves. Table 3.3 identifies these speculative study methods, data collected, significance of the data collected for the study, and correlation to research questions.

Table 3.3

Speculative study methods and rationales.

Study Method	Data Collected	What It Tells Me	Why It's Important	RQ Correlation
Search Engine Optimization (SEO)	Likely SEO decisions made on search engine, search engine results pages (SERP)	How SEO likely impacted the organization and coding of both pages, especially results	Design decisions related to SEO are about attracting visitors and matching standards	2) Identify agent(s); Trace agency
Programming and Natural Language Coding	Likely programming decisions made on building search indexes from crawled content, matching search terms with results	The impact of programming, coding, and indexing methods and strategies on search results	Programming and design decisions are ideological and presumptive, and they therefore affect results	1) Algorithmic influence 2) Trace agency
Research in Algorithm-related Fields	Algorithm programming methods, assumptions, directions, and priorities	General and/or specific assumptions made by programming teams about users, processes, indexes, and interfaces	Programming decisions are ideological, and therefore influence search matching, indexing, and ordering of results	2) Trace agency

The goal of these methods was to trace the emergence of agency among users, algorithms, and platforms (see Gillespie, 2010) in which algorithms and users interact, in algorithm-mediated activity.

3.5 METHODS

This study makes a clear distinction between **methodological foundations**, which direct the general approach to the study and analysis of emergent assemblage agency, and **methods**, which describe the tools and practices used to collect and assemble data for analysis. While the methodological foundations remained consistent in both pilot study and focus group, the methods used in each differed slightly. Analysis of data collected remained consistent and, most importantly, results remained consistent across both participants in the case study. The following description of methods will provide insight into how a study constructed as a pilot study followed by a focus group turned into a case study of two participants.

3.5.1 Pilot Study

For the pilot study, two case study participants were recruited as a purposeful concept sample (Cresswell, 2015, p. 207) from an Old Dominion University technical communication class to ensure participants entered the testing session able to engage in an assigned research-based project. Cresswell (2015) indicates that studies of one or two participants are appropriate for case study methods; this study focuses on two participants to investigate differences that may arise from variation among human and nonhuman entities engaged in the research process. It also limits the number of case study subjects in order to limit related quantitative data collected from its posthuman approach to rhetorical agency. Because this case study seeks to situate observation and analysis in real-world conditions among "typical" undergraduate researchers, the study selected participants familiar with academic life, who have likely conducted online search many times in their lives and can provide a literacy narrative, and who would be accessible to the researcher during the study period. The specific research activities of the pilot study participants were to be used to point toward successful focus group research methods and to generate data for

collection and analysis using mixed methods across network activity, rather than to make claims of representing a broader population.

Two undergraduate students from a technical writing class at Old Dominion University were recruited for the pilot study. Each participant engaged individually in an hour-long study that included a recorded usability test, one on January 24, 2018, and the other on January 25, 2018. The study was held in a small computer lab of MediaPark, a graduate and faculty multimedia workspace in the College of Arts & Letters on the Old Dominion University campus. MediaPark is not a testing facility, nor was it closed to the public during the study sessions. Participants used their own laptop computers during the study to more accurately reflect the lived experience of research in a college setting, including environmental influences (like overheard hallway conversations) and ideological influences (like hardware settings and background software applications) that students both engaged and overcame.

Pilot study participants completed a web usability test administered online using TryMyUI.com while the researcher observed. The Old Dominion University Library's main search tool, Monarch OneSearch (http://www.odu.edu/library), was used as the web interface for the usability study. During the usability study, participants were asked to conduct a search to find at least one resource that could potentially be used to answer a self-defined, course-assigned, or principal investigator-provided research question. Participants were asked to use think-aloud protocol to describe their search activity in order to collect participants' "cognitive processes during an information problem solving task" (Hinostroza et al., p. 6; see also Oh and Wildemuth, 2009). Participants' narrative descriptions of their activities and contexts were recorded as the audio track generated by the usability testing tool, while participants' screen activities were recorded as the video track generated by the usability testing tool.

The goal of the pilot study was to test the methodological approaches and the methods selected on a smaller group of participants before expanding the study to a focus group. Although usability testing is a common method in technical and professional communication studies, this study modifies usability testing in several key ways.

First, usability tests are traditionally deployed to measure the ease of use of a website, product, or process for targeted users. However, in this case, a usability test was deployed as a tool for collecting data on an online research session, not for testing or evaluating the usability of the search interface. Usability testing software provides an audio and video record of a browsing session, including mouse movements and text entries, and generally includes an audio recording of a participants' speak-aloud narration. The data captured during the usability test is chronological and includes a running timestamp; this timestamp provides a useful indexing tool for correlating additional data collected during the testing session.

Second, participants were asked to use Google Chrome web browser (which was the default browser used by both) and to make visible Chrome's Developer Tools. Among Developer Tools is an option to record and save the log of network activity. Upon opening any new browser tab, participants were asked as part of the testing session to refresh the destination page and ensure that network activity was being recorded and logged. Generally, usability testing encourages little communication between researcher and participant during the usability test itself, since the goal of most usability testing is to determine the product's ease of use without assistance. However, because capturing network activity is a primary goal of the study, the researcher intervened regularly to remind participants to collect this data.

Third, because of the technical nature of data collection using Chrome's Developer Tools, steps in the usability test included activities unrelated to the primary task of conducting research

online using the library's search interface. Prior to starting the usability test, participants completed several tasks to collect additional data points about their hardware and software and to set up their browsers for collecting network data. Participants were asked to install and activate the Ghostery browser extension for Chrome to enable on-screen (and therefore recorded) display of web trackers engaged during the research session. Participants were also asked to visit the Digital Advertising Alliance's WebChoices Consumer Choice Tool for Web in order to generate a browser-specific report on advertising platforms enabled and disabled. Additionally, participants were asked to run a network speed test using the online Speedtest as a baseline for their laptop's network speed.

During the testing session, I used ethnographic methods to capture observation notes on the **testing environment**, focusing on temperature, lighting, cleanliness, orderliness, location in MediaPark, seating area, and apparent comfort; on the **participants**, focusing on appearance, timeliness, comfort with search, questions asked, willingness as participant, and apparent search literacy; and on **technology**, focused on laptop brand and other technologies (phone, earphones, music playing, other applications) running open during testing. I also used my own laptop, connected to the same wireless network in the same testing space, to run network speed tests at approximately 5-minute intervals to record network speed variation throughout the testing session.

Upon conclusion of the recorded usability test session but as part of the usability testing software, participants were asked to provide written responses to four prompts. These prompts asked participants to outline their research strategy for the testing session and to describe their prior online search and research experiences, both generally and in terms of the Monarch OneSearch.

3.5.1.1 Outlining the Testing Session

Upon arrival and after describing the study and receiving informed consent from the participants, each participant received an outline of the testing session. The testing instructions presented to participants is available as Appendix A, and the usability test content is available as Appendix C. The following outlines the study session.

I explained to participants that the study comprised three parts, **technical setup**, **usability testing** and **data collection**.

I then provided an outline of the **technical setup** for the testing session. Participants and I collaborated to prepare their laptops for the testing session as follows:

1. Confirm that the laptop's microphone works.
2. Ensure participant is connected to MonarchODU wifi network.
3. Install, or confirm installation of, Google Chrome browser, and sign in to Google account if that's common practice.
4. Open Chrome and install the Ghostery plugin for Chrome.
5. Run a connection speedtest and record the results.
6. Visit the DAA WebChoices Browser Check to review opt-out status for customized ads.
7. Close all Chrome tabs, then open a new Chrome tab.
8. Log into TryMyUI to take the Pilot Test.
9. Start recording to initiate Usability Test, following prompts as directed.

I explained that new windows and tabs would open during the test, and asked that participants confirm that Developer Tools remained open, recording, and logging when new tabs and windows opened. I also explained that I would remind them to do this during the testing

session as needed. I requested that participants not close any browser tabs or windows, but minimize them as needed to return to the testing interface.

I then explained that, during the **usability test** itself, I would be taking observation notes and recording photos of the session without showing faces, and that I would use the notes and photos to describe and measure the surroundings of the test. I also explained that I would be conducting regular network speed tests to see if network speeds varied or remained consistent throughout the test. I shared that participants were welcome to ask me questions at any time, but otherwise asked that they try to ignore, to the best of their ability, my presence and activity.

I asked that participants bring to the study their own research project or assignment, and that the goal of their participation was to identify one academic source (journal article or book) using Monarch OneSearch. If participants needed an assignment prompt, they could use this prompt: *Research ways to solve a public problem, like poverty or sea water rise or hunger, in a particular region or locale*.

I provided the following instructions for the usability test. The usability test itself prompted participants to go from step to step, so these instructions served as an overview of the usability testing procedure itself. I provided a brief definition of think-aloud protocol, which reinforced instructions in the usability test itself.

- Follow the on-screen prompts. Use *think-aloud protocol* to explain each choice you make during the test. The on-screen prompts will ask you to read all instructions aloud. Please do so.
- Think-aloud protocol asks you to narrate aloud your actions throughout the test. Be verbose, and don’t be afraid to sound funny. The more information you provide about why you’re doing what you’re doing, the better.

- Scenario: You have been assigned a research project for a class. Use the ODU Library Monarch OneSearch to identify at least one scholarly resource that will help you complete this project.
    - Use Monarch OneSearch to identify at least one relevant scholarly source for your research project.
    - Access and open the full text (if available) of the source you've selected.
    - Preview the source for relevance.
        - If still relevant, the research activity is complete.
        - If not relevant, continue researching to identify a relevant source.
    - End the TryMyUI recording.
    - Complete the post-search survey with verbose written responses.

I explained that, once the post-search survey was complete, we would work together to **gather and collect** HAR files logged by Developer Tools open in each window or tab. I explained the procedure we'd follow so there were no surprises. In generally, we right clicked on open Developer Tools in each tab/window, selected "Save as HAR file with content," saved files to the desktop, then copied files onto a flash drive I provided. I then explained that, once all HAR files are saved to their computer, participation in the testing session was complete and that they could close the Developer Tools windows, delete the TryMyUI recorder, delete the Ghostery plugin, and delete Chrome (if installed for this test).

Upon conclusion, participants left the testing session with a copy of their consent documentation. I then reflected on the testing session and wrote post-session reflections focused on testing conditions, issues, timing, problems, successes, participant anxiety, and my own anxiety during the session. I transferred HAR files from the flash drive to a Google Drive folder

shared exclusively with the Responsible Principal Investigator (who also serves as my dissertation chair). I also scanned my handwritten ethnographic observations and reflections as PDF files and saved them to the same Google Drive folder. I downloaded speed test results as a comma separated (CSV) file and saved the file to the same Google Drive folder.

3.5.1.2 Reviewing Collected Data

Over the next several weeks, I downloaded the usability testing video files from TryMyUI.com and saved them to Google Drive. I typed up handwritten observations and reflections in a Google Doc (available as Appendix B), and I transcribed the audio portion of the usability testing video files as a separate Google Doc (available as Appendix E). I then reviewed the content of the HAR files using Google's G Suite Toolbox HAR Analyzer (toolbox.googleapps.com/apps/har_analyzer) and Jan Odvarko's HTTP Archive Viewer 2.0.17 (www.softwareishard.com/har/viewer). Because HAR files are complex JSON structure, data from HAR files cannot easily be flattened into a CSV file for analysis. However, I was able to place the HAR files in the chronological order of the usability test, associate each HAR file with a portion of the usability test video file, and correlate participant think-aloud protocol narratives, environmental sounds, screen activity, research activity, search results, and network activity in a flat file representing participant, ambient, and network activity. The results of this correlation are presented in Chapter 4.

3.5.2 Transitioning from Pilot Study to Focus Group

The goal of the pilot study was to determine the effectiveness of methods in collecting and describing the collective agency emergent during online research activity. As a result of drafting results of the pilot for review, I was able to identify several changes to implement in the focus group portion of the study.

The pilot study intended to use Ghostery as a visual method for identifying trackers encountered by the browser during research activities. However, participants and I discovered that we could not get Ghostery to display real-time tracker activity during the recording. Ghostery is intended to be opened and reviewed after page load to identify (and potentially block) the activity of trackers accessed during page load; since the usability test already gets interrupted by opening Developer Tools and reloading new pages and tabs that open when search results are displayed and individual search results are selected, I determined the report that Ghostery provides would not be useable for the study. As a result, I removed the Ghostery installation from the focus group portion of the study. Data from HAR files can be used to isolate the activity of trackers.

The pilot study intended to use the Digital Advertising Alliance's WebChoices Consumer Choice Tool for Web to ensure that advertiser ads were not blocked by the browser. However, participants and I discovered that their browsers were, in fact, blocking some ad platforms and that the tool was not able to successfully load profiles on all advertising platforms during its browser analysis. I also recognized that the construction of the study called for browsers to be used "as is," meaning whatever settings participants had on their browsers (if they were consistent Chrome browser users, as they were) should remain in place for the test. As a result, I decided to capture the results of the tool's analysis as a PDF print for each participant in the focus group rather than simply use it to ensure advertising platforms were not being blocked.

The pilot study placed a number of technical setup steps into the recorded portion of the usability test. The usability testing software has a 20-minute time limit for recording activity, and for one participant in the pilot test, there was not enough time to complete the research task assigned in the usability test. The results of reaching this time limit are detailed later in this

chapter, but the immediate impact was to revise the recorded portion of the usability test to focus on research, and to shift technical setup entirely to the opening of the test session, before starting the usability test. This change was made to ensure that focus group participants were able to complete and record a successful research task within the 20-minute constraint of the recording software.

The pilot study used the TryMyUI.com usability testing tool in an unorthodox manner. Rather than deploying the test as a stand-alone activity that enabled participants to complete the test using their own TryMyUI.com accounts, I deployed the pilot usability test as a "testing" session in my administrative account. The recorded result is the same, but participants were required to log into my administrative account to access the usability test, and only one participant at a time could be logged into the administrative account. Since the focus group format called for the possibility of multiple participants logging onto the usability test simultaneously, I revised the usability test for deployment through individual accounts that participants set up at the start of the testing session. The process of setting up and testing the tool on their own browser added a little time to the start of the testing session, but ensured that multiple participants could record their usability testing session as part of a focus group.

The pilot study did not include an impression test, a common practice in website usability tests that asks testing participants to record their impressions of the page being tested (e.g., what it's about, who it's designed for) following a timed, 15-second preview of the page. The purpose of an impression test in usability testing is to get a rough sense of whether the design of the page matches its original purpose and uses. Since this study implements usability testing in an unorthodox way, asking participants to give their impressions of the library search interface was not an immediate priority. However, impressions of the page might provide insight into study

participants' expectations of the search interface's function, useful in understanding the prior experience and search literacy participants brought to the research activity. Identifying these prior experiences and search literacies has the potential for providing additional data about the collective agency, including prior experience, that emerges through the search experience. As a result, in order to capture these impressions as qualitative data on prior research experience and literacy, I added an impression test to the start of the focus group usability test during which participants were asked to preview the library search interface for 15 seconds then record their impressions through think-aloud narrative.

Initiating the pilot test demonstrated the general success of methods in collecting data from environmental, technological, human, and ideological sources. Environmental data were collected in ethnographic observations and reflections, in network speed test scores, in audio recordings, and in photographs. Technological data were collected in ethnographic observations, HAR files, network speed test scores, and DAA WebChoices analysis results. Participant data were collected in ethnographic observations and reflections, usability testing recordings, and photographs. Ideological data were collected in HAR files (through university, organizational, and corporate servers and trackers identified in the HAR data), in SERP design and relevance sorting, and in ethnographic observations and reflections. Eliminating Ghostery as a data collection method did not hamper my ability to identify trackers engaged during the research process, since trackers are included among network activity recorded in HAR files. Capturing DAA WebChoices analysis results as a PDF file enabled me to demonstrate the variability of participant and technological preferences across focus group participants. Revising the order and structure of the technical setup prior to the recorded usability test did not have a significant

influence on usability testing results captured in the TryMyUI.com tool; in fact, doing so ensured that recording data was captured within the constraints of the recording tool.

The moderate changes made between pilot study and focus group were not enough to disqualify one of the pilot study participants from being included in the case study write-up of this dissertation. As a result, one of the two participants' research activities detailed in this dissertation was from the pilot study. Section 3.6 engages in a reflection on results of both pilot study and focus group toward two purposes: to demonstrate ways that studies can unfold unpredictably, and to illustrate my understanding of the challenges of knowledge production in the academy.

3.5.3 Focus Group

The intention of the focus group portion of this study was to implement changes to pilot methods in order to collect data for use in the study's write-up. Ethnographic methods (as described in the pilot study) and focus groups (as implemented in the formal data collection portion of the study) are among methods implemented in usability and user experience studies (Rubin & Chisnell, 2008). Creswell (2015) recommends focus groups "when the time to collect information is limited and individuals are hesitant to provide information" (p. 217), while Rubin and Chisnell (2008) caution against using focus groups for "learning about performance issues and real behaviors," recommending focus groups for collecting "general, qualitative information" (p. 17). These are precisely the qualities required for a study of agency as it emerges across multiple intertwined entities in the research process. There is little need to collect data on the performance issues of the web interface—these are not within the scope of the study—while general qualitative information along with quantitative information collected in HAR files is the stated data collection goal of the study. Creswell's note about time to collect

information is informative as well. When developing the idea for focus group as a study method, up to four possible groups, each constituting four participants, were considered. Because students in a class were identified as a convenience (but meaningful) sample for study, and because participation hinged upon earning bonus points toward a final grade, the opportunity was given to all students in the class to participate in either the pilot study or one of the four focus groups. For the pilot study, two participants volunteered, with one replaced at the last minute with another participant due to an illness. The pilot study was conducted early in the semester. The focus groups, on the other hand, were scheduled late in the semester during study days prior to final exams. Although volunteers could sign up for focus groups throughout the semester using a shared Google Sheet, only three students elected to be participants in a focus group. As a result, rather than running four focus groups with multiple participants in each group, I conducted a single focus group consisting of three participants. Although this result did not change my approach or the need to update the focus group methods as described earlier, smaller numbers increased the odds of methodological errors affecting results. Rather than data from multiple focus group, I would rely on data from a single, smaller than average focus group of willing participants. Since the end of the semester was upon them, there was not enough time to break out the focus group of three into three individual case studies. Ultimately, this decision would initiate significant issues in data collection, presented in detail in section 3.6 and Chapter 4. However, the decision to implement the focus group remained intact.

The focus group was held on April 24, 2018, from 12:30 to 1:30 p.m. in the same testing location and environment as the pilot study. Three students volunteered to participate in the focus group, each bringing their own laptop as described earlier. While the pilot study and the focus group differed in format, the design of the two studies remained closely aligned. This alignment,

along with differences between the two study methods, are presented and highlighted in Table 3.4.

Table 3.4

Differences in data collection methods between pilot study and focus group.

Technical Setup	
Pilot Study	Focus Group
Test microphone	Test microphone
Connect to MonarchODU wireless network	Connect to MonarchODU wireless network
Install/open Chrome browser	Install/open Chrome browser
Install Ghostery plugin for Chrome	*N/A: Removed from study*
Run a speed test	Run a speed test
Run DAA WebChoices report to ensure ads aren't blocked	Run DAA WebChoices report *and save results*
Close Chrome, then reopen a new tab	Close Chrome, then reopen a new tab
Usability Test	
Pilot Study	Focus Group
Log into administrative interface of TryMyUI.com	*Visit testing URL and open TryMyUI.com test*
Open Pilot Test	Set up Developer Tools for HAR file collection
During usability test, set up Developer Tools for HAR file collection	Follow instructions to *initiate usability test starting with impression test*
When new windows and tabs open, be sure Developer Tools are collecting data	When new windows and tabs open, be sure Developer Tools are collecting data
Complete survey when research task is complete	Complete survey when research task is complete
Data Collection	
Pilot Study	Focus Group
Save HAR files to laptop, transfer to flash drive	Save HAR files to laptop, transfer HAR *files and DAA WebChoices report* to flash drive

Note: Italicized values represent data collection differences between Pilot Study and Focus Group.

Table 3.4 demonstrates that planned revisions to the study did not significantly change the data collected during the two study types. While data from Ghostery were eliminated during the focus group, additional data from the DAA WebChoices report and the impression test were added to provide additional evidence of prior research experience and potential corporate influence, or lack of influence, on the research process and results.

3.5.3.1 Outlining the Testing Session

On the day of the study, Participant 1 and 2 arrived early and on time, respectively, but Participant 3 emailed to indicate they were running late and would arrive as soon as possible, potentially 20 minutes late. As a result, I began describing the study, procuring informed consent, and outlining the technical steps with the first two participants. Only the initial step described above went smoothly; from that point onward, different paces of completing technical setups dictated very different feedback and participation from me as researcher. Although I remained a non-participant researcher in that I was not myself engaging in the focus group or the usability test itself, I was not free to capture observations as I worked with each participant individually to troubleshoot technical setups.

Similar to the pilot study, focus group participants received an outline of the testing session to follow as I described the process and stepped participants through the technical setup. The outline as presented to participants is available as Appendix A, and the usability test content is available as Appendix C. Because I started the focus group session with two of three participants, I repeated much of the information twice; once, in detail, for the two participants who arrived on time and again, in summary, for the participant who arrived late. The outline and my descriptions closely mirror the outline and descriptions from the pilot test, with notable exceptions as highlighted in Table 3.4.

I explained to focus group participants that the study comprised three parts, **technical setup**, **usability testing** and **data collection**.

I then provided an outline of the **technical setup** for the testing session. Participants and I collaborated to prepare their laptops for the testing session as follows:

1. Confirm that the laptop's microphone works.
2. Ensure participant is connected to MonarchODU wifi network.
3. Install, or confirm installation of, Google Chrome browser, and sign in to Google account if that's common practice.
4. Run a connection speedtest and record the results.
5. Visit the DAA WebChoices Browser Check and download a PDF of results.
6. Close all Chrome tabs, then open a new Chrome tab.
7. Visit the TryMyUI testing link (provided in the outline, http://bit.ly/DissDataHocutt) to access the usability test.
8. Start recording to initiate Usability Test, including the impression test, following prompts as directed.

I explained that new windows and tabs would open during the test, and asked that participants confirm that Developer Tools remained open, recording, and logging when new tabs and windows opened. I also explained that I would remind them to do this during the testing session as needed. I requested that participants not close any browser tabs or windows, but minimize them as needed to return to the testing interface.

I then explained that, during the **usability test** itself, I would be taking observation notes and recording photos of the session without showing faces, and that I would use the notes and photos to describe and measure the surroundings of the test. I also explained that I would be

conducting regular network speed tests to see if network speeds varied or remained consistent throughout the test. I shared that participants were welcome to ask me questions at any time, but otherwise asked that they try to ignore, to the best of their ability, my presence and activity.

I asked that participants bring to the study their own research project or assignment, and that the goal of their participation was to identify one academic source (journal article or book) using Monarch OneSearch. If participants needed an assignment prompt, they could use this prompt: *Research ways to solve a public problem, like poverty or sea water rise or hunger, in a particular region or locale*.

I provided the following instructions for the usability test. The usability test itself prompted participants to go from step to step, so these instructions served as an overview of the usability testing procedure. I provided a brief definition of think-aloud protocol, which reinforced instructions in the usability test itself.

- Complete the impression test. View the webpage for the time allotted by the testing software, then record impressions aloud.
- Follow the on-screen prompts. Use *think-aloud protocol* to explain each choice you make during the test. The on-screen prompts will ask you to read all instructions aloud. Please do so.
- Think-aloud protocol asks you to narrate aloud your actions throughout the test. Be verbose, and don't be afraid to sound funny. The more information you provide about why you're doing what you're doing, the better.
- Scenario: You have been assigned a research project for a class. Use the ODU Library Monarch OneSearch to identify at least one scholarly resource that will help you complete this project.

- Use Monarch OneSearch to identify at least one relevant scholarly source for your research project.
- Access and open the full text (if available) of the source you've selected.
- Preview the source for relevance.
    - If still relevant, the research activity is complete.
    - If not relevant, continue researching to identify a relevant source.
- End the TryMyUI recording.
- Complete the post-search survey with verbose written responses.

I explained that, once the post-search survey was complete, we would work together to **gather and collect** HAR files logged by Developer Tools open in each window or tab. I explained the procedure we'd follow so there were no surprises. In general, we right-clicked on open Developer Tools in each open tab/window, selected "Save as HAR file with content," saved files to the desktop, then copied files onto a flash drive I provided. I then explained that, once all HAR files were saved to their computer, their participation was complete and that they could close the Developer Tools windows, delete the TryMyUI recorder, delete the Ghostery plugin, and delete Chrome (if installed for this test).

Upon conclusion, participants left the testing session with a copy of their consent documentation. I then reflected on the testing session and wrote post-session reflections focused on testing conditions, issues, timing, problems, successes, participant anxiety, and my own anxiety during the session. I transferred HAR files from the flash drive to a Google Drive folder shared exclusively with the Responsible Principal Investigator. I also scanned my handwritten ethnographic observations and reflections as PDF files and saved them to the same Google Drive

folder. I downloaded speed test results as a comma separated (CSV) file and saved the file to the same Google Drive folder.

3.5.4 Differences between Pilot Study and Focus Group

The focus group testing session was significantly different from the pilot study testing sessions. During the pilot study, I was able to focus attention on a single participant during technical setup, usability testing, and data collection. Focusing attention on a single participant enabled me as observer to identify and address issues that arose with capturing HAR file data using Developer Tools. When search engine result pages (SERPs), individual search results, and single sign-on (SSO) pages opened in a new tab or window, Developer Tools would need to be opened, the logging option activated, and the destination page reloaded in the browser. Because this artificial constraint on the research process required careful attention to tabs and windows, participants would sometimes forget to activate the logging option in Developer Tools and refresh the page. As an observer in a one-on-one testing session, I was able to intervene to remind the pilot study participant to activate logging and refresh each new tab or window. This individual attention on my part as researcher enabled participants to capture the entire research process in HAR files.

The focus group significantly fractured my attention across three participants, each working on a different personal laptop, two using an Apple operating system (OS) and one using a Windows OS. My decision to move forward with the testing session with two participants, then work to incorporate the third participant upon arrival, exacerbated the fracturing of my attention as observer. Rather than observing a single participant's activity during the usability test, my attention was divided among three participants working simultaneously at different paces. One participant struggled to access the MonarchODU wireless network and ultimately connected to a

much slower wireless network. The same participant's laptop also appeared to work more slowly, resulting in lengthier installation time for the testing software, slower browsing and searching, and slower saving of HAR files. The other participants worked more rapidly; the third participant who arrived later eventually caught up with the other two participants, but only after I divided my attention between one of the first participants moving ahead quickly and the second of the earlier participants bogging down in network and hardware slowness. One of the most significant outcomes of this frenetic and fractured testing session was loss of logged HAR file data. Because I was unable to provide individual attention to each participant in each step of the research process, I was unable to recognize when a new tab or window had opened and to remind participants to open Developer Tools, activate logging, and refresh each new window or tab. Because my attention was split between three participants, another outcome was the inability to capture photos during the testing session and to run network speed tests in consistent five-minute intervals during the testing sessions. Problems with methods, and reflections on ways to mitigate those problems in future testing, are detailed in section 3.6.

Most significantly, the combined results of pilot study and focus group usability testing sessions resulted in two case studies—one from the pilot study and one from the focus group—rather than focus group results comprising three participants. Data from one participant in the pilot study and one participant in the focus group were complete; only partial data was captured from other participants, data that could not be fully analyzed using the methods and methodology applied to the study. This shift in research approach represents the iterative discovery process of research described by Sullivan and Porter (1997), who observed that "research methodology should not be something we apply or select so much as something we construct out of particular situations and then argue for in the write-ups of our studies" (p. 46). I have used this chapter to

argue for my methodological approach, and I will use the remainder of this chapter to continue arguing for my selected research methods and to construct the results of those approaches based on the particular situation of the study's testing sessions.

In summary, the results of testing across the two case studies, labeled from this point as Participant 1 (from the pilot study) and Participant 3 (from the focus group), show consistencies in terms of general types and quantity of data collected. However, differences in the methods applied to the pilot and the focus group, along with the intrusive challenge of implementing HAR file collection into usability testing protocol, offer important findings about methods for tracing assemblage agency using technical communication methods. The following section details these reflections and implications on research approaches in technical communication.

3.6 REFLECTION ON METHODS

This reflection intends to address questions about methods directly, the result of applying a combination of orthodox and unorthodox research methods to an unorthodox research problem. The challenge of tracing the influence of black box algorithm-centered processes and their technological mediation in human-initiated activities like online research is daunting. This dissertation applies multiple methods, reflecting its focus as a technical communication research document and its interest in developing a practical approach to explain and illustrate posthuman agency. In terms of Johnson-Eilola and Selber's (2013) four-phase heuristic to solving problems in technical communication, this section extends the dissertation's approaches to understanding the problem by reflecting on ways the methods themselves both address and exacerbate that problem.

Posthuman approaches to rhetorical agency are highly theoretical. While disparate scholars like Braidotti (2013), Ferrando (2012), Hayles (1999), Gries (2016), and others theorize

the intertwined agency that emerges when humans and technologies combine efforts, few identify practical methods for revealing ways that agency emerges as posthuman, intertwined and combined. Put another way, few operationalized methods are offered to demonstrate that agency emerges in the combined activity of human and nonhuman actors. This dissertation seeks to identify existing methods that, when modified, tweaked, or combined with methods from other fields and disciplines, can operationalize the tracing of assemblage agency in algorithm-centered activity like online research.

This dissertation relies heavily on methods from web development. When troubleshooting webpage behavior on browsers—especially network asset calls and responses, load times, and load order—HAR files provide invaluable information to web developers for debugging processes. By revealing network calls in chronological relation to one another, and providing timing for each network call and server response, web developers can tweak code and scripts to reorder processes and ensure the quickest, most efficient order for page loading. Additionally, methods of search engine optimization (SEO), which seek to construct webpage content and structure in ways most easily read and optimized by search engines, are represented in this dissertation. The goal of employing SEO methods in web development—which include structuring webpage information to represent logical order, including relevant keywords in titles and body copy, applying meaningful <*alt*> tags on imagery, and providing accurate meta-tags that match page content and purpose—is to ensure pages are easily "understood" by algorithmic processes that seek to match indexed metadata about a given webpage to search terms entered in a search interface.

By tracing network activity through chronological browser activity collected in HAR files, and by considering ways that SEO shapes web developer activity and algorithmic matches

in online search, this dissertation combines the mixed methods of technical communication—usability testing, textual analysis, ethnographic observation and reflection—with the coding and troubleshooting methods of web development—SEO and network activity tracing with HAR files—to reveal the emergence of assemblage agency in online research activity. In practice, mixing these methods imperfectly captures network activity and user experience. This chapter addresses these imperfections while confirming the overall integrity of the data collected and analytical approaches applied to that data.

3.6.1 Rationale for Using Existing Tools

As calls for increased technological and algorithmic literacy proliferate (Davidson, 2011; Hovde & Renguette, 2017; Rainie & Anderson, 2017; Striphas, 2011; Swarz, 2011), the methods employed in this dissertation are intended to be usable and accessible by technical communication students, even those without access to usability or user experience labs. As a result, software and tools used in the dissertation are publicly available and free or reasonably priced for student use. Of course, this is also a deeply practical consideration for completing this dissertation at Old Dominion University, which has neither a UX lab nor funding for expensive usability testing software. While it's likely that more accurate or integrated studies could be constructed using more expensive methods, this dissertation seeks to operationalize assemblage agency tracing using tools readily available and visible to most students and scholars. The following tools were used for data collection and analysis:

- Usability testing: TryMyUI.com, one free project for educational use (EDU plan)
- HAR files: Accessed using Chrome Developer Tools, free for all users
- Transcripts: Manually transcribed, recorded and coded using Google Docs, free for all users

- Network activity chronology: Manually integrated using Google Sheets, free for all users
- Network speed testing: Speedtest by Ookla, free for all users
- Advertising platform influence: DAA WebChoices tool, free for all users
- Browser and web beacon tracking: Ghostery, free for all users
- Tag clouds for concept mapping: TagCrowd, free for all users
- Photographs of testing environment: iPhone camera, personal phone owned by PI

3.6.2 Challenges to Integrity of Methods

3.6.2.1 No Formal Usability Lab

While Jacob Nielson (2012) of the Nielson Norman Group claims that "user testing can be done anywhere," it's worth noting the potential challenges to methodological integrity that conducting user testing outside a usability or UX lab may initiate. First, vocal recordings using a standard laptop microphone pick up a broad range of sounds beyond the user's think-aloud narration. While this broad range proved useful in one-on-one testing sessions, it proved quite challenging during a focus group, where each individual participant's microphone picked up sounds from their own narratives, the narratives of others, the ambient sounds of the testing space, and the dialogue of researcher with individual participants and focus group members as a whole. The resulting audio files, while usable, are extremely difficult to transcribe. Partially as a result of this challenge, only one of three focus group participants' usability testing A/V files is used for analysis in this study. Second, no secondary video is available to reveal the activity of participants beyond activity on their computer screens. While ethnographic observations supplement audio and video files from the TryMyUI.com testing software, these observations do not capture the full range of participant or environmental activity occurring during the testing session. Furthermore, the full range of interaction among focus group participants and the

researcher during the testing session is represented only by audio files, which are challenging to decipher, especially since all three participants had similar voices on the recording. Important aspects of assemblage agency found in the environment and in focus group participant interaction were lost as a result of the lack of video record of the testing session. Third, the testing method itself required considerable one-on-one interaction between researcher and participant; during the focus group, this interaction distracted the researcher from making real-time ethnographic observations of participants and their activities. The observations collected from the focus group activity rely on the researcher's memory, which can and should be considered suspect. However, this study clarifies that ethnographic reflections are combined with field notes among qualitative data sources.

3.6.2.2 Freeware Limitations

Freeware limitations also challenged the integrity of methods in this study, primarily revealed in the use of TryMyUI.com for usability testing combined with using Chrome Developer Tools for quantitative browser data collection. TryMyUI.com offers a single test free of charge in the EDU version. This limitation resulted in running the pilot study in the researcher's administrative interface rather than the user interface. The end user's testing session was almost identical, but the slight variations in step-by-step instructions between the pilot study and the focus group resulted in moments of confusion for participants and researcher alike, especially in the early moments of the usability testing session. These moments of confusion were exacerbated by focus group participants arriving at different times, requiring a catch-up session with a late arrival several minutes after the initial participants started their testing session.

Additionally, the free version of TryMyUI.com testing software places a 20-minute limit on the test session recording. The second participant in the pilot study reached this 20-minute limit, with the result that the video file did not render correctly and provided only a small, blurry thumbnail of desktop activity. While the audio recording of the testing sessions remained viable, and the HAR files collected during the testing session were intact, the inability to tie specific participant actions from the recording of desktop activity to HAR file activity and think-aloud narrative required the testing session results to be discounted.

Chrome Developer Tools offer a remarkable amount of troubleshooting information to web developers, but collecting HAR files requires a refresh of each page or tab that opens. This requirement during the usability testing session introduced an artificial, testing-generated activity into the research activity being studied, breaking the rhythm of research and adding a slightly heightened level of anxiety to the testing experience. This requirement also introduced an easily missed step into data collection. One-on-one testing sessions easily accounted for this drawback, allowing the researcher to gently nudge participants to refresh resulting pages and ensure Developer Tools were collecting data into a log. The focus group testing session, on the other hand, could not be as easily monitored by a single researcher, and resulted in HAR data loss during the testing session. As a consequence, only one of three focus group participants generated complete HAR file logs that could be used in data analysis.

3.6.2.3 Focus Group as a Method

As the previous paragraphs reveal, problems with using a focus group as a testing method for this specialized application of usability testing permeated the study and its results. Before summarizing those problems, a brief review of reasons for selecting a focus group as a testing method may be useful. First, a focus group proved an expedient way to provide a larger number

of participants the opportunity to earn extra credit in a class as a reward for participation. Because the study used a convenience sample of students in a technical communication class, the cooperating instructor and I ensured that every student in the class had the opportunity to earn extra credit by participating in the study. Since the pilot study was limited to two participants, the planned focus groups needed to accommodate another sixteen participants in focus groups of four participants each. These four focus groups were initially scheduled on four consecutive days near the end of the semester; however, despite reminders early in the semester, participants did not sign up for testing sessions (we used a Google Doc that participants used for indicating their interest in participating). Additionally, the researcher needed to delay focus group sessions to complete a thorough analysis and write-up of pilot test results. Once rescheduled, only three participants volunteered to participate in the focus group in order to earn extra credit. The combination of expediency, convenience sampling, and end-of-term *ennui* clearly influenced the makeup of the focus group and the results generated.

Second, committee members determined that a study of two participants, which comprised the study parameters of the dissertation prospectus, was inadequate to confirm findings. Committee members recommended that the initial study proposed be considered a pilot study and that, based on findings from the pilot, focus group methods be used to generate results for the final study. Following these recommendations proved essential in developing methods for the study, but deploying the study in a focus group ultimately introduced methodological issues that forced a reframing of the project as a case study of two individuals rather than a seemingly more widely representative focus group of multiple participants whose results could be compared, contrasted, triangulated, and replicated more broadly.

The problems introduced by the focus group have been named and described throughout this study, but a brief review will frame the insights that these problems offered during data analysis.

1. One focus group member arrived much later than the other two. Rather than waiting for the third participant, I started the focus group with the first two participants, then restarted with the late-arriving third participant. This resulted in considerable background noise to the other participants who were further along in the testing session.
2. The testing method that combined the use of usability testing software and Chrome Developer Tools required a great deal of one-on-one support to set up the environment on each participant's laptop and to ensure that Developer Tools were collecting data correctly from each page and tab opened during the research session. The focus group required the researcher's attention to be spread among three participants, which resulted in far less one-on-one attention to participants' testing sessions.
3. The usability testing software is clearly intended for a single user to complete a discrete task. Implementing the test with a focus group resulted in laptop microphones capturing both the laptop owner's think-aloud narrative and all of the audio surrounding the testing session: other participants' think-aloud narratives and questions directed to the researcher, the researcher's one-on-one conversations with other participants, and the researcher's instructions to both the group and individuals. The resulting audio files, as noted earlier, were quite challenging to decipher and transcribe.
4. Focus group interviews are intended to focus researcher attention on the interactions among focus group participants (Cresswell, 2015, p. 217). However, the focus of this study is on the interaction of the human participants with the various technological,

environmental, and ideological actors involved in online research. As a result, the value of capturing focus group interaction was minimized by the study's focus, and the interaction among participants itself was difficult to trace with existing audio and video tools.

3.6.3 Insights from Reframing the Study

As noted earlier in the chapter, methodological issues introduced during the pilot and revealed in all their glory during the focus group forced the study to be reframed from results of a focus group to results of a case study of two participants. The process of reframing came from reflecting on the study and determining how best to present the results, which remain important to the field. Reflecting on the study reveals several insights that are important to present as ancillary results, potential fodder for additional study.

3.6.3.1 Real-World Conditions are Better to Study but Harder to Test

The study was designed to capture and trace individual users' interaction with technological, environmental, and ideological actors during the research process. In order to capture the widest range of activity, the study was located in a campus space that was open to external stimuli, literally through the open door of MediaPark and figuratively through the existing conditions of the room: a small computer lab. The study asked participants to use their own laptops in order to include in the study potential influences from other applications, network processes, and computing processes happening in the background. The study did not include an external camera to capture participant activity, relying instead on the relationship forged between the researcher and participants during the 45-minutes testing session to capture participant observations and insights. The study did not seek to incorporate HAR file capturing into the testing software through a customized application or hybridized and costly test software,

preferring to use simple, existing applications that could be quickly downloaded, activated, and used with existing hardware and software. All of these decisions in the design of the study resulted in conditions that were deeply challenging to test.

Nearly all of the variables introduced by the design of the study could have been eliminated by using a campus computer lab consisting of public computers that load with a clear browser history, with no additional applications running in the background, and with a dedicated, wired connection to the campus network and the internet. The lab could have been isolated from the rest of campus for crisp, clean audio without external interruptions. The lab could have included a secondary camera to capture testing participants' activities and the interaction between participants and researcher. While these decisions would have resulted in a cleaner testing environment, they also would have narrowed the focus of the study to eliminate the external and internal variables that "real world" research activity always contends with. A real-world study of research activity might seek to capture a student in a dorm room conducting last-minute research late at night with noises of a party coming from the next room, with distractions of a roommate making out on the bed across the room, with loud music playing in headphones to drown out the sounds of the party and the make-out session, with a movie streaming in the background, required viewing for a class tomorrow, and with social media and email notifications pinging throughout the night. In such an environment, assemblage agency coalesces from so broad a range of influences and actors as to be impossible to capture. The design and implementation of this study revealed the importance of compromising between lab and real-world testing conditions. Ultimately, the data captured during the focus group likely comes closer to capturing real-world research activity conditions in a classroom, including the sound of a teacher in the background offering a continual drone of commentary, the sound of other

students in the room talking among themselves and to themselves, guiding themselves through unfamiliar and archaic browsing experiences, remarking on how challenging the research interface can be, asking questions of the teacher and one another to try to figure out how to access a particular resource or asking if it's enough to use the abstract because it's too hard to find the full text of the article. For this reason, data from at least one participant in the focus group is very useful to the study and its results.

3.6.3.2 Think Carefully About the Focus of the Study, and Design Accordingly

I was quick to follow the advice of committee members to add a focus group component to the study. It was a convenient way to collect more data without dedicating time to multiple one-on-one sessions, an important consideration for someone who lives two hours away from campus. As the difficulty of recruiting participants for the study without funds to provide some material incentive for participation became clear, the idea of offering extra credit for participation made sense with the cooperation of an on-campus professor. However, it also required that every student in the class be given the opportunity to participate in the study to earn extra credit. The design of the study shifted from a focus on single participants to the need to focus on multiple participants as a result of that decision. In short, expedience and convenience contributed to the focus of the study rather than my object of study—a human user conducting research online and interacting with technological, environmental, and ideological actors throughout the process. But hindsight, while clairvoyant, is only useful when applied to the future. The present moment required a way to collect and analyze data from a pilot study and a focus group, and the best way seemed to be two case studies. And the truth is that a single case study might have sufficed. The focus of the study is a single user's interaction in assemblage agency. Collecting data around multiple users' interaction focuses on a different aspect of

assemblage agency—the way collective human activity interacts with collective technological, environmental, and ideological activity. Within a single user's research activity, there are already sufficient actors engaged and interacting to demonstrate how and when assemblage agency emerges from the interaction of all actor types. A second user's individual research activity may demonstrate changes in research processes, network speeds, and other variables, but it will demonstrate broadly the same assemblage agency emerging.

This reality explains in part my decision to use a single participant's activity from the focus group. What the activity surrounding Participant 3 reveals throughout the study is that environmental factors play a considerable role in the ability to solve both study methods and research problems. An instructor's voice droning in the background is merely a different source of ambient noise, as is the sound of other participants in the study. There's more distraction to contend with in a focus group, but the individual participant still manages to complete the research activity and record the data required for the test successfully.

In essence, the focus group revealed the limitations of using a focus group to address my research question, which centers around a single user in relation to other actors in the online research process. This is a limitation I would not have realized without trying. In this sense, one of the most significant lessons learned from this project is the importance of applying just the right methods to just the right research questions. Only by comparing and contrasting the results of the one-on-one pilot study with those of the focus group study did I come to fully understand the importance of collecting data from a one-on-one usability test to address the very specific research question I raised.

For this reason, I did not scrap my results and start again. Knowledge in the field of technical communication does not only come from perfect application of research methods, but

from careful attention to the methods themselves, and from understanding the relationship between research question and those methods. This study contributes both knowledge about assemblage agency as it emerges in online research along with the value of careful attention to research methods and the relationship between those methods and the research question at hand.

3.6.3.3 Technical Communication Methods Don't Address Assemblage Agency Well

Without a doubt, this study cobbles together a variety of methods under the general methodological umbrella of actor-network theory. Cobbling together methods to study assemblage agency is necessary because the field lacks methods that identify and trace agency that emerges from interactivity among multiple actors. The field remains firmly ensconced in the humanist paradigm in which human rhetors authorize and explain how technologies function. Technologies and technicalities remain objects of human experience, and human rhetors compose texts (broadly writ) to explain those technicalities and technologies to other human subjects. Yet important theoretical work in composition studies more generally, and technical communication more recently, questions the Cartesian approach to the technical as object of human subjectivity. Losh (2016), for example, applies Bitzer's rhetorical situation to smart objects that communicate among themselves as a starting point to representing technologies as agents: "Given the rise of smart devices that may serve simultaneously as rhetor, audience, exigence, and constraint, Bitzer provides a vocabulary to connect rhetoric and computation." Brown (2016) applies Derrida's Law of Hospitality with Galloway's approach to information management through protocol to posit algorithmic, protocol-driven laws of hospitality that emerge and govern control of rhetorical traffic in a network:

> Understanding how software's ethical programs are written and rewritten and how they engage the Law of hospitality is central to understanding, in Galloway and Thacker's words, "the shape of the ethical encounter when one 'faces' the swarm." But each of

> these ethical programs is rhetorical. It makes an argument, marshals persuasive resources, and addresses the particulars of a situation. (loc. 246)

And Holmes (2016) addresses the ontological emergence of agency from digitally coded procedures like video games as rhetorical persuasion: "The lesson is clear: all are agents in persuasion; all code decisions are embodied and enacted through temporal and material fashion. Code as fixed object—technical or expressive—is only a moment of provisional cohesion that is enacted and re-enacted across its temporal and material iterability."

Theories of assemblage agency in composition studies and technical communication are emerging. But practical approaches to revealing and studying agency through its emergence from assemblage interactions are lacking. We have, at best, methods for exploring aspects of this assemblage as it emerges—human activity, encoded process, environmental conditions, hidden ideologies. What's required is a way to put together these activities to reveal their interactions and the agency emergent in those interactions. This study uses chronology as a framework for placing these activities in relation, but there are also spatial dimensions that can be used as frameworks. This study reveals the gap in methods and seeks to fill it with accessible, off-the-shelf solutions that work—but just barely. The field needs methodologies and related methods that enable scholars to study assemblage agency as it emerges, not from its requisite actors and activities, but in its emergent unity. After all, research produces results: we can find sources to support a particular claim. The question of "whose" results they represent is one that needs an answer. It isn't only the researcher's results.

CHAPTER 4

RESULTS

Pausing to review progress to this point helps keep track of territory this dissertation has covered to this point and seeks to cover in its remaining chapters. Chapters 1 and 2 introduced and mapped the problem of tracing emergent agency and situated that problem in the mundane research activities assigned to students in writing- and research-intensive classes. Chapter 2 also situated the work of addressing this problem in the field of technical communication, where the relationship between users and technologies is often studied through user experience (UX) testing. Chapter 3 described a mixed-methods approach to addressing this problem that combines the qualitative analysis of usability testing results with a quantitative analysis of data files generated by browsing sessions. This chapter opens a two-chapter focus on what Johnson-Eilola and Selber (2013) call *developing problem knowledge*: describing the results of the study and explaining their significance in the field of technical communication. This chapter will present results of the pilot test and the focus group portions of this study. It will frame the results as a case study involving two participants, and will introduce replicable findings from the case study. Chapter 5 will explain why these results matter to the field, how they might be incorporated into future study, and what they suggest about user experience and usability testing in technical communication.

4.1 BUILDING A CASE STUDY

As noted in Chapter 3, the purpose for the pilot study was to test methodological approaches and methods toward formalizing approaches and methods for the larger focus group. Throughout the pilot study, questions remained whether the methods would generate useful data, and whether that data could be analyzed toward addressing the study's research questions. Upon

reviewing and analyzing data from the pilot study, both the methodological approach and the method were confirmed. The usability test generated usable and useful data, lessons about the usability testing tool were identified and applied to the focus group study plan, and data analysis demonstrated and traced assemblage agency as it emerged through the research process. As a result of the pilot study, minor changes were made to methods while methodological approaches adhered.

The purpose of the focus group was to collect qualitative and quantitative data from a small group of participants toward developing replicable findings about assemblage, algorithm-centered agency in online research activity. Focus groups are often used in usability testing, and the qualitative results from focus groups provide valuable insight into the product, service, or tool whose usability is being tested. As a result, bringing together a focus group to complete the online usability test appeared to be a useful way to collect additional data from a larger number of users to replicate the results of the pilot study, specifically the collection of participant narratives, survey data, and network activity from HAR files. The underlying assumption about the focus group was that the results would coalesce around findings similar to the pilot study.

Three unforeseen, or at least unexpected, aspects of the study forced fundamental changes to the study's structure. First, constraints of the usability testing software used resulted in unexpected data loss. Second, untested changes to the usability test itself, specifically the addition of an impression test in the focus group and shifting from deploying the usability test in the administrative portal during the pilot test to the tester interface during the focus group, resulted in unexpectedly high levels of technical support required to get the testing session running in the focus group. Third, a focus group whose participants seek to complete a similar recorded tasks on three individual (and completely different and untested) laptops using

downloaded and installed applications, combined with the need for collecting HAR file data beyond the function of the usability testing tool, requires divided attention among participants; divided attention, in turn, results in lost quantitative data in the form of HAR files. This chapter focuses on presenting the results successfully captured in the pilot study and the focus group, and placing them in relation to one another as two case studies addressing similarities in the ways agency emerges in the online research process.

Ultimately, data from two participants—one from the pilot study and one from the focus group—were adequately complete for analysis. These participants are called Participant 1 and Participant 3, respectively. The following section presents the causes for data loss from the second pilot study participant and the other two focus group participants.

In the pilot study, the usability test for Participant 1 worked as expected. I successfully collected ethnographic observations, audio and video recordings of the search session, network speed measurements, survey responses, HAR files, and photos of the testing environment and test session for analysis. In contrast, the usability test for Participant 2 ran afoul of recording limits in TryMyUI.com. The recording session reached the 20-minute time limit for capturing audio and video of the test, resulting in unprocessed video that is unusable for transcribing or analysis. The methodological approaches to agency applied to this study require placing human activity in chronological and logical relation to technological, environmental, and ideological activities. The loss of recorded think-aloud narrative and on-screen activity (e.g., search terms, search results, mouse movements) eliminated the majority of participant activity, effectively removing traces of human involvement from the assemblages forming. Because of this lack of participant recorded activity, results from Participant 2 were removed from the pilot study and its

write-up. However, HAR file data and ethnographic observations from Participant 2 were collected successfully.

In the focus group, on the contrary, audio and video recordings from all three participants were captured successfully. However, because I needed to provide significantly more technological support to get the usability test set up, and because I provided support to each participant at a different pace, I was unable to ensure that network activity logs were captured from reloaded pages each time a new browser tab or window opened during research. As a result, incomplete HAR files for the research session were captured for two of the three focus group participants. HAR files from only one participant (Participant 3) were complete for analysis. Because of this lack of HAR file data for the other two participants in the focus group, results from Participants 4 and 5 were removed from the focus group and its write-up. However, usability testing recordings and limited ethnographic observations from Participants 4 and 5 were collected successfully.

As noted in Chapter 3, methods used to capture pilot study data differed little from methods used to collect focus group data. Table 3.4 identifies these differences in order to demonstrate the legitimacy of analyzing data collected from Participant 1 in the pilot study and Participant 3 in the focus group in a unified way. The primary data collections used for analysis are the usability test results with their think-aloud narratives, recorded screen activity, and post-test open-ended survey; ethnographic observations and reflections; network speed test results; and HAR files recording network activity. Full data sets were collected from Participant 1 and Participant 3. As a result, despite entering the testing interface differently, data from both Pilot Study and Focus Group participants can be analyzed together. Table 4.1 reveals complete, adequate (complete enough for analysis in the opinion of the PI), and incomplete data collections

by participant, and highlights the incomplete data collections that disqualified participants from full analysis in the study.

Table 4.1

Data successfully collected in Pilot Study and Focus Group by participant.

Pilot Study						
Participant	Usability Test Recording	Post-Test Survey	Observation Notes	Speed Test	DAA Webchoices	HAR Files
P1	Complete	Complete	Complete	Complete	Incomplete	Complete
P2	*Incomplete*	Complete	Complete	Complete	Incomplete	Complete
Focus Group						
Participant	Usability Test Recording	Post-Test Survey	Observation Notes	Speed Test	DAA Webchoices	HAR Files
P3	Complete	Complete	Adequate	Adequate	Complete	Complete
P4	Complete	Complete	Adequate	Adequate	Complete	*Incomplete*
P5	Complete	Complete	Adequate	Adequate	Complete	*Incomplete*

Note: Italicized values represent data loss that disqualified the participant from consideration.

Upon discovering that incomplete HAR files were captured for two of three focus group participants, I initially planned to reschedule participants in one-on-one testing sessions similar to the methods employed in the pilot test. Using a focus group with the modified approach to usability testing I employed proved confusing for participants and equally frustrating for me as researcher, since I was unable to collect and ensure collection of clean, useful data. Developing a method for deploying some sort of hybrid focus group that incorporated individual testing sessions but collected and analyzed the results as a group toward developing replicable conclusions seemed the best approach for moving forward. However, as I reflected on the results, and especially as I recognized the similar conclusions drawn from data collected from

Participant 1 and Participant 3, I began to see the two testing sessions as part of a case study in which a close, careful analysis of individual activity is developed. As expected from a case study, write-ups of each participants' activity provided a deep dive into the data. Those deep dives into data collected from Participant 1 and Participant 3 are presented in the following sections. Using case study as a formal research approach addresses the potential error inherent in the revised methods implemented during the focus group by shifting attention from methodological orthodoxy toward a unified approach to data analysis. Since data collected from Participant 1 and Participant 3 were similar, a unified approach to analysis is possible. More significantly, this decision to shift methodological approach reflects an iterative research practice recommended by Sullivan and Porter (1997), encouraging researchers to "use more elastic notions of methods so that methodological legacies such as 'case study,' 'survey,' etc., are not seen as a path to be chosen but instead are adapted to fit the circumstances of studying writing technologies" (p. 74). While this study focuses on research practices, at its heart it seeks to identify and trace rhetorical agency as it emerges from assemblages of human and nonhuman actors. Given the shifting nature of the unit of analysis, a research approach must adapt.

4.2 QUANTITATIVE RESULTS

Both pilot study and focus group successfully collected quantitative data from network speed tests and HAR files. Although focus group participants installed the Ghostery plugin for Chrome, the plugin did not provide the expected on-screen listing of trackers identified during page load. The Ghostery listing would have replicated data collected in HAR files—for example, as will be shown later, Facebook, Twitter, Google Analytics, Google Tag Manager, and other trackers can be identified in the HAR file data. As a result, Ghostery data, originally included among quantitative data sources in the methods, were eliminated from collection and analysis in

the focus group. Focus group participants also ran the DAA WebChoices tool and shared the onscreen results with me, but because the pilot test's stated purpose for running the tool was to check, rather than record and collect, advertising networks blocked by the participant's browser, no DAA WebChoices data were collected or noted other than the following general notation in technological observations: "some opt outs, lots of *Status Unavailable*." Because focus group participants were originally intended to provide the primary data sets for this study, the focus group participants saved a PDF version of the DAA WebChoices data for later analysis. However, once it became clear that a pilot study participant and a focus group participant would contribute data to the dissertation study, DAA WebChoices data was also eliminated from analysis.

4.2.1 Network Speeds

Using my personal laptop, I measured upload and download times using Speedtest by Ookla (www.speedtest.net) at approximate five-minute intervals during the pilot study usability tests; during the focus group usability tests, I was forced to delay collecting speed test data until later in the testing session, but I was able to capture baseline speed test data from focus group participants and to capture interval data later in the testing session. While these results do not represent the exact speeds experienced by participants on their personal laptops, the results may be extrapolated to represent the network speed trends experienced by participants during the usability test. All participants and I were in close proximity in the same room in the testing facility. All but one participant used the primary campus wireless network, MonarchODU; one focus group participant joined the consortium-based Eduroam network. Baseline network speed trends for all participants are represented in Table 4.2, and interval speed test readings for

participants are represented in Table 4.3. All participants are included to demonstrate the level of variability present in these connection speeds.

Of note during the focus group testing session were significant differences in baseline speeds collected by Participants 3, 4, and 5 prior to starting the usability test. These differences were likely the result of different wireless networks. Participant 3 was unable to connect to MonarchODU. Instead, this participant regularly used and connected to Eduroam during the testing session, a separate wireless network available on campus. Old Dominion University (2017b) differentiates the two networks as follows:

- MonarchODU: Primary network for students, faculty, and staff that are regularly accessing Wi-Fi on their own devices(s) and are primarily located on campus.
- EDUROAM: Researchers, faculty members, staff, and students that travel to other educational institutions frequently.

While these descriptions do not indicate any difference in network speeds, when Participant 3 connected to Eduroam at nearly the same time that Participants 4 and 5 connected to MonarchODU, network speeds were not comparable, as seen in Table 4.3.

Table 4.2

Baseline network speed measurements during testing session.

Pilot Study			
Participant	Network & Operating System	Download (Mbps)	Upload (Mbps)
Participant 1	MonarchODU on Mac OS	34.28	60.91
Participant 2	MonarchODU on Windows OS	16.72	20.91
Focus Group			
Participant	Network & Operating System	Download (Mbps)	Upload (Mbps)
Participant 3	Eduroam on Windows OS	8.05	22.45
Participant 4	MonarchODU on Mac OS	72.85	66.31
Participant 5	MonarchODU Mac OS	85.10	130.22

Note: Network connection speeds measured using Speedtest by Ookla on participants' laptops connected to wireless networks.

Download *STD* = 34.01; Upload *STD* = 44.50.

Baseline upload and download speeds measured using participant laptops at the beginning of the testing session reveal considerable differences in Table 4.2, demonstrated by high standard deviations for upload and download speeds. As noted in Chapter 3 and later in this chapter, slow network connection and slow hardware and software caused significant delays in preparing Participant 3 to start the usability test, to complete the test, and to save test data. It's likely I was able to focus more attention on Participant 3, and therefore collect complete HAR files from them, because their testing procedure ran slower than others in the focus group.

Table 4.3

Network speeds taken at intervals during testing sessions.

Pilot Study P1		
Timestamp (hh:mm)	Download (Mbps)	Upload (Mbps)
12:48	53.09	86.23
12:55	19.91	43.87
12:59	23.89	39.66
13:05	29.27	50.25
13:09	23.95	46.76
Pilot Study P2		
Timestamp (hh:mm)	Download (Mbps)	Upload (Mbps)
12:50	9.63	14.43
12:56	44.21	69.81
13:02	41.44	54.43
13:07	37.64	59.78
13:19	36.89	61.17
Focus Group (P3, P4, P5)		
Timestamp (hh:mm)	Download (Mbps)	Upload (Mbps)
12:35	29.9	43.37
13:06	39.85	71.36
13:13	56.64	96.21
13:24	35.61	95.61

Note: Speeds measured using Speedtest by Ookla on researcher's laptop connected to wireless network.

Download M = 36.63; Upload M = 65.73. Download STD = 12.17; Upload STD = 23.97.

As seen in Table 4.3, download and upload speeds showed considerable variability throughout the testing period, demonstrated by the relatively high standard deviations in both upload and download speeds. The mean speeds of 36.63 Mbps download and 65.73 Mbps upload represent entirely adequate speeds for the searches completed during the test; network lag likely played little role in affecting search practices, even for Participant 3. The mean download speed is lower

than the U.S. average download speed of 64.17 Mbps, but the mean upload speed is significantly higher than the U.S. average download speed of 22.79 Mbps (Ookla, 2017).

4.2.2 HTTP Archive (HAR) Files

Participant 1 generated a total of eight HTTP Archive (HAR) files, while Participant 3 generated six HAR files. Each new tab or window that opened generated a new HAR file, but because multiple search pages, SERPs, and result details can be opened in a single tab during a browsing session, some HAR files represented multiple webpages while others represented the activity of a single page. The World Wide Web Consortium (W3C), which develops and supports web standards and has drafted the HAR format, describes the HTTP Archive specification as "an archival format for HTTP transactions that can be used by a web browser to export detailed performance data about webpages it loads" (World Wide Web Consortium, 2012). HAR files are saved in JavaScript Object Notation (JSON) format; as such, they contain too many related data points to be flattened as a comma-separated (CSV) file. However, the general data points included for each asset (URL) represented in a HAR file are as follows:

- Timestamp (in GMT)
- HTTP response code (100, 200, etc.)
- Request size (in bytes)
- Response size (in bytes)
- Total time (in milliseconds)
- Timing (represented by a timing waterfall)
- Request method (GET or POST)
- Asset location (URL)

To illustrate, in the usability test completed by both case study participants, the action of opening the ODU Library webpage generated a portion of a HAR file consisting of 60 assets, each of which generated the general data points listed above. However, in addition to these general data points, detailed data from the request for and response from each asset is also included in the file. For the GET http://odu.edu/library asset (one of the 60 network assets requested and received), for example, the HAR file included *Request* information collected by the browser and sent to servers (detailed in Tables 4.4, 4.5, and 4.6) and *Response* information collated by the servers and sent to the browser (detailed in Table 4.7, 4.8, and 4.9).

Table 4.4

Request *overview for "GET http://odu.edu/library" asset in browsing sessions.*

Participant 1				
method	url	httpVersion	headersSize	bodySize
GET	http://odu.edu/library	HTTP/1.1	688	0
Participant 3				
method	url	httpVersion	headersSize	bodySize
GET	http://odu.edu/library	HTTP/1.1	2745	0

Table 4.4 shows a much larger header size request (2,745 bytes vs. 688 bytes) in the request sent by Participant 3 than by Participant 1. This is likely the result of a much longer cookie file sent during the browsing session by Participant 3 (see Table 4.5 to see the difference in cookies sent by each participant).

Table 4.5

Request *headers for "GET http://odu.edu/library" asset in browsing sessions.*

Participant 1	
name	value
Pragma	no-cache
Accept-Encoding	gzip, deflate
Host	odu.edu
Accept-Language	en-US,en;q=0.9,fa;q=0.8
Upgrade-Insecure-Requests	1
User-Agent	Mozilla/5.0 (Macintosh; Intel Mac OS X 10_13_2) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/63.0.3239.132 Safari/537.36
Accept	text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,image/apng,*/*;q=0.8
Cache-Control	no-cache
Cookie	*232* characters†
Connection	keep-alive
Participant 3	
name	value
Accept-Encoding	gzip, deflate
Host	www.odu.edu
Accept-Language	en-US,en;q=0.9,fa;q=0.8
Upgrade-Insecure-Requests	1
User-Agent	Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/65.0.3325.181 Safari/537.36
Accept	text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,image/apng,*/*;q=0.8
Cache-Control	no-cache
Cookie	*2,324* characters†
Connection	keep-alive

† See Table 4.6 for detail. Differences in cookie sizes italicized.

Table 4.5 shows the content of the request headers sent by each participant's browser. It's clear at a glance that the request sent from Participant 3's browser included much more information (2,324 characters vs. 232 characters) in the cookie submitted in the request. Table 4.6 details these differences.

Table 4.6

Request *cookies for "GET http://odu.edu/library" asset in browsing sessions.*

Participant 1	
name	value
LPVID	dkZTljZDgxNGFhYTY3NWU5
_ceir	1
_ga	GA1.2.1773575877.1510610468
_gid	GA1.2.410272931.1516814987
BIGipServerWEB_PROD.app~WEB_PROD_pool_int	rd741o00000000000000000000ffffc0a86095o80
_gat_UA-2088428-1	1
_ceg.s	p32mo2
_ceg.u	p32mo2

Participant 3	
name	value
AMCVS_1B6E34B85282A0AC0A490D44%40AdobeOrg	1
AMCV_1B6E34B85282A0AC0A490D44%40AdobeOrg	690614123%7CMCIDTS%7C17639%7CMCMID%7C06155669867206073661656450332118285980%7CMCAAMLH-1524593342%7C7%7CMCAAMB-1524593342%7CRKhpRz8krg2tLO6pguXWp5olkAcUniQYPHaMWWgdJ3xzPWQmdj0y%7CMCOPTOUT-1523995742s%7CNONE%7CMCAID%7C2C51AA3D8507AB14-60000109C0012F11%7CMCSYNCSOP%7C411-17646%7CvVersion%7C3.1.0
AMCV_774C31DD5342CAF40A490D44%40AdobeOrg	793872103%7CMCIDTS%7C17641%7CMCMID%7C04012734417119275062010740913223316168%7CMCAAMLH-1524760002%7C7%7CMCAAMB-1524760002%7CRKhpRz8krg2tLO6pguXWp5olkAcUniQYPHaMWWgdJ3xzPWQmdj0y%7CMCAID%7CNONE
BIGipServerWEB_HTTPS_PROD.app~WEB_HTTPS_PROD_pool_int	rd741o00000000000000000000ffffc0a86095o80
BIGipServerWEB_PROD.app~WEB_PROD_pool_int	rd741o00000000000000000000ffffc0a86095o80
__gads	ID=9a7226514b00e7b6:T=1488236700:S=ALNI_Mbnfp8lezzQ4OnGaCclITpYpL5Qjg

Table 4.6 continued

Participant 3	
name	value
_ceg.s	p7nixf
_ceg.u	p7nixf
_ceir	1
_ga	GA1.2.2106982523.1477324074
_gid	GA1.2.390354291.1524506682
_vis_opt_s	1%7C
_vis_opt_test_cookie	1
_vwo_ds	3%3Aa_0%2Ct_0%3A0%241523819219%3A45.25523751%3A%3A%3A306_0%2C305_0
_vwo_uuid	D93B9F23C51B84F50A0C27EAEC2D0DB86
_vwo_uuid_v2	D93B9F23C51B84F50A0C27EAEC2D0DB86|2ad514977204b76a1518ab1b3ba84b3e
cX_S	izopl7stotc6s31g
check	true
fsr.s	%7B%22v2%22%3A1%2C%22v1%22%3A1%2C%22cp%22%3A%7B%22cxreplayaws%22%3A%22true%22%2C%22Error_Page%22%3A%22no%22%2C%22No_Results%22%3A%22no%22%2C%22My_Research%22%3A%22no%22%2C%22Advanced%22%3A%22no%22%2C%22Professional%22%3A%22no%22%2C%22User_IP%22%3A%22128.82.252.58%22%2C%22Session_ID%22%3A%22D5C1E0E19BB6964FFA45AA472FB844D6.i-06ebe1189f9ad5ccc%22%2C%22Usage_Session%22%3A%2220180417181932426%3A468281%22%2C%22Account_ID%22%3A%2212967%22%7D%2C%22rid%22%3A%22d44bc21-87714681-82ae-31c8-9458f%22%2C%22to%22%3A4%2C%22mid%22%3A%22d44bc21-87714908-107e-35ae-ad6fd%22%2C%22rt%22%3Afalse%2C%22rc%22%3Afalse%2C%22c%22%3A%22https%3A%2F%2Fsearch-proquest-com.proxy.lib.odu.edu%2Fdocview%2F814472448%2F1FF1C44D6FEE4748PQ%2F5%22%2C%22pv%22%3A4%2C%22lc%22%3A%7B%22d0%22%3A%7B%22v%22%3A4%2C%22s%22%3Atrue%7D%7D%2C%22cd%22%3A0%2C%22sd%22%3A0%2C%22f%22%3A1523989243424%2C%22pn%22%3A0%7D
mwtbid	81508D66-9B2F-474C-BDF3-372FA4527DF0
mwtses	asp01
my.odu.edu.login	1512667769593-wicket
s_cc	true
s_fid	7E6C03EB5DD2AB89-108EF5B3D58D7D34
s_ppv	article%2520view%2C33%2C33%2C803
s_sq	%5B%5BB%5D%5D
tp	2450

Some of the differences in cookies include that Participant 3 appears to be logged into their myODU portal account (shown by the "my.odu.edu.login=1512667769593-wicket" name/value pair), a fact that may in turn generate a number of additional cookie values related to website optimization: several *vis* and *vwo* cookie values are set, for example, which relate to the web tracking company VWO; the *mwtbid* and *mwtses* cookie values from Participant 3 appear to relate to the publishing company Elsevier; and the lengthy *frs* cookie value appears to be set by optimization company ForeSee. It's useful to recognize that, given nearly identical testing scenarios, two different participants using personal devices and browsing habits generate considerably different content sent as a request in the same header framework. It's also useful to recognize that these request header contents represent data sent in a request from the participant's browser to destination servers.

Table 4.7 provides a list of response values from destination servers generated from requesting the ODU Library webpage.

Table 4.7

Response *overview for "GET http://odu.edu/library" asset in browsing sessions.*

Participant 1						
status	statusText	httpVersion	redirectURL	headersSize	bodySize	_transferSize
200	OK	HTTP/1.1		250	40993	41243
Participant 3						
status	statusText	httpVersion	redirectURL	headersSize	bodySize	_transferSize
200	OK	HTTP/1.1		250	10745	10995

Table 4.7 reveals that the body size of the response (generally, the code of the request response, in this case the HTML file for the ODU Library webpage) is larger for Participant 1 than Participant 3. Both loaded the same page URL, so there's little data available to explain that difference—in the usability test recordings, both successfully loaded the page in their browsers. As Table 4.9 will reveal, however, the content data was not successfully captured in the HAR file for Participant 3. Table 4.8 presents the header values for the response returned to the request. Minor differences in header values relate to the length of the header values, slightly longer for Participant 1.

Table 4.8

Response *headers for "GET http://odu.edu/library" in browsing sessions.*

Participant 1	
name	value
Date	Wed, 24 Jan 2018 17:46:26 GMT
Content-Encoding	gzip
Server	Apache/2.2.15 (Red Hat)
Vary	Host,Accept-Encoding
Content-Type	text/html; charset=UTF-8
Connection	Keep-Alive
Accept-Ranges	bytes
Content-Length	11032
Participant 3	
name	value
Date	Tue, 24 Apr 2018 16:55:25 GMT
Content-Encoding	gzip
Server	Apache/2.2.15 (Red Hat)
Vary	Host,Accept-Encoding
Content-Type	text/html; charset=UTF-8
Connection	Keep-Alive
Accept-Ranges	bytes
Content-Length	10745

Values in Table 4.8 reinforce the validity of comparing Participant 1 from the Pilot Study and Participant 3 from the Focus Group, as the structure of the data remains consistent through browsing sessions.

Table 4.9

Response *content for "GET http://odu.edu/library in browsing sessions.*

Participant 1			
size	mimeType	compression	content
40993	text/html	0	entire HTML of search page, too lengthy to include
Participant 3			
size	mimeType	compression	content
40270	text/html	Yes, saved 29525 bytes.	No content available in the HAR file.

Table 4.9 represents the content of the response sent by the odu.edu server to each participant's browser. As noted earlier, the contents of the *content* field for Participant 1 comprise the entire HTML file of the ODU Library webpage, too lengthy to include in the table. The content of the same field was not captured in the HAR file from Participant 3's browser. The usability test video record reveals that Participant 3 refreshed the browser 5 milliseconds after the last asset loaded on the page, and the HAR file data captures the value of the content field in a separate segment of the HAR file related to that refresh; if Chrome Developer Tools are actively recording activity when a page is loaded or refreshed, a new segment of a HAR file is created. Table 4.11 represents each new segment in a single HAR file as a page (e.g., 1 of 2 pages, 2 of 2 pages, etc.). This variability in content reveals differences that browsing habits can make in the

way data is sent to and from an individual's browser, reinforcing the idea that browser and machine work in concert toward meaning-making in search activity.

The information in Tables 4.4-4.9 represents different layers of data sent from and received by the browser. The data is collected in the HAR file as a JSON object; the tabular depictions seek to flatten portions of the data for readability, but the data itself represents information generated around a single network action, the request from the browser for the ODU library webpage and the response from the server of the page content.

While the content of the data listed in Tables 4.4-4.9 is technical, it represents a *request* sent by the web browser to a web server (ODU server) and the server's *response* to the request back to the browser. The request includes the *header* and *cookies*. The header contains information about the browsing session (keep alive, no-cache), the browser itself (Chrome), the operating system (Mac OS X 10.13.2 for Participant 1, Windows NT 10.0; Win64; x64 for Participant 3), and the network access host (www.odu.edu). Common cookies between both participants include session settings defined for the web server (BIGipServerWEB_PROD.app~WEB_PROD_pool_int), for the live chat application (LPVID), for the web performance tool Crazy Egg (_ceir, _ceg.s, _ceg.u), and for the web analytics tool Google Universal Analytics (_ga, _gid, _gat). Cookies sent by Participant 3 include a remarkable number of additional session settings defined for the analytics and marketing tool Adobe Experience (AMCV_…, AMCVS_…, s_cc, s_cc, s_ppv, s_sq), for the advertising platform Google Ads (_gads), for the conversion optimization service VWO (_vis_opt_s, _vis_opt_test_cookie, _vwo_ds, _vwo_uuid, _vwo_uuid_v2), for the Elsevier publishing platform (mwtbid, mwtses), cookies with unknown origin or purpose (cX_S, tp), for the ForeSee Developer Portal (fsr.s), and for the ODU portal (my.odu.edu.login). The response includes the

header and the *content*. The header includes general information about the server software (Apache Red Hat) and encoding. The content includes the full HTML code from the ODU server for Participant 1, in this case the *library.html* page.

What's important to note is that what's described above represents only one of 60 total assets loaded when each participant opened the ODU Library webpage. For each asset—image, script, HTML, CSS, JS object—similar information was sent by the browser as a *request* and received as a *response* from a server. Table 4.10 details the 60 requests and responses involved when loading the ODU Library webpage along a timeline that spans merely 1.780 seconds. These results are specific to Participant 1, but the page load for Participant 3 is nearly identical.

Table 4.10

Timeline of library webpage load by asset and requested domain.

HAR File Timestamp	Asset Requested by Browser
17:46:26.681	HTML (odu.edu)
17:46:26.703	JS (jquery.com)
17:46:26.704	CSS (odu.edu), CSS (odu.edu), JS (odu.edu), CSS (odu.edu), JS (odu.edu), CSS (odu.edu)
17:46:26.705	JPG (odu.edu), JPG (odu.edu), JPG (odu.edu), CSS (fonts.googleapis.com), CSS (odu.edu), PNG (odu.edu)
17:46:26.706	JPG (odu.edu), CSS (odu.edu), JPG (odu.edu), JPG (odu.edu), PNG (odu.edu), JPG (odu.edu)
17:46:26.707	PNG (odu.edu), PNG (odu.edu), PNG (odu.edu)
17:46:26.708	PNG (odu.edu)
17:46:26.975	JS (twitter.com)
17:46:26.976	JS (facebook.net)
17:46:27.017	WOFF (fonts.gstatic.com), PNG (odu.edu)
17:46:27.018	WOFF (fonts.gstatic.com)
17:46:27.019	WOFF (odu.edu)
17:46:27.020	JPG (odu.edu)
17:46:27.038	GIF (odu.edu)
17:46:27.039	WOFF (fonts.gstatic.com)
17:46:27.044	PNG (odu.edu)
17:46:27.068	JS (facebook.net)
17:46:27.094	HTML (odu.edu)
17:46:27.096	HTML (odu.edu)
17:46:27.097	HTML (odu.edu)
17:46:27.098	HTML (odu.edu)
17:46:27.099	HTML (odu.edu)
17:46:27.100	HTML (odu.edu)
17:46:27.158	JS (googletagmanager.com)
17:46:27.377	HTML (odu.edu)
17:46:27.553	JS (google-analytics.com)
17:46:27.590	TXT (twitter.com)

Table 4.10 continued

HAR File Timestamp	Asset Requested by Browser
17:46:27.607	JS (google-analytics)
17:46:27.610	JS (crazyegg.com)
17:46:27.754	PHP (facebook.com)
17:46:27.779	PXL (google-analytics.com)
17:46:27.817	TXT (twitter.com)
17:46:27.869	PXL (google-analytics.com)
17:46:27.956	JS (facebook.com)
17:46:27.958	JS (facebook.com)
17:46:27.971	JS (facebook.com)
17:46:28.079	PXL (twitter.com)
17:46:28.208	HTML (twitter.com)
17:46:28.460	PXL (facebook.com)
17:46:28.461	JS (facebook.com)
17:46:28.461	JS (facebook.com)

Note: Abbreviations represent different data types: web (HTML, TXT), pixels (PXL), scripts (JS: Javascript), style (CSS), images (JPG, PNG, GIF), and fonts (WOFF).

Table 4.10 depicts the search activity of Participant 1 loading the ODU library webpage. From that start of loading the page, all depicted activity is happening in the hardware, software, and network of the search environment; Participant 1 does not "do" anything other than open a webpage. The potential influence of hardware, software, and network on this portion of the search activity is enormous, given the lack of involvement participants have in these browser activities. After reviewing these results, the potential influence of variable upload and download speeds might be more significant than stated earlier; if networks speeds lag, search activity

necessarily follows suit because the participants have no power or agency to influence the search activity once initiated.

It's important to reiterate that only a portion of a single HAR file, representing the opening of the library search page by each participant, is represented in Table 4.11. To appreciate the amount of data collected during the study session, the total number of pages loaded during the study session, along with summary data from the HAR file, is presented in Table 4.11.

Table 4.11

Total assets requested during study sessions, sorted by timestamp and HAR file.

Participant 1				
HAR File	Pages	Timestamp	Description	Requests
archive01.har	1 of 1	17:46:26.645	Initial ODU Library page load	60
archive02.har	1 of 1	17:50:53.967	Initial search	66
archive03.har	1 of 1	17:52:21.172	Second search	60
archive04.har	1 of 3	17:53:25.768	Third search, misspelled	23
archive04.har	2 of 3	17:53:48.472	Third search, corrected (in-page)	62
archive08.har	1 of 2	17:54:42.974	ProQuest logo call	1
archive08.har	2 of 2	17:54:44.076	Article detail viewed	41
archive04.har	3 of 3	17:55:37.647	Fourth search (added term)	66
archive07.har	1 of 1	17:56:18.232	Title selection	7
archive05.har	1 of 1	17:56:51.043	Title selection	7
archive06.har	1 of 5	17:57:17.725	Login proxy call	1
archive06.har	2 of 5	17:57:24.123	Shibboleth call	1
archive06.har	3 of 5	17:57:24.403	Shibboleth authentication	12
archive06.har	4 of 5	17:57:28:153	Shibboleth authenticated	2
archive06.har	5 of 5	17:57:29:315	Title load	190
8 files	*15*	*00:11:02.670 elapsed time*	*15 pages loaded*	*599*
Participant 3				
HAR File	Pages	Timestamp	Description	Requests
archive01.har	2 of 3	16:46:35.126	Initial ODU Library page load	62
archive01.har	3 of 3	16:46:43.060	ODU Library page refresh	60
archive02.har	1 of 2	16:51:21.439	First search results	61
archive02.har	2 of 2	16:51:59.074	Result detail	41
archive03.har	1 of 1	16:54:08.789	Article	73
archive04.har	1 of 7	16:56:43.473	Second search results	48
archive04.har	2 of 7	16:57:01.251	Result detail	39
archive04.har	3 of 7	16:57:41.275	Third search result	47
archive04.har	4 of 7	16:58:34.582	Result detail	39
archive05.har	1 of 1	16:59:06.832	Access page	7
archive04.har	5 of 7	17:00:41.817	Search results	46
archive04.har	6 of 7	17:00:56.923	Result detail	33
archive04.har	7 of 7	17:01:21.551	Result detail (refresh)	32
archive06.har	1 of 2	17:01:51.233	Article page	48
archive06.har	2 of 2	17:01:59.561	Article PDF	56
6 HAR files	*15 pages*	*00:55:24.435 elapsed time*	*15 pages loaded*	*692*

Note: Totals italicized at the bottom of each column. Timestamp total represents total time from first to final timestamp, written as hh:mm:ss.mss.

Table 4.11, sorted chronologically using HAR timestamps (measured as *hh:mm:ss.mss* GMT), demonstrates that multiple page loads can be captured in a single HAR file if the page loads in the same tab. The table also demonstrates the breadth and depth of data collected by HAR files during this study. A total of 599 assets were loaded during the 11-minute research session for Participant 1, and a total of 692 assets were loaded during the 55-minute research session for Participant 3. Each of the assets loaded by each participant's browser includes the data points identified in Tables 4.4-4.9. The length of Participant 3's session was longer than Participant 1's because Participant 3's laptop and network connections were slower, requiring longer to download and install applications and longer to conduct searches and view results. Additionally, I was unable to respond immediately to Participant 3 questions about usability testing software and the testing session itself, the result of the focus group requiring divided attention among three participants. As a result, Participant 3 sometimes was forced to wait patiently for feedback before moving forward to the next task in the study session.

While participants initiated the activity described in the Description column of Table 4.11, the 599 (Participant 1) and 692 (Participant 3) assets loaded at various points during research were requested and received invisibly in response to programmed, algorithm-centered commands encoded in the browser, webpages, scripts, and servers.

4.3 QUALITATIVE RESULTS

Since the primary method used in this dissertation was usability testing, qualitative data are important components of the results. All participants narrated the research process using think-aloud protocol, a common practice in usability testing. The TryMyUI.com testing platform recorded audio of participant think-aloud narration, which I transcribed with minimal revision (see Appendix E for Participant 1 and Appendix H for Participant 3). Participants also typed

responses to four post-test questions seeking to describe the participant's baseline literacy and search competences. Additionally, as a non-participant observer (with the exception of providing testing direction and support), I recorded written observations about environment, technology, and participant during the testing session. I also recorded written reflections on the testing process and environment following the study session. These written data, in addition to the recorded screen activity from the usability testing platform, comprise the qualitative data collected during the study session.

4.3.1 Think-Aloud Narration

The transcripts of the think-aloud narration from the participants' usability tests are included in full as Appendix E (Participant 1) and Appendix H (Participant 3). Table 4.12 summarizes word counts and purposes for each participant's transcript.

Table 4.12

Summary of think-aloud narrative transcripts from testing sessions.

Participant	Usability Testing Questions	Participant Think-Aloud (& P3 Questions)	Researcher-Added Context (& P4 & P5)	Researcher Instructions	Totals
P1	561 (36%)	516 (33%)	377 (24%)	113 (7 %)	1,567
P3	255 (6%)	591 (13%)	2,643 (57%)	1,118 (26%)	4,607
Totals	*816 (13%)*	*1,107 (18%)*	*3,020 (49%)*	*1,231 20%)*	*6,174*

Note: Results represent number of words followed by percentage of total words in parentheses.

Table 4.12 reveals significant differences in researcher involvement in the Focus Group as seen in the results for Participant 3. The transcript for the Focus Group includes questions and commentary from three participants. The *Participant Think-Aloud (& P3 Questions)* column

separates out Participant 3 think-aloud narrative and questions directed to the researcher from those of Participants 4 and 5, which can be heard in the audio file for Participant 3. The *Researcher-Added Context (& P4 & P5)* column includes the text of researcher context shared with all Focus Group participants along with the text of questions and comments made by Participants 4 and 5.

As a starting point for analysis, the text of think-aloud narration from each participant was used to create a tag cloud of key terms and their frequency. This method follows the example of Selfe & Selfe (2013) for quickly identifying key concepts in a corpus. Although this method for mapping content is not regularly used in technical communication, it conveniently identifies key concepts to which attention should be paid. The tag cloud depicting the 516 words from Participant 1's think-aloud narration is presented as Figure 4.1, and the tag cloud depicting the 488 words from Participant 3's think-aloud narration and the 103 words that represent Participant 3's questions and statements is presented as Figure 4.2.

Figure 4.1. Tag cloud of Participant 1 think-aloud narration. TagCrowd. (n.d.a). *Tag cloud narration*, run May 23, 2018, at https://tagcrowd.com. Creative Commons licensed BY 4.0.

The Participant 1 tag cloud (Figure 4.1) was produced using tagcrowd.com with the following settings:

- Words pasted into the Paste Text area: 507
- Maximum words to show: 100
- Minimum frequency: 2 (must appear at least twice to be displayed)
- Show frequencies: Yes
- Group similar words: Yes
- Convert to lowercase: Yes
- Don't show these words: *ah*, *cool*, *hurricane*, *okay*, *power*, *puerto*, *rico*, *um*, *whoa* (represents metalanguage used by Participant 1 or search terms spoken by Participant 1)

The tag cloud maps the goals and concepts Participant 1 considered important during the usability test, focusing attention on a desire to identify *articles*, *resources*, and *sources* that addressed the chosen research topic. *Expect*ation plays a role in the usability test, which could represent something Participant 1 *expect*ed to see (and perhaps did not) or reflect anxiety about the *expectations* of the study session itself. Repeated use of *really* might represent metalanguage or might point toward a desire to identify meaningful or useful results in the usability test. Most importantly, the tag cloud identifies objects and attitudes that exert influence on the research activity. The expectation (and potential anxiety) of finding meaningful results during a research session is likely based on prior (re)search experiences like Google searches, suggesting research literacy or competency may influence the online research process.

Figure 4.2. Tag cloud of Participant 3 think-aloud narration. TagCrowd. (n.d.b). *Tag cloud narration*, run August 15, 2018, at https://tagcrowd.com. Creative Commons licensed BY 4.0.

The Participant 3 tag cloud (Figure 4.2) was produced using tagcrowd.com with the following settings:

- Words pasted into the Paste Text area: 599
- Maximum words to show: 100
- Minimum frequency: 2 (must appear at least twice to be displayed)
- Show frequencies: Yes
- Group similar words: Yes
- Convert to lowercase: Yes
- Don't show these words: *alright, deforestation, okay, um, yeah* (represents metalanguage used by Participant 3 or search terms spoken by Participant 3)

The tag cloud maps the goals and concepts Participant 3 considered important during the usability test. Participant 3 appeared focused on actions during the usability test like *going* and *looking*. This focus may represent a desire to complete the research task, or a level of anxiety about what it takes to complete the test itself. The repetition of the term "going" especially

reveals a high level of interest in achieving a future state in the research activity, as in "*going* to complete…" or "*going* to search…" Unsurprisingly, the term "search" is often repeated throughout the research process, demonstrating clarity of purpose during the usability test. More surprisingly, the frequent appearance of the term *access* may suggest issues with, or concerns about, being able to access the resources found during the research session. Logging into the single sign-on (SSO) environment in order to access university firewall-protected resources is an intrusive process that postpones the flow of activity during research, confirmed by evidence from the usability test on-screen activity recording. Importantly, this brief mapping exercise offers insight into the influences of environmental variables (like firewalls, access challenges, and single sign-on interruptions), testing requirements (causing the participant to focus on *looking* and *searching* during the usability test), and self-imposed pressure to succeed (resulting in intently future-focused "*going* to…" statements throughout the testing session). While these mapped terms may not represent direct influences on research activity, they do reveal additional complexity in identifying actors in assemblage agency that coalesces around research activity.

In addition to mapping terms from participants' think-aloud narratives, technical communicators study the rhetorical situation of texts to focus (among other aspects) on audience, purpose, and context, especially ensuring communication artifacts address audience needs. The testing environment, usability testing methods, and testing scenario (researching a topic) reveal complex relations among participant, researcher, environment, search results, and search interface including SERPs. Think-aloud narratives included in Participant 1 Usability Testing Transcript (Appendix E) and Participant 3 Usability Testing Transcript (Appendix H) show that "audience" is a concept with fluid meanings throughout the testing session.

In some cases, the researcher is an audience for questions about testing protocol. For example, Participant 1 shares that research topics from their classes are inadequate for use in the usability test as rationale for selecting the suggested research topic ("proposing to solve a public problem") rather than an existing topic from class: "Umm, the topics for our courses were too vague, I think…" Similarly, Participant 3 asks several questions about the testing process, revealing what appears to be insecurity about completing the testing tasks to the satisfaction of the researcher. Participant 3 asks, "Should I— uh, sorry, should I go ahead and like put it in the search now, or keep doing this?" and "Is it supposed to come up at the bottom when I put in a new…?" Throughout their think-aloud narratives, both participants appeared to consider the researcher as a primary audience of their testing, seeking to ensure they completed testing tasks correctly and as required.

In some case, the search interface was an audience they addressed, either directly or indirectly through statements and questions addressed to the researcher. At one point during the testing session, Participant 1 misspelled a search term in a search phrase and completed the search without correcting the term. The following exchange, addressed to the researcher, reveals surprise at the search interface's treatment of the misspelled term. "I misspelled 'Puerto Rico' for the third time. It actually ruined my search, that's really funny, I would expect them to be more Google-esque." Note the personification of the search interface and its algorithmic matching processes as "them." While this use of "them" represents a figure of speech in which people refer to networks and technology using third-person neutral pronouns, it also reveals a clear sense that the interface is responding as a receptor and processor of search terms. The participant's complaint identifies an expectation of the interface as audience—that it should "be more Google-esque," which appears to be a reference to Google's ability to suggest search results based on

recognizing common misspellings—and disappointment in the interface's inability to respond as expected. Participant 3 also experienced similar disappointment, or at least surprise, at the way the search interface responded as an audience to their search actions. At one point, Participant 3 selected a source that generated a popup window. The participant remarks, "I'm going to close this ad out. I don't need that." In the context of the activity occurring on screen, the popup window is clearly an unexpected distraction. While popups are certainly a frequent experience of daily browsing, Participant 3 appears disappointed at the use of popups in the context of academic search, which reflects an unmet expectation from the interface as audience of their search activity.

In some cases, the participant reveals a sense of being an audience of the search interface, suggesting a role reversal as the algorithm-centered processes of search matching and relevance sorting appears to take primary agency in the research process. When Participant 1 received search results that were very different from what was expected, they expressed disappointment with the programmed agency of the search engine.

> I would expect more—well, I guess I'm not familiar enough with this system to understand where it's pulling sources from but when it says articles, for example, I would expect them to have, I mean, everything—CNN, or whatever else, as well, and I, I would just expect way more headlines and what-not to be appearing up here.

This brief response suggests both a lack of familiarity as an agent in the search process, but also a disappointment with the agency of the search interface. The participants appears disappointed that the search process isn't indexing appropriate results and that the results provided are not related to their understanding of the topic as entered into the search interface. Similar, Participant 3 found results from searches to be inadequate. As the participant reviewed results from one of several searches on a broad keyword ("deforestation"), they expressed disappointment with the results provided: "Um, so I'm looking here, and I don't see—it's not a good—so let me keep

looking—and search it again." In the context of the testing session, this passage reveals a sense that the search interface is to blame for the lack of relevant results. While such a response is certainly a common practice for novice (and perhaps not-so-novice) researchers, it reflects a shifting understanding of the searcher's role in research—from agent of search to audience of search results.

This analysis of audience and context in these brief think-aloud narratives produces results that are not unexpected. They reveal in microcosm the complexity of identifying and tracing agency in online research. If agency is shared among researcher and interface (with interface as an approximate proxy for the technological and ideological entities in assemblage agency), the audience of agency must likewise be shared. Restated in Burke's terms, agent and agency shift, and even trade places, in online research scenes. Since think-aloud narratives can be synchronized with specific timestamps in the research process, rhetorical analysis of these narratives offers a useful method for identifying where agency resides at the moment specific utterances are made.

4.3.2 Post-Test Survey Responses

The post-test survey questions sought to elaborate on the potential influences literacy and prior experience may have had on participant research activity. Participants' individual responses to the survey questions are provided as Appendix D. The responses reveal several key aspects of the participants' information literacy:

1. Participant 1 had "not used the OneSearch tool prior to" this usability testing session. Participant 3 had "used this search tool many times" prior to this usability testing session and reported having an "intermediate level" of experience with the search interface.

2. Participant 1 appeared to have a general understanding of online search related concepts like web “usability” and search “relevance.”
3. Participant 3 described the testing environment as follows: “Small, a little noisy, 4 people with someone working in the other side of the room. Cold, rainy day.” These details may reveal discomfort with the environment, and may inform some of the mapped terms used during think-aloud narratives.
4. Participant 1 reported using other online accounts regularly (three Google accounts, a Facebook account, and a Reddit account), which suggests extensive online experience with search-related tools.

Additionally, responses to question four in the post-test survey reveal that each participant brought to the topic a particular attitude. Participant 1 brought to the search topic an attitude of shame: “I am interested in this topic [the recent Puerto Rico Power Outage crisis] because I am so incredibly embarrassed by our country's formal(?) [sic] response & relief efforts.” This attitude may have influenced the approach Participant 1 took in conducting the search, in determining whether the search was successful, and in selecting (and not selecting) results during the research session. This statement also reflects a sense of expectation about results (as revealed in the think-aloud protocol) that was either confirmed or thwarted as a result of research results. Importantly, this response also reveals the personal ideologies that may be brought into a research session, used to filter or otherwise prioritize results beyond algorithmic filtering and priorities in the SERP.

Participant 3 brought to the search topic an interest in learning more about the topic: “I researched the impacts of deforestation. I searched for a more vague article that broadly shows the details and definitions of deforestation.” This desire to reveal the “details and definitions of

deforestation" represents a specific approach to the initial steps of research as a learning activity, revealing a relatively advanced understanding of the need to research broadly in secondary sources before identifying primary resources around a specific aspect of the topic. It also reflects a specific approach used to identity useful sources, an approach that may not work in the same way algorithmic relevance sorting might order SERP results.

4.3.3 Environment Observations

During the usability testing sessions, I collected observations describing the environment and the participants. Following each session, I wrote reflective notes on the experience. A transcript of these handwritten observations and reflections are provided for both pilot study (Participant 1 only) and the focus group as Appendix B. Because these observations are not aligned with timestamps from the usability test, they do not provide specific insight into potential direct influences on the participant's research activity. Broadly considered, however, environmental conditions necessarily influence participant activities. Adhering to Thomas Rickert's (2013) understanding of the material ambience of rhetorical activity, this dissertation considers the rhetorical influence of material and nonhuman activity by attuning to conditions in and surrounding the testing environment. Rickert claims that

> what matters, ultimately, is how a particular object fits with other objects into a pattern of life, that is, the characteristics marking a particular culture or dwelling practices of a community…. It is never just the thing itself rather, it is the thing both caught up in the situation and its withdrawal from that situation. (p. 23)

During these testing sessions, the usability test and research activity represented "the thing" embedded in the situation of the testing environment. The testing environment included the room in which the testing was held (an English department graduate and faculty study lounge and workspace) and its temperature, lighting, noise (both internally and externally sourced), furniture, and inhabitants. Aspects of the testing environment had the potential to influence

testing results. Room temperature can make work comfortable or uncomfortable, requiring extra clothing or causing shivers or sweating. Room furnishings can be soft and accommodating, hard and cramped, or something in between. Noise within and from outside the testing environment can enable focus or prove a distraction, and the room's design itself may provide a warm vibe, a cluttered disconnection, or a clinical coldness. For both pilot study and focus group, the conditions of the testing room were cramped but temperate. The room was filled with tables holding computer workstations on two walls, the third wall included a dorm-size refrigerator and entryway, and the fourth wall consisted largely of blind-covered windows. Figure 4.3 depicts the testing environment during the pilot study including Participant 1; furnishing and lighting in the testing room were nearly identical for the focus group with the exception that three participants and the researcher were spread among the computer workstations finding room for their own laptops.

Figure 4.3. Overview of the testing environment. Computers cover two walls, the photo is taken from the third wall entryway, and the fourth wall is largely filled with blind-covered windows. Photo by author.

In the pilot study and in the focus group, participants sat at workstations that contained a large monitor and keyboard. The researcher sat at a nearby workstation next to participants, also containing a large monitor and keyboard. At the participants' workstations, the monitor and keyboard were pushed back on tables to make room for participants' laptops (see Figure 4.4 with Participant 1 for an example of the conditions).

Figure 4.4. Participant 1 at workstation with personal laptop in front of large monitor and keyboard. Researcher's workstation is situated next to the participant. Photo by author.

As Figure 4.4 depicts, Participant 1 was cramped in a small workspace that was not designed for BYOD (bring your own device) work. Similarly, the three participants in the focus group found workspace in the computer lab, but none had a comfortable amount of space for working. Since I was providing support for all three participants simultaneously during the focus group, I was only able to sit still after all three were deeply engaged in their research activities. My active presence, frequent vocal interruption to instruct or clarify, and regular interactions with

participants made the small space noisier than usual; rarely did Participant 3 work in focused silence or with dedicated attention from me.

During the pilot test, the environment was comfortably cool without requiring a jacket, although both Participant 3 and researcher wore long sleeves for comfort. Lighting was provided by fluorescent fixtures combined with outside light filtered through mostly closed blinds (see Figure 4.5). During the focus group, rain outside resulted in cooler, clammier conditions in the testing environment along with cloud-filtered light filtering through the (still mostly closed) blinds.

Figure 4.5. Blinds-covered windows filtering out direct sunlight. Photo by author.

The testing room adjoins a lounge space in which a graduate student works and into which other graduate students and faculty can enter any time the room is open. The door from this adjoining room to the main hallway is open, so sounds from people walking outside the room could be heard at various times during the testing sessions. The sound of the refrigerator compressor cycling on and off could be heard periodically throughout all testing session, and the sounds of the elevator arriving, signaled by an audible *ding*, could be heard as people arrived and departed

the floor by elevator. Despite these observed sounds, Participant 1 described themselves as "probably the noisiest person around."

Despite cramped, often noisy testing conditions during the focus group, I collected the following observations about the testing session, focused directly on Participant 3 but including some general statements about the testing environment as a whole.

Environmental Conditions

- Muggy and cool, raining outside
- Sound of refrigerator humming in the background, sometimes rattling
- Graduate student working in next room
- Cloudy light from partially closed blinds mixed with fluorescent overhead lights
- Seated at cramped workstation, using personal laptop in front of desktop monitor and keyboard
- Regularly talking at the same time as other participants and principal investigator leading testing session

Participant Conditions

- Arrived early and left later
- Unsure and nervous at first, but engaged and interested as the project was described
- Conscientious about completing research task
- Asked questions about next steps

Technological Conditions

- Unable to access MonarchODU network, connected to Eduroam, a slower network
- Using Windows, experienced slower experience throughout the testing session, especially on Ad Checker and downloading TryMyUI app

- Unsure how to use flash drive and save files in a known location for retrieval on personal laptop
- Appears to be Chrome user
- Did not have other major apps running or music playing during testing session

Reflective Observations

Following the testing session, I reflected on the testing session environmental conditions and wrote reflective observations about the testing session. These brief reflections are collected below and detailed in Appendix B:

- Group testing session did not enable one-on-one assistance
- My voice remained a constant hum in the background
- Group setting produced a very different vibe [from the pilot test]. There was noise throughout, and not sure any of the reading can be clearly heard on recording.
- I was sweating and nervous throughout the session; participants were calm but unsure about what they were doing or how to do it

4.3.4 Ambient Sound

The audio recording of testing sessions captured not only participants' think-aloud narrative, but also ambient sounds. Table 4.13 identifies sounds at specific timestamps during the pilot test.

Table 4.13

Environmental sounds heard in the audio recordings of usability tests.

Participant 1	
Timestamp (hh:mm:ss)	Description of Sound
00:03:40	Background shuffling noise
00:03:42	Elevator chimes in background
00:04:11	Clicking/latching sound in background
00:04:20	Grinding sound in background
00:04:26	Clicking/latching sound in background
00:04:42	Voices in background
00:05:06	Dog barks in background
00:05:32	Background shuffling noise
00:05:56	Background walking sound from hallway
Participant 3	
Timestamp (hh:mm:ss)	Description of Sound
00:01:45	PI and P3 and P4 converse
00:03:37	PI and P4 converse loudly in background
00:04:15	PI and P5 converse loudly in background
00:04:34	PI and P3 talk through testing and search procedure
00:05:26	PI and P4 converse loudly in background
00:10:13	PI and P5 converse loudly in background
00:11:12	PI converses with P4 and P5 quietly in background
00:11:53	PI and P5 converse loudly in background
00:13:13	PI and P5 converse in background

In addition to these ambient noises captured by the audio recording, the sounds of typing and trackpad clicks can be heard throughout both pilot study and focus group usability testing sessions; the sound of a refrigerator compressor cycling on and off, often rattling, occurred periodically; and sounds from the adjoining room, where graduate students were working, and adjacent hallway, where people arrived and departed on the elevator and walked through the halls; all intruded on the testing environment.

The significance of environmental conditions during the usability testing should not be overestimated, but they should be considered. Ambient rhetorical influence represents an important aspect of posthuman studies of rhetoric, identified largely with Rickert (2013). The material embodiment of rhetorical activity represents an area ripe for exploration, and this study seeks to contribute to that exploration. Tracing the rhetorical agency of assemblages comprised of human and nonhuman agents necessarily requires careful inspection of environmental conditions as potential influences on the rhetorical activity of online search. It is this careful inspection that yields findings discussed in the next section.

CHAPTER 5

DISCUSSION

This chapter closes the two-chapter focus on what Johnson-Eilola and Selber (2013) call *developing problem knowledge*: describing the results of the study and explaining their significance in the field of technical communication. Chapter 4 presented results of the pilot test and the focus group portions of this study, framed the results as a case study involving two participants, and introduced findings from the case study. This chapter reflects on the problem of methods in posthuman approaches as revealed during the study sessions described, explains why these results matter to the field and how they might be incorporated into future study, and suggests implications these results might have to user experience studies and usability testing in technical communication.

Placing disparate data types in conversation with one another presents significant challenges to existing methods of rhetorical study. The results in Chapter 4 offer interesting, perhaps even useful, data points, but they do not explain in adequate detail the connections among the data. This section seeks to make explicit those connections and, in doing so, demonstrate their relevance to the field of rhetorical studies broadly, and to technical communication specifically.

5.1 THE TIMELINE

Tracing rhetorical agency requires establishing a timeline on which agentive activity can be placed and agency identified. Agency emerges along this timeline. Usability testing provides the tools needed to establish this timeline, to identify participant activity, and to provide context to that activity by showing screen activity and recording think-aloud narrative and ambient sounds. The more technical approach of saving and analyzing HAR files provides the tools

needed to recognize the activity of hardware, software, networks, and servers throughout the process, while the usability test timeline can be synchronized to the HAR timeline to draw relations among technological and human activity. Because the usability test records a research session, the results of entering specific search strings as queries are captured. These search string and result pairs, and especially search results selected by the participant, provide evidence of algorithmic indexing and selection activities and enable reverse engineering of the algorithmic processes that affect search results. The timeline of the usability tests by Participants 1 and 3 is basic, and consists of a test start and test end time (see Figure 5.1).

Figure 5.1. Basic timeline of the usability test by Participants 1 and 3. Elapsed time is listed in hh:mm:ss (2-digit hour, 2-digit minute, 2-digit second) format.

5.2 TRACING PARTICIPANT ACTIVITY

The purpose of usability testing in this study was not to determine the usefulness or effectiveness of a webpage to its users. However, tracing agency assembled over time across

participant and technological activities requires a recording of participant activity in relation to technology. The usability test enables mapping participant activity in the research process at specific timestamps. Table 5.1 places specific research activities completed by Participant 1 into chronological order along the timeline depicted in Figure 5.1. Similarly, Table 5.2 places specific research activities completed by Participant 3 into chronological order along the timeline depicted in Figure 5.1.

Table 5.1

Participant 1 search activity mapped to the usability test timeline. Represents basic search activity.

Timestamp (elapsed)	Activity
00:00:00	Start of test recording
00:00:49	Opens ODU Library page
00:04:22	Describes research question/task
00:04:57	Conducts first search
00:05:21	Reviews search results
00:06:00	Sees need for more recent results
00:06:32	Conducts second search
00:07:04	Sees need for power grid results
00:07:31	Conducts third search
00:07:35	Sees search yields no results
00:08:01	Conducts revised third search
00:09:07	Select SERP result #1
00:09:20	Expresses confusion about results
00:10:01	Conducts fourth search
00:10:31	Selects “Open” for SERP result #3
00:11:32	Selects LexisNexis for SERP result #3
00:11:46	Selects MonarchKey access option
00:11:47	Logs in to Shibboleth access
00:11:53	Accesses selected resource
00:13:30	End of test recording

Table 5.2

Participant 3 search activity mapped to the usability test timeline. Represents basic search activity.

Timestamp (elapsed)	Activity
00:00:00	Start of test recording
00:01:37	Opens ODU Library page
00:04:34	Discusses research question/task with PI
00:05:20	Conducts first search
00:06:35	Reviews results, reflects on quality
00:07:00	Selects SERP result
00:07:45	Selects “Open” for SERP result
00:07:52	Selects Elsevier for SERP result
00:07:56	Selects MonarchKey access option
00:08:00	Logs in to Shibboleth access
00:08:11	Expresses disappointment in result
00:08:44	Loads PDF of SERP result
00:11:03	Conducts second search
00:11:10	Reviews results
00:11:25	Uses tools to refine results
00:12:02	Selects SERP result
00:12:23	Selects Sage Knowledge for SERP result
00:12:29	Sees need for more specific results
00:12:42	Repeats second search
00:13:05	Reviews second search results again
00:13:36	Selects SERP result
00:14:13	Attempts to open full text; network slows
00:15:45	Conducts third search
00:15:58	Selects SERP result
00:17:02	Accesses PDF of selected result
00:19:37	End of test recording

Participant activities depicted in Tables 5.1 and 5.2 represent basic search actions:

1. Opening the search page
2. Identifying a research topic/question

3. Completing the iterative process of:
    a. Entering search terms
    b. Reviewing search results for relevance
    c. Revising search terms to narrow results
    d. Identifying a relevant result
    e. Accessing the result using single sign-on (SSO) credentials
    f. Reading the result to determine its applicability to the research topic/question
4. Selecting the result as relevant and ending the search session

The research activity traced in Tables 5.1 and 5.2 reveals that two participants can have two different approaches to conducting research. Participant 1 methodically reviewed each SERP for relevance before revising or revisiting a search, but Participant 3 selected a result before fully evaluating its match to research needs. While these results are beyond the scope of this dissertation, it's important to recognize that users' preferences for conducting online research will necessarily influence the results of a study seeking to measure or identify agentive activity among technological actors. The assemblage agency that emerges from the research activity will necessarily be influenced by different user approaches to research. In this case, the two different approaches required careful attention to the relationship between HAR files generated and participant activity.

5.3 TRACING BROWSER ACTIVITY

The research process timeline includes not only participant activity, but also a large number of browser activities, captured by the HAR files. Appendix F provides a timeline of all HAR files and Appendix G provides a comprehensive timeline of all browser activities for Participant 1; Appendix I provides a timeline of all HAR files and Appendix J provides a

comprehensive timeline of all HAR files for Participant 3. For each participant activity, there are related browser activities. For example, when Participant 1 loads the search page—the first action in the timeline, at elapsed time 00:00:49—60 individual browser actions start running as captured by the HAR file (archive01.har). Table 5.3 reveals the 60 browser actions initiated by opening the search page, all of which occur within the span of 1.816 seconds. The results of HAR file activity are quite similar for both Participant 1 and Participant 3. For ease of reading, only browser activity collected for Participant 1 will be listed for the remainder of this section.[11]

Table 5.3

Participant 1 activity overlaid with example of browser activity captured in archive01.har.

HAR Timestamp	Browser Activity
17:46:26.645	Start loading page
17:46:26.681	GET http://odu.edu/library
17:46:26.703	GET https://code.jquery.com/jquery-3.2.1.min.js
17:46:26.704	GET http://odu.edu/etc/designs/odu/clientlibs/libs/slick.min.css
17:46:26.704	GET http://odu.edu/etc/designs/odu/clientlibs/libs/fontawesome4.min.css
17:46:26.704	GET http://odu.edu/etc/designs/odu/clientlibs/libs/slick.min.js
17:46:26.704	GET http://odu.edu/etc/designs/odu/clientlibs.min.js
17:46:26.704	GET http://odu.edu/etc/designs/odu.css
17:46:26.704	GET http://odu.edu/etc/designs/odu/clientlibs/libs/jquery-migrate-3.0.0.min.js
17:46:26.704	GET http://odu.edu/etc/designs/odu/clientlibs.min.css
17:46:26.705	GET http://odu.edu/library/_jcr_content/par/columns_2/column_0/image.img.280.jpg/1449783741833.jpg
17:46:26.705	GET http://odu.edu/library/_jcr_content/par/columns_2/column_1/image.img.280.jpg/1449783679618.jpg
17:46:26.705	GET http://odu.edu/library/_jcr_content/par/columns_2/column_2/image.img.280.jpg/1403193539167.jpg

[11] The differences in HAR file activity for Participants 1 and 3 are revealed in the order of their browsing and the content of their search. The activity of opening the ODU Library webpage is a standard and largely universal activity for any user, although differences in the content of specific components of each network call (represented by individual rows in Table 5.3) are discussed in Chapter 4.

Table 5.3 continued

HAR Timestamp	Browser Activity
17:46:26.705	GET http://odu.edu/library/_jcr_content/par/columns_3/column_0/image.img.280.jpg/1499270287471.jpg
17:46:26.705	GET http://fonts.googleapis.com/css
17:46:26.705	GET http://odu.edu/etc/designs/odu/images/odu-crown-breadcrumb-home.png
17:46:26.706	GET http://odu.edu/library/_jcr_content/par/columns_3/column_1/image.img.280.jpg/1449695872727.jpg
17:46:26.706	GET http://odu.edu/etc/clientlibs/wcm/foundation/accessibility.min.css
17:46:26.706	GET http://odu.edu/library/_jcr_content/par/columns_0/column_0/image.img.280.jpg/1427397845012.jpg
17:46:26.706	GET http://odu.edu/library/_jcr_content/par/columns_0/column_1/image.img.280.jpg/1427400245315.jpg
17:46:26.706	GET http://odu.edu/library/_jcr_content/par/columns_0/column_2/image.img.280.png/1447370819220.png
17:46:26.706	GET http://odu.edu/library/_jcr_content/par/columns_3/column_2/image.img.280.jpg/1485280513691.jpg
17:46:26.707	GET http://odu.edu/library/_jcr_content/rightpar/section/columns/column_0/image.img.40.png/1414161379932.png
17:46:26.707	GET http://odu.edu/library/_jcr_content/rightpar/section/columns/column_1/image.img.40.png/1414161412427.png
17:46:26.707	GET http://odu.edu/library/_jcr_content/rightpar/section/columns/column_2/image.img.40.png/1414161438916.png
17:46:26.708	GET http://odu.edu/settings/_jcr_content/footer-parsys/columns/column_1/image.img.200.png/1476516137858.png
17:46:26.975	GET https://platform.twitter.com/widgets.js
17:46:26.976	GET http://connect.facebook.net/en_US/all.js
17:46:27.017	GET http://fonts.gstatic.com/s/opensans/v15/cJZKeOuBrn4kERxqtaUH3ZBw1xU1rKptJj_0jans920.woff2
17:46:27.017	GET http://odu.edu/etc/designs/odu/images/logo-university.png
17:46:27.018	GET http://fonts.gstatic.com/s/opensans/v15/MTP_ySUJH_bn48VBG8sNShampu5_7CjHW5spxoeN3Vs.woff2
17:46:27.019	GET http://odu.edu/etc/designs/odu/clientlibs/libs/fontawesome4/fonts/fontawesome-webfont.woff2
17:46:27.020	GET http://odu.edu/library/_jcr_content/headerimage.img.1280.jpg
17:46:27.038	GET http://odu.edu/etc/designs/odu/images/disc-1.gif
17:46:27.039	GET http://fonts.gstatic.com/s/opensans/v15/k3k702ZOKiLJc3WVjuplzBampu5_7CjHW5spxoeN3Vs.woff2
17:46:27.044	GET http://odu.edu/content/dam/odu/images/webadmin/images/search.png
17:46:27.068	GET https://connect.facebook.net/en_US/all.js
17:46:27.094	GET http://odu.edu/library/_jcr_content/rightpar/section_1159742434/listplaces.nocache.html
17:46:27.096	GET http://odu.edu/library/_jcr_content/rightpar/section_1890638568/listplaces.nocache.html
17:46:27.097	GET http://odu.edu/library/_jcr_content/rightpar/section_1390515182/listplaces.nocache.html
17:46:27.098	GET http://odu.edu/library/_jcr_content/rightpar/section_1561465455/listplaces.nocache.html

Table 5.3 continued

HAR Timestamp	Browser Activity
17:46:27.099	GET http://odu.edu/library/_jcr_content/rightpar/section_782371188/listplaces.nocache.html
17:46:27.100	GET http://odu.edu/library/_jcr_content/rightpar/section_891662689/listplaces.nocache.html
17:46:27.158	GET http://www.googletagmanager.com/gtm.js
17:46:27.377	GET http://odu.edu/content/odu/search/a-to-z-global.html
17:46:27.553	GET http://www.google-analytics.com/analytics.js
17:46:27.590	GET https://platform.twitter.com/widgets/widget_iframe.34f1d98fbddc2d328cb7fb206fcd1806.html
17:46:27.607	GET https://www.google-analytics.com/analytics.js
17:46:27.610	GET http://script.crazyegg.com/pages/scripts/0034/9379.js
17:46:27.754	GET https://www.facebook.com/impression.php/f37f23cf7d668b/
17:46:27.779	GET http://www.google-analytics.com/collect
17:46:27.817	GET https://syndication.twitter.com/settings
17:46:27.869	GET https://www.google-analytics.com/collect
17:46:27.956	GET https://staticxx.facebook.com/connect/xd_arbiter/r/lY4eZXm_YWu.js
17:46:27.958	GET http://staticxx.facebook.com/connect/xd_arbiter/r/lY4eZXm_YWu.js
17:46:27.971	GET https://staticxx.facebook.com/connect/xd_arbiter/r/lY4eZXm_YWu.js
17:46:28.079	POST https://syndication.twitter.com/i/jot
17:46:28.208	GET https://platform.twitter.com/jot.html
17:46:28.460	GET https://www.facebook.com/connect/ping
17:46:28.461	GET http://staticxx.facebook.com/connect/xd_arbiter/r/lY4eZXm_YWu.js
17:46:28.461	GET https://staticxx.facebook.com/connect/xd_arbiter/r/lY4eZXm_YWu.js

Note: Each line of activity depicted in the Browser Activity column is related to the single participant research activity of opening the ODU Library page,

For each participant activity related to search depicted in Tables 5.1 and 5.2, a HAR file is generated that displays browser activity. Each HAR file generated can be traced to a point on the usability test timeline. For example, the browser activities depicted in Table 5.3 can be traced back to the initial search activity of Participant 1 in the usability test timeline, starting at elapsed time 00:00:49 in the test.

Within each of the browser activities depicted on each row in Table 5.3—counting one browser action per line—there is a request made by the browser to a server specified in the activity line and a response from the specified server back to the browser. The *request* contains metadata about the browsing session and the request, while the *response* contains both metadata and content of some kind. Depicting the level of detail available in both requests and responses challenges the dimensions of a printed publication, but Table 5.4 highlights the request contents for a single browser action from the Table 5.3, the action "GET https://code.jquery.com/jquery-3.2.1.min.js" at HAR timestamp 17:46:26.703 (hh:mm:ss.mss) in the second row of data. This request is made 22 milliseconds following the request for the search page.

Table 5.4

*Detail of a single browser request for a standard Javascript library file, the JQuery Core Library, minified (*jquery-3.2.1.min.js*) from jquery.com.*

General	
Field Name	Value
Request URL	https://code.jquery.com/jquery-3.2.1.min.js
HTTP Version	http/2.0
Request method	GET
Remote Address	151.139.237.113
Headers	
Field Name	Value
authority	code.jquery.com
method	GET
path	/jquery-3.2.1.min.js
scheme	https
accepts	*/*
accept-encoding	gzip, deflate, br
accept-language	en-US,en;q=0.9,fa;q=0.8
cache-control	no-cache
pragma	no-cache
referrer	http://odu.edu/library
user-agent	Mozilla/5.0 (Macintosh; Intel Mac OS X 10_13_2) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/63.0.3239.132 Safari/537.36
Size	
Field Name	Value
headers (computed)	460 bytes
body	0 bytes
total (computed)	460 bytes

The request depicted in Table 5.4 identifies the destination to which the request is sent (Request URL), contains a number of HTTP headers sent along with the request; these headers "define the parameters of an HTTP transaction" ("List of HTTP Header Fields," 2018). The particular purpose of each of these field/value pairs is beyond the scope of this study, but is readily available online. The request for this asset was made by the browser on behalf of Participant 1 as

part of the process of loading the search page. The specific request for this specific asset, the JQuery core library version 3.2.1.min, was made as a result of the web browser software reading the HTML file, library/index.html, and processing the following command encoded in the HTML head area:

<script src="https://code.jquery.com/jquery-3.2.1.min.js"></script>

It's critical to recognize that HTML code written by a developer far removed from the search experience of Participant 1 included the command to request the JQuery library. The participant did not make this request, nor was the participant aware that the request had been made by the browser on their behalf. The browser is acting on its programming, but that programming is beyond the awareness or recognition of the participant loading the search page.

While Table 5.4 depicts the request submitted by browser action initiated by Participant 1, Table 5.5 depicts the response received from the server to the request. Before presenting this depiction, it's important to reflect on the anatomy of the process outlined by the browser actions depicted in Tables 5.1-5.4.

1. Searcher enters URL/visits webpage
2. Browser software initiates a request for the HTML file
3. Reading the HTML file, the browser initiates asset requests encoded in the HTML
4. Each asset request is submitted to a server or local destination; the request includes content encoded into HTTP headers
5. Each request receives a response (which may include a response that the asset could not be found); the response includes content that is likely displayed or encoded in the page loaded

The response from the jquery.com server in this example is depicted in Table 5.5.

Table 5.5

Detail of a single server response from jquery.com to the request depicted in Table 5.4.

Full Response	
Field Name	Value
200 OK	http/2.0
Headers	
Field Name	Value
access-control-allow-origin	*
cache-control	max-age=315360000
cache-control	public
content-encoding	gzip
content-type	application/javascript; charset=utf-8
date	Wed, 24 Jan 2018 17:46:26 GMT
etag	W/"58d026fb-15283"
expires	Thu, 31 Dec 2037 23:55:55 GMT
last-modified	Mon, 20 Mar 2017 19:01:15 GMT
server	NetDNA-cache/2.2
status	200
vary	Accept-Encoding
x-cache	HIT
Size	
Field Name	Value
Headers (computed)	420 bytes
Body	86659 bytes
Total (computed)	87079 bytes

The “Body” referenced above under “Size” reflects the size of the content of the response from jquery.com to this single request from the browser of Participant 1. Table 5.5 lists the metadata for the response; the actual response is an 86 kilobyte script too lengthy to include here. The server response includes the status code “200 OK,” which is the “standard response for successful HTTP requests” (“List of HTTP Status Codes,” 2018) along with header, cache, and size metadata. This response data is received and interpreted by the browser, but is not visible to

Participant 1. The browser's programming enables it to interpret the HTTP status code received from the jquery.com server and to accept the content that is sent from the server. In this case, the actual content sent by the server to the browser is the *jquery-3.2.1.min.js* file, a JavaScript file that enables JavaScript objects and actions to be encoded in other parts of the search page HTML[12]. At most, Participant 1 may recognize the enhanced usability that loading the JQuery Core library affords in the search experience, but little of the actual content of the jquery.com server response will be visible to the participant.

The detail of browser activity presented in this section serves the purpose of depicting the remarkable amount of activity occurring outside the awareness of the participant during the search session. The activity detail provided in the preceding paragraphs and tables represents the activity of a browser request and server response happening in the elapsed time of less than a second. This process is repeated for every single browser request/server response pair captured in the HAR files generated during the usability test with each participant. To recognize the scale of browser activity occurring during each testing session, it's possible to calculate the number of browser request/response pairs processed during each usability testing session:

- In the eight HAR files captured during the usability test completed by Participant 1, over the test's elapsed time of 13 minutes, 30 seconds, 599 browser request/server response pairs were processed, each generating request metadata and response metadata and content in the search interface. On average, that's 1.35 request/response pairs per second.

[12] It's useful, but beyond the scope of this study, to recognize the potential influence of loading this or any other library or asset. The code of the jquery library governs a number of potential browser-based activities, as does any other JavaScript file. Such files loaded by the browser are also enacted by the browser, enabling a seemingly endless number of unseen browser actions. Furthermore, each library or asset can be traced by third-party providers, which adds a massive layer of hidden activity to the browsing session.

- In the six HAR files captured during the usability test completed by Participant 3, over the test's elapsed time of 19 minutes, 37 seconds, 692 browser request/server response pairs were processed, each generating request metadata and response metadata and content in the search interface. On average, that's 1.70 request/response pairs per second.

This activity occurs beyond the recognition or awareness of each participant, programmed as the procedure by which browsers send and receive data across networks. While the activity of the browser in connection with servers is initiated by participants, the activity beyond initiation is limited to the hardware, software, networks, and services that provide the content of the webpage to participants for use. This represents an assemblage of technical and human actors engaged in the meaning-making activity of opening a webpage. While we may not immediately recognize opening a webpage as a rhetorical act, this project's approach to rhetorical agency suggests that the activity of humans and technologies working together to make meaning—in this case, to open a webpage that can be meaningfully experienced by a user—is agentive and therefore rhetorical. In terms Miller (2007) might appreciate, agency emerges from the kinetic energy of opening the webpage for its use in search.

5.4 TRACING CORPORATE ACTIVITY

Included among the 599 browser request/server response pairs captured during the Participant 1 usability test and the 692 browser request/server response pairs captured during the Participant 3 usability test are requests to corporate entities beyond the library and university servers. One such example, the request for the JQuery Core library (*jquery-3.2.1.min.js*), has already been addressed in terms of its influence on the participant's search experience. However, this request also generates data for its owners; in this case, calling the library from the jquery.com server appears to generate data collected in Google Analytics that can be used by the

owners of jquery.com to examine use patterns and domains requesting the JQuery Core library. In this case, the activity of corporate owners cannot be captured or traced directly in the HAR file, but tracing the JQuery Core library to its domain, code.jquery.com, and using the WASP.inspector (Web Analytics Solution Profiler) plugin for Chrome Developer Tools, enables a clearer sense of corporate activities embedded in the request for and response from the JQuery Core library. In this case, WASP reports that Google Analytics is recording access to the JavaScript and tracking the file's use via cookies *_utma*, *_utmz*, *_utmb*, and *_utmc*.

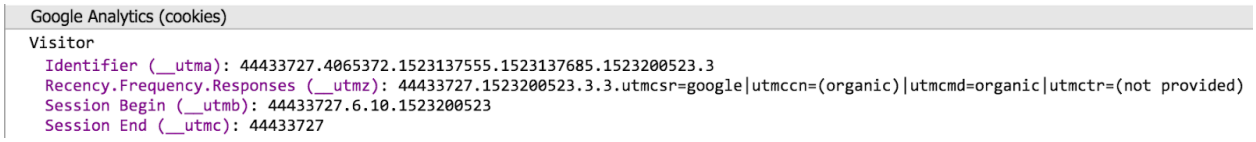

Figure 5.2: Google Analytics cookies tracked during *jquery-3.2.1.min.js* access, as reported by the WASP.inspector Chrome Developer Tools plugin. WASP. (n.d.). *Report on code.jquery.com*, run May 23, 2018, using WASP.inspector plugin for Google Chrome Developer Tools. Screenshot by author.

The Google Analytics information shown in Figure 5.2 reveals that the domain owner of jquery.com is using the Google Analytics web metrics tool to measure traffic and user interactions with content on its domain. This suggests that JQuery and Google corporate interests have combined efforts to measure activity coming to and from the jquery.com domain. This activity, traced from the original HAR files, indicates that beyond the HAR files, each browser request may also involve corporate activities outside the library and university domain.

Additional evidence that domains, and their parent corporate interests, are engaged in the participant's search experience can be found in the non-ODU domains requested by the

browser. In the 1,304 browser request/server response calls captured from Participant 1 and Participant 3 HAR files, requests for a number of non-ODU domains are made by the browser, depicted in Table 5.6.

Table 5.6

List of domains requested (in order of numbers of requests) as reported by HAR files captured during Participant 1 and Participant 3 usability tests.

Participant	Domain	Corporate Owner	# Requests
P1,P3	exlibrisgroup.com	Ex Libris owned by ProQuest	660
P1,P3	odu.edu	Old Dominion University	372
P1	lexisnexis.com	LexisNexis owned by RELX	154
P3	proquest.com	ProQuest owned by Cambridge Information Group (CIG)	88
P1,P3	libraryh3lp.com	Nub Games	60
P1,P3	amazonaws.com	Amazon	36
P1,P3	jquery.com	Open source (JS Foundation: Linux Foundation)	33
P1,P3	facebook.com	Facebook	32
P1,P3	google-analytics.com	Google owned by Alphabet	22
P3	sciencedirect.com	Elsevier owned by RELX	21
P3	books.google.com	Google owned by Alphabet	17
P1,P3	twitter.com	Twitter	17
P1,P3	googleapis.com	Google owned by Alphabet	14
P1,P3	gstatic.com	Google owned by Alphabet	13
P1	translate.google.com	Google owned by Alphabet	12
P3	visualwebsiteoptimizer.com	Wingify	12
P3	cloudfront.net	Atlassian-managed on Amazon Web Services (AWS)	11
P3	elsevier.com	RELX	8

Table 5.6 continued

Participant	Domain	Corporate Owner	# Requests
P3	optimizely.com	Optimizely	8
P1,P3	doubleclick.net	Google owned by Alphabet	7
P1,P3	googletagmanager.com	Google owned by Alphabet	6
P3	cloudflare.com	Cloudflare	5
P3	adobedtm.com	Adobe	4
P1,P3	crazyegg.com	Crazy Egg	3
P3	go-mpulse.com	Akamai Technologies	2
P1,P3	googleadservices.com	Google owned by Alphabet	2
P1	azalead.com	Jabmo	1
P1	bizographics.com	LinkedIn	1

Note: Results sorted by # *Requests* column in descending order.

The assets requested from the domains requested in Table 5.6 are used for a variety of purposes. As noted earlier, the JQuery Core library enables a variety of JavaScript object and functions to be coded into the page. Fonts from Google (enabled by fonts.googleapis.com and fonts.gstatic.com) enable improved usability on the search page by implementing theme-based typefaces across the ODU web platform. Google Tag Manager centralizes management of tracking pixels, or tags, that report to specific marketing platforms and to Google Analytics. ODU Library domain owners have opted to implement Facebook, Twitter, and YouTube (also owned by Google) links on the library webpage and have also implemented tracking pixels on the page for marketing and marketing retargeting. Crazy Egg and Google Analytics are web metrics aggregators and reporting tools that help domain owners understand and measure traffic and user interaction across the domain.

The volume of domains outside the institution (odu.edu) engaged during usability testing is high, despite starting on the Old Dominion Library search page. As noted in the introduction, search functions across the collections and databases of an individual library will often incorporate partners. In this case, ODU has partnered with ProQuest to provide access through its Ex Libris service to resources available in both the ODU Library collection and in its subscription databases. This explains the vast number of browser requests/server responses to exlibris.com. After launching the ODU Library search interface, most activity occurs on exlibris.com pages branded as ODU pages. Each partner may have its own relationships with other partners, especially for web metrics. This explains the number of metrics and analytics companies included in Table 5.6, including cloudfront.net, googletagmanager.com, google-analytics.com, adobedtm.com, crazyegg.com, and more. While ODU's library may not engage these corporate entities, partners and their providers certainly do. In partnering with LexisNexis, RELX, and CIG (visible in these two tests) as content providers, the library also partners, or at least places researchers in relation with, additional corporate entities. Only deep excavation into browser activity reveals the extent to which corporate entities are engaged in research.

Each of the files requested by the browser from these non-ODU domains represent activities that are unseen by the participant. Furthermore, each sends data to, and receives data from, the domain server it contacts. This data is sent in the form of HTTP headers including URL parameters as well as cookies, depending on the asset requested and domain involved. One of the more communicative browser requests to a domain is the Google Analytics tracking pixel, which sends a number of URL parameters, called "query arguments," in its server request.

Query arguments:

- **v** 1
- **_v** j66
- **a** 166199117
- **t** pageview
- **_s** 1
- **dl** http://odu.edu/library
- **ul** en-us
- **de** UTF-8
- **dt** University Libraries - Old Dominion University
- **sd** 24-bit
- **sr** 1440x900
- **vp** 1190x826
- **je** 0
- **_u** QACAAAAB~
- **jid**
- **gjid**
- **cid** 1773575877.1510610468
- **tid** UA-2088428-1
- **_gid** 410272931.1516814987
- **gtm** Gc5MDTQZL
- **z** 267603653

Some of the query arguments passed as URL parameters in the request are self-evident, while others remain opaque. Regardless of their values, these parameters were not sent or initiated by participants in the usability test, but were in fact generated and sent as part of the request as a result of the domain owner implementing Google Analytics as a tracking tool on the search page itself. Here the corporate activity of the domain owner, in this case, Old Dominion University, is clearly visible: only the domain owner can authorize Google Analytics to track user activity on the page, and only the domain owner and designees can view the reports that Google Analytics provides.

5.5 TRACING ENVIRONMENTAL ACTIVITY

As convoluted and deeply embedded as corporate activities may be to trace, requiring an exploration of domain ownership and data sent from browser to server and back, the activity of the environment surrounding the usability test is even more challenging to trace. Identifying the environmental conditions and activities that might have an influence on the usability test is difficult, but not impossible. First, network condition is an environmental variable that has potential to affect the browsing session. When the elapsed time of browser and network activity is measured in milliseconds, any latency in network activity could slow the search process, frustrating the user and causing the potential for abandoning search altogether. Although Participant 1 did not experience severe networking slowing, Table 4.1 reveals significant variability in network speeds over the elapsed time of the usability test. Participant 3 did experience slow network access, likely the result of connecting to the Eduroam rather than MonarchODU wireless network. And while the audio and video recording of the usability test reveals no obvious effects from this network variability, it's possible for both case study participants to have altered search practices and browser use because of network lag.

Second, the testing environment—cool enough not to remove jackets, fluorescent lit, cramped workspace—did not have a visibly measurable impact on search activity. However, as any regular use of a laptop will attest, there are ideal use angles, heights, and spaces that make laptop use comfortable, and less ideal conditions to which users must adjust. Figure 4.4 reveals how cramped Participant 1 appeared to be, resulting in one-handed, rather than two-handed, browsing. Like network speed, it's difficult to identify a clear correlation between conditions in the testing environment and browsing habits.

Throughout the audio recording of the usability test, ambient noises loud enough to be caught on the participant's laptop microphone are audible. These noises, and the people in and around the testing environment, may have an influence on the participant's search activity. Appendix G, the comprehensive Participant 1 usability test timeline, identifies some of these sounds. Examples include "background shuffling noise" at elapsed time 00:03:40, "voices in background" at elapsed time 00:04:42, and "background walking sound from hallway" at elapsed time 00:05:56. The testing environment itself is part of an *L*-shaped room; if the testing computers pictured in Figure 4.3 represent the longer portion of the *L* shape, the shorter portion represents a space in which a graduate assistant was working throughout the testing session. The door to the *L*-shaped room opened to the hallway, as noted in the Results section, which enabled sound to carry from the hallway and elevator lobby into the test environment. Figure 5.3 offers an outline of the testing environment and demonstrates the ease with which ambient noises and background sounds could enter the testing space.

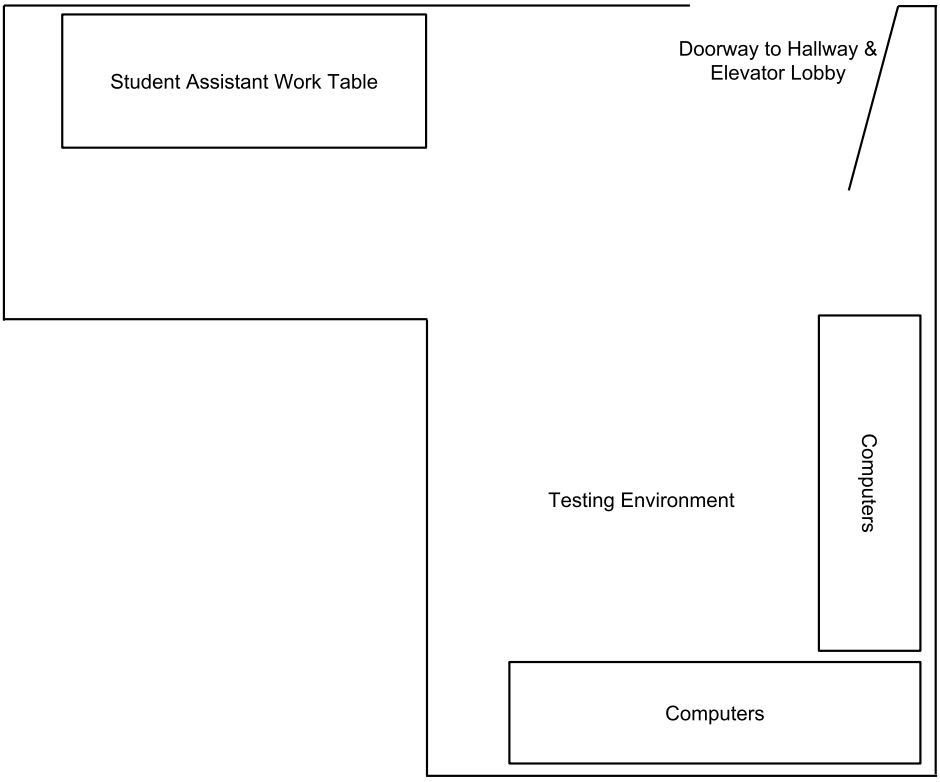

Figure 5.3: Testing environment diagram (not to scale) showing proximity of testing environment to open workspace and door open to hallway.

Because the room is open to English graduate students whenever a student assistant is present, at least one student stopped by to chat with the student assistant during the testing session. The sounds of this activity and these interactions made its way into the testing environment and had the potential, and perhaps even probability, to influence or affect the search session in some small way.

The same testing environment was used for the focus group including Participants 3, 4, and 5. Since all three participants were completing the test and vying for the PI's attention, the test results for Participant 3 include a much wider range of environment noise clutter—much of it in the form of the PI's voice attempting to support testing at three different test rates. Appendix

J, the comprehensive Participant 3 usability test timeline, identifies these sounds and reveals the interruptions and delays caused by conversations among participants and with the PI. A number of times an indecipherable but audible question gets asked by another participant, picked up by the Participant 3 microphone, that is followed by a sometimes more distinguishable response from the PI. At other times, Participant 3 is clearly seen on the usability testing video to be fumbling around, awaiting support from the PI who is providing audible instruction in the background to other participants. This note, recoded as part of the testing transcript, typifies several instances throughout the testing session. Text inside angle brackets (<text>) represents descriptions of what's seen and heard on the video. Indented text represents conversation happening simultaneously with non-indented text. Other text represents direct quotations by the speaker noted.

> <**P3** appears confused by the lack of developer tools at the bottom of the tab that opens with the search results. **P3** requests assistance from **PI**. While **P3** expresses confusion by shifting from the search interface tab to the results tab and back, **PI** is talking with **P4** and **P5**.>
> **P3**: Refresh this tab.
>
> **PI** <to P4>: If you'll go back. So. Keep going back. What I'd like for you to do is… you've read that already?
> **P4**: Yep.
> **PI** <to P4>: So now is where you actually do a search.
> **P4**: Ohhh.
> **PI** <to P4>: Once you've finished with that, go ahead and do a search. Perfectly fine.
>
> **P3**: I need to make sure
>
> **P4**: Oh. Ah. Okay.
> **PI** <to P4>: So just do your search, but tell me about what you're entering, why you're entering it.
>
> **P3** <to PI>: Is it supposed to come up at the bottom when I put in a new…
> **PI** <to P3>: It should have
> **P3**: Yeah, I was confused about that.

These brief snippets from two testing sessions demonstrate the indirect influence that environmental conditions can have on the research session. While aspects of the environment were certainly within the PI's power to control (like conducting individual rather than focus

group testing sessions), other aspects, like being unsure what to do next, having to wait one's turn for assistance and support, and working in a loud, intrusive, cramped environment, represent the conditions in which students conduct research. These results demonstrate the potential that environmental conditions may have to influence research practice and results. More importantly, the environment plays an active role in research activity, and as a result, should be considered as we work to make students aware of the actors beyond themselves at work in their research.

5.6 CONCLUSION

This dissertation set out to address three research questions using a problem-solving heuristic for technical communication presented by Johnson-Eilola & Selber (2013). The questions addressed are as follows:

1. To what extent can search algorithms, and the platforms, networks, and systems that support them, be considered rhetorical?
2. In the process of conducting research using online search engines, when and where does rhetorical agency emerge and how can its activity be traced?
3. What practical applications do the results of this study offer to researchers, teachers, programmers, and designers?

The problem this dissertation set out to solve was the problem of obscurity in black-boxed programmed procedures surrounding algorithm-centered activities of online research. The goal of the dissertation was to pry open this black box to uncover what has been described as the "rhetoric of algorithms" in order to demonstrate that algorithm-centered processes and procedures combine with researcher activities to generate rhetorical activity in the form of online research. The role of the conclusion is to determine whether and to what extent these questions, purpose, and goal have been addressed.

In mapping the problem, I sought to reveal the potential of rhetorical influence that resides in a number of components involved in online research.

- The research literacy of the researcher is rhetorical.
- The web-based interface of the search tool is rhetorical.
- The programmed activity and machine learning functions of algorithms are rhetorical.
- Advertising on SERPs is rhetorical.
- The ideologies of corporations and teams is rhetorical.
- The technological media of device and network are rhetorical.

By mapping the problem within the experience of a user's online research session, I was able to isolate aspects of algorithm-centered processes on which to focus study—namely, the human, technological, ideological, and environmental forces that exert influence on research activity.

In situating the problem, I brought rhetorical theory to bear on the research process. Burke's pentad offers a clear way to understand the interrelations of technologies and users, and their ideological and environmental influences, within the online research scenario. While individual components of research activity may be rhetorical, this dissertation seeks to further explore what makes the interrelations of users and technologies rhetorical. Latour's (2005) Actor-Network Theory (ANT) provides a useful theoretical framework for understanding the network activity among human and nonhuman actors as assemblage-oriented, focused less on individual actions than on the relations among actors in research activity. Rhetorical theorists have found much that is useful in ANT to explain rhetorical agency that emerges not from individual actors or activities, but from the interconnected activities of actors that emerge from networked relations. These theories suggest that rhetorical agency in online research activities resides in the assemblage activity emerging through the research process rather than from the

activities of individual actors involved in online research. While Burke's pentad remains a valid and useful theoretical approach to understanding rhetoric as assemblage-oriented, it does not address the primary question of where agency resides in assemblage activity, nor does it provide methods for studying that emergence.

In developing problem approaches, I reviewed literature and practice to determine whether methods for identifying and studying assemblage agency exist. The field of technical communication has developed strong user-centered methods for studying rhetorical agency in online activities. Usability testing, with its voice and video recordings, ethnographic observations, and open-ended surveys, offers researchers a clear and established methodology for studying user-centered rhetorical agency. However, while theories exist to explain the rhetorical agency of digitally networked images (Gries, 2016), ideologies (Brown, 2015), procedures (Bogost, 2010), and environments (Rickert, 2013), technical communication offers few clear methods for studying the agency of technologies or of their relations with human users.

In their editorial introduction to a recent special issue of *Technical Communication Quarterly* on technical communication methodologies, Brian McNely, Clay Spinuzzi, and Christa Teston (2015) divide contemporary methodological approaches available to technical communication scholars into three categories: sociocultural, associative, and new material. These categories offer a useful way to position my own approach. The sociocultural approach focuses attention on the material surroundings of communicators "because everyday activities are carried out and mediated by heterogeneous artifacts and tools" (p. 2). This sociocultural approach describes well my interest in prior search experiences, environmental conditions, and technologies used during the research search. McNely, Spinuzzi, and Teston (2015) identify the weakness of sociocultural approaches in "[assuming]… a purposeful human actor who retains

agency during processes of technical communication" (p. 4). My methodological approach seeks to address this shortcoming, as it becomes clear throughout research activity that users share agency with nonhuman actors. The associative and new material approaches identified in the article more clearly resonate with my approach. Associative approaches "analyze humans and nonhumans as parts of intersubjective systems across which agency and motives are stretched" (p. 4), while new material approaches

> share a radically symmetrical perspective on relationships between humans and nonhumans—between people and things, whether those things are animal, vegetable, or mineral. Agency, from this perspective, is a function and emergent property of collectives: It is distributed and interdependent. (p. 5)

This approach to agency as "a function and emergent property of collectives" reflects the approach this project takes to agency. Yet the methodological approaches McNely, Spinuzzi, and Teston (2015) ascribe to this new material approach, *object-oriented ontology* (p. 5), reveals in its name the shortcoming inherent in the approach: it focuses attention on relations of subjects and objects in collective activity rather than embracing the "radically symmetrical perspective" on agency this project seeks to reveal.

As a result, I piloted a set of methods to enable technical communication researchers to capture and study both user-centered and technology-centered agency as radically symmetrical. By synchronizing timestamps of user-centered usability test results and browser-centered data collections, a clear timeline of user and browser activities can be established, and agency can begin to be traced in these interrelations. These methods offer researchers in technical communication ways to trace rhetorical activity as it emerges not only from user interaction with technologies, but also from technology interaction with users. These methods can help researchers identify where and how agency emerges in online research activity.

In developing problem knowledge, I piloted these research methods with student users. The success of testing sessions was variable and depended a great deal on providing one-on-one support for participants throughout the testing session. I was able to capture the complete user-centered and browser-centered activities of two participants, which have become the case study on which this dissertation relies. The knowledge generated from these tests can be replicated with other participants. The data collected during these research sessions offers valuable insights to scholars and students alike about the extent to which user activity does—and does not—influence or affect programmed, algorithm-centered procedures that occur well beyond the user's awareness. Placing user activity in a timeline with browser activity, and examining the minutiae of both activities, reveals that human users are essential to online research activity, but upon initiating that activity, little user interaction is needed for research activity to proceed. The large number of networks engaged during an online research session reveals how pervasively institutional and corporate ideology shapes, or at least invests in, the search completed and the search results presented. These methods enable tracing this influence across networks, browser tabs, and pages to users. The result may not definitely prove that agency emerges in or through assemblages, but it certainly reveals the way agency emerges through the interactivity of users and technologies throughout the research activity timeline.

These methods reveal that agency emerges chronologically. However, the chronology surrounding browser activity is measured in seconds and milliseconds. Each human deliberation, often taking several seconds or even minutes, is responded to by the browser and its networked technologies in seconds. Agency emerging from the human-machine-network assemblage is the work of individual actors responding to each other at an often frenetic pace, impossible to experience in real time and requiring methods to slow and study the process. The methods

piloted in this dissertation are a first step toward capturing the real-time process and enabling slow, systematic study of agency emerging from the interrelations of users and browsers.

These methods are intentionally approachable and free, or relatively inexpensive, for researchers, teachers, students, and practitioners to use and implement. Using a free usability testing platform, freely available software, and ubiquitous software that is platform agnostic, the methods piloted offer teachers an opportunity to present these methods and findings to their students and to encourage them to test, refute, and improve them.

This write-up reveals, using a case study of two participants, that rhetorical agency does not reside in a single actor during common research activity. Participants clearly shaped the discourse of search by selecting and revising search terms, by repeating searches, by reviewing results, and by selecting results that could be used to respond to a specific research topic. Yet participants' laptops, browser software, and network connectivity also clearly shaped the discourse of search by submitting requests, by sending data with those requests, and by responding to those requests by sending metadata and content. Algorithms also clearly shaped the discourse of search by matching participant keywords to previously indexed content and by returning content in the form of dynamic responses to search queries entered by the user. Corporate entities also clearly shaped the discourse of search by tracking participant activities and behaviors and storing metrics of those behaviors on analytics servers and advertising platforms far from the testing environment. The testing environment itself likely shaped the discourse of search by distracting and influencing the participant (and the researcher) as ambient rhetoric. Programmers, additional hardware, software, prior search experiences, information literacy, and many more factors whose detail is beyond the scope of this study also shaped the discourse of search.

When all of these actors, seen and unseen, shape discourse within the timeframe of milliseconds, these actors can no longer be isolated as "participant," "browser," "network," "corporation," or "environment." Instead, they must be addressed as assemblages of actors whose activities must be viewed as collaborative and emergent. It is only through the process of searching—the "search activity" of the usability test—that agency can be identified and traced. And it cannot be identified or traced in terms of single agents acting subjectively on objects or objectively on subjects. Rather, it must be identified as emergent in search activity itself, embedded in the process and visible only through its unfolding. Agency is activated only through assemblage activity, not by the activity of a single user engaging in online search.

5.7 IMPLICATIONS

The third research question this dissertation seeks to address relates to implications: "What practical applications do the results of this study offer to researchers, teachers, programmers, and designers?" I've touched on the implication to teachers, who I encourage to teach and test these methods with their students to refute and improve them. However, I believe there are broader implications for the field of technical communication than having new methods to teach and test. I offer the following implications, and their specific application by scholars in the field, as a starting point to discussing where this work might spread.

These implications take the form of ethical imperatives in which I recommend actions that should be taken in the field. I make these recommendations from a genuine concern that students and scholars are woefully unaware of the unseen algorithmic forces that shape literate activity like online research. If agency emerges from our relations with algorithm-centered technologies, as this project reveals, then it's equally true that agency emerges from their relations with us as scholars. "Their" refers in part to the technological corporations that

program, own, and deploy proprietary search algorithms, along with the algorithms and technologies themselves where online research occurs. Given shared agency, we should know as much as possible about the entities with which we share that agency.

The stakes of locating and recognizing the locus of agency are high. Safiya Umoja Noble (2018) opens her ominously titled book, *Algorithms of Oppression*, with this claim about the values inherent in algorithm-centered agency: "The near-ubiquitous use of algorithmically driven software, both visible and invisible to everyday people, demands closer inspection of what values are prioritized in such automated decision-making systems" (p. 1). The urgency in Noble's call to inspection is palpable, and this project represents a response to that call. Noble's cause for concern aligns directly with this project's focus on online research: "The insights about sexist or racist biases that I convey here are important because information organizations, from libraries to schools and universities to governmental agencies, are increasingly reliant on or being displaced by a variety of web-based 'tools' as if there are no political, social, or economic consequences of doing so" (p. 9). These consequences of deploying biased tools like algorithms should be explored.

Shoshanna Zuboff (2019) goes further, encouraging not only study and exploration but recognition and resistance. Focusing on surveillant capitalist practices, pervasive in the major corporations that deploy machine-learning algorithms in search (e.g., Google, Microsoft, Facebook), that limit individual freedom, Zuboff claims: "If democracy is to be replenished in the coming decades, it is up to us to rekindle the sense of outrage and loss over what is being taken from us. In this I do not mean only our 'personal information.' What is at stake here is the human expectation of sovereignty over one's own experience" (p. 521). Zuboff's dystopian vision of a future in which surveillance capitalists consolidate power is a future this project seeks

to avoid, in part, by revealing the ways agency is shared in online research activity. The urgent calls to action revealed in Noble and Zuboff's texts reflect, and perhaps explain, the imperative verbs that pepper the implications that follow.

5.7.1. Rhetorical Agency as Assembled and Emergent in Online Research

Rhetorical agency in online research should be re-examined for its assemblage and emergent qualities. When users conduct research online, they are involved in meaning-making activities that extend into many aspects of modern life, from navigation to purchasing to scholarship. For our students, online research is the method we encourage students to use in developing new or updated ideas. Our practice rarely takes into account the extraordinary influence algorithmic processes have on such research. We assume the instrumental nature of procedures, not always recognizing the processing power required to provide answers to our queries. Even a simple research question, like "what coffee shops are near me?" requires algorithmic procedures to make meaning on our behalf.

1. Natural language processing works to make sense of the query, removing semantically meaningless terms like "what" and "are" to get at the keywords useful for a search, "coffee shop," "near," and "me."
2. Geolocation services engage networks to determine your location in order to make suggestions.
3. Differences between "coffee shop" as "a place to order and drink coffee and other beverages while working on wifi" must be distinguished from other meanings of "coffee shop," like "a grocery store that sells coffee" or "a wholesale coffee distributor."

4. Pre-existing databases containing information about local business must exist, created through indexing existing and new web content, to which valid query terms can be matched.
5. General understanding that "near" suggests a query about a place should generate results that include a map, one that meaningfully denotes both the searcher's current location (understood as "me") and the proximity of coffee shops to that denoted space.
6. Advertising dollars will likely introduce sponsored results into so common a search, generating results that may include coffee shops "near me" geographically and nearing my psychographic profile stored in my browser's cookies and captured through marketing and tracking pixels.
7. A logical and meaningful interface for displaying results should be created that includes details likely to be meaningful to me, based in large part on stored data on my previous coffee drinking habits.

Despite the many ways in which programmed procedures and machine learning algorithms influence the online research process, we tend to teach students that the results provided are as good as the search terms we enter. If we can provide the right search terms, we'll receive the results we seek. Yet there's clearly more to online research than entering the right search terms. Algorithmic procedures are sophisticated and infused with machine learning technology, but we are generally unaware of the algorithmic and machine learning procedures driving search. When we are unable to study the rhetorical agency emerging from collaborations in which human users and technological actors engage, we are likely to attribute too much agency to one side or the other of the assumed binary. To suggest a student or instructor or user exerts sole agency in digitally mediated environments like online research is to artificially isolate human activity from

its embedded, emergent digital mediation. Human activity is enmeshed in technological activity in online research, and the agency emerging from that enmeshing must be accounted for with more than a nod to human or technological agency. The agency that emerges is neither human nor technological, centered neither ideologically or environmentally—it is both human and technological, centered both around ideology and environment. We should explore rhetorical agency as posthuman, enmeshed in the technological, ideological, and environmental. Our studies of rhetorical agency should embrace Rickert's ambient rhetoric, Gries' material rhetoric, and any other approaches to rhetorical agency that recognize the agency of nonhuman actors in our mundane activities.

For technical communication students and scholars, the stakes are high. If ours is the field that both explains the technical to non-technical audiences and uses technology to do that work, then our field needs to understand the role that technology plays in rhetorical agency. Rather than placing human users at the center of our practice, we should consider whether an assemblage user might be better situated to advance the field beyond our study of human/machine interactions. We might do well to recall the mediating influence that technology has on our work, and seek to embrace that influence while recognizing its power and sway.

5.7.2. UX Design as Assemblage Oriented

The "end user" of UX design is an assemblage. Paying careful attention to the activity of user and browser in online research reveals the extent to which each actor is dependent on the other. Most obviously, research can't happen online without the interface for searching, the network infrastructure for sending data over great distances extremely quickly and efficiently, the browsing hardware and software necessary to conduct online research, and the vast data farms that contain both the information we seek and the indexed metadata our search terms can

be matched with to produce useful search results. However, all those technological infrastructures, structures, interfaces, and programmed procedures are dependent on users' need to find information. In this sense, our agencies are always intertwined and combined.

Technical communicators generally see themselves developing user-centered communication tools. The user is generally assumed human. However, there are ways in which technical communicators are developing user-centered communication tools and experiences that are technology-centered. Search engine optimization (SEO) is one of the most common approaches to algorithm-centered user experience that technical communicators engage. While SEO is typically considered a marketing tool to ensure webpages match human users' search terms and concepts, it's also a sophisticated method of developing webpages that are easily read and digested by indexing bots. Indexing bots, as noted in the introduction, do the work of indexing web content for later retrieval and use in matching to queries. In SEO, technical communicators deploy user- and technology-centered tools to "help" algorithms more easily identify a match in search query and indexed keywords, thereby ensuring the webpage in question appears as high as possible on a search engine's SERP.

Methods like SEO, which seek to address both human and technological users, are the exception rather than the rule. However, the results of this study suggest much programmed activity is happening beyond the awareness of users. In other words, despite the field's important work to encourage technical communicators to build interfaces that are user-centered, much of the technological activity occurring in online research activity is technology-centered. The deployment of web analytics pixels and marketing beacons in code are aimed at collecting data that will be assessed, organized, and used by technological procedures to optimize profit. These data may also be reviewed by technical communicators to assess usability or to optimize user

experience on the site, but only after the technological platforms engaged have done automated, algorithm-centered work to optimize efficiency and profit. In short, these pixels and beacons are technological users whose purposes and intents, while programmed and limited, are nevertheless rhetorically active in the work of meaning making—often making meaning for technological rather than human-centered processes.

This leads me to draw the conclusion that the "end user" of usability testing and UX design is an assemblage agent, not a human or hardware or algorithmic or network entity. To design for the human user alone is to ignore the mediated digitality of online experience. Agency in online research activity is far more complex than the field has accepted or recognized. Experiences should be designed that provide an efficient, meaningful, ethical, and accessible user experience to users that combine technological and human agency. Designing experiences for assemblage agents make ever more complicated the work of technical communicators. Accessibility for human users is already deeply challenging in online spaces; how do we design for agency that is exerted by assemblages of human and nonhuman users? How do we begin to understand user experience as assemblage, rather than human-user, centered? And what do we call this field?

The field of "posthuman user experience," or "posthuman UX," may not be recognized, but its users are already in the wild. Its users include artificial intelligence and machine learning procedures along with the human users who deploy them and use them. Posthuman agency is not merely a theoretical construct; this study reveals the extent to which posthuman users are already engaging in our products and services. They are optimizing our ad purchasing habits; directing our allegiance, seen or not, to corporate ideologies; and influencing, if not outright manipulating, our search results. The field of technical communication may wish to rethink its approach to

usability to encompass the technological actors, and their interactions with human users, that are necessarily engaged in the communication tools and methods we produce.

5.7.3. Online Search as Rhetorical Activity

We should teach online search as a rhetorical activity. When we teach search in composition and technical communication classes, we tend to teach it as an instrumental tool useful for achieving the goals of research. We teach research writing as a rhetorical activity, and we teach the process of knowledge making through research as rhetorical as well. However, we seldom examine the search process itself as a rhetorical activity. This practice can change. The results of this study starkly reveal the meaning-making activities underlying the entire research process. We tend to focus attention on the front-end student activity of constructing a meaningful search and on the tail-end process of evaluating sources from among results suggested. These are important aspects of the online search process, but this approach elides the complex rhetorical work that occurs as search terms are matched and results ranked by relevance on the SERP.

Of course, constructing a meaningful search is important, as is evaluating sources for authority and relevance from among search results. But just as meaningful are the reasons we emphasize these tasks. When we ask students to develop meaningful search queries, to test different versions of queries in different research tools, and to engage search interfaces and tools other than Google, we are adapting to the rhetorical agency of the search interface's affordances and constraints. We recognize through practice that natural language processing is imperfect, sometimes even laughable (as millions of embarrassing autocorrected entries confirm). As a result, we adapt to the vocabulary and structure of our search tools by teaching and using controlled vocabulary, by running searches in different search interfaces, and by combining keywords and keyword phrases in novel ways. We tend to teach these adaptations as necessary

aspects of algorithm-centered procedures—which they certainly are—rather than the rhetorical adaptations to audience we could be teaching. In essence, the natural language processing, keyword matching, and content indexing processes are the audiences of our search terms, and we as researchers are the rhetors seeking just the right combinations to receive the best understood, most relevant results to our queries. Adapting to search interfaces in the construction and deployment of our search terms is a rhetorical activity, and we have an opportunity to teach it as such.

When we ask students to evaluate sources for authority, accuracy, relevance, and timeliness, we are again responding to the rhetorical agency of the algorithmic processes that returned those results. We seldom dig into the particulars of how search "works," yet our response is to mistrust, or at least wish to verify, the results returned from our searches. We recognize the imperfections of online search and the matching process that connects our search queries to indexed keywords and ranks the results in relevance order. What we miss is the rhetorical character of our mistrust. The agency of algorithmic matching activity is not something we're eager to trust, for reasons likely beyond the scope of this study. But what's important is that we mistrust a meaning-making action whose mechanics we can't see. Our response to this mistrusted meaning-making activity is to evaluate the results, to critique them, to apply critical methods to them. We are well-served to teach these skills. But we miss the opportunity to teach the search process as a rhetorical activity to which we respond by addressing the rhetorical appeals of the returned results. Online search is a rhetorical activity, filled with layers of meaning-making that can and should be foregrounded in our pedagogy.

Teaching "online search" requires a much broader approach to teaching the underlying processes and actors that influence search activity. Information literacy must broaden its

approach to understanding assemblage agency as collaborative posthuman intent that emerges in algorithm-mediated activity. This focus on information literacy, and even algorithmic literacy, becomes more critical as we see the advent of more voice-activated, and audio-responsive, search applications. Today's web search is a user's dream, because a user can enter a single query and receive hundreds or thousands (or millions) or results. All of those results are theoretically available in sequentially numbered pages of results, ten results to a page, even if we seldom go beyond the first ten results. Audio search using voice-activated smart devices like Google Home or Amazon Alexa do not have the luxury of an interface to provide pages and pages of results. The search algorithms that conduct the voice-activated search must select a single response, or at most a handful of responses, to return to the user as audio responses. To return the equivalent of pages and pages of results in audio format would be a usability nightmare. As a result, the rhetorical activity of evaluating sources is housed within the algorithmic process without significant oversight, meaning the top search results will likely become the "authoritative" results. Without teaching the search process, and the underlying technologies that enable search, as rhetorical, students will face the prospect of unquestioningly accepting the result rendered authoritative by the smart device—not necessarily because it's the right answer, but because it's the top answer in a search.

5.7.4 Posthuman Agency as a Site of Critique

Critical media literacies must widen their critique to include posthuman agency. Critical media literacies tend to focus their attention on cultural critiques of media through depictions and the assumptions made in those depictions. Anchored on McLuhan's maxim that the medium is the message rightly recognizes the reality that media mediate. Rhetorical scholars consider this mediation rhetorical, and the composition subfield of computers and writing seeks to explore the

extent of this mediation in rhetorical activity like composition. However, neither of these fields or approaches addresses rhetorical agency at the level of actors composing or comprising the medium. This gap in focus is readily visible through the results of this study, where the mediating effects of the browser on the research processes are actively comprised of mediating effects of networks, procedures, algorithms, applications, and scripts. In this study, the browser (or the hardware and software on which the browser operates) is the medium, and the actors in that medium are the hundreds of browser request/server response pairs activated through that medium.

The browser is a coalescing of technological and network actors. Through the search interface, hundreds of actors are called together to perform the meaning-making work of identifying relevant search results. Among the many actors are markup languages like HTML, styling agents like CSS, programming languages like C++ and ASP, scripting languages like JavaScript, tracking pixels and beacons, cookies, and analytics and metrics pixels (often also used for tracking). Each of these actors plays a role in assemblage agency through the browser and involving human users. Literacies that address technologies and media should focus not only on the media, but on the technological, linguistic, and network actors that comprise the media.

Beyond the scope of this study, but worth pointing toward, is the fact that each of the corporate entities represented in Table 5.6 involves an online actor engaged in its own rhetorical work. When the Google Analytics pixel is activated when its script is run during page load, that pixel collects and delivers user and visit metrics on that page to a server where those data points are aggregated, merged, and analyzed for use patterns toward improving search and search advertising. When the Twitter universal pixel is activated by its script during page load, it collects and delivers data about the user and the page to its servers to determine whether this

particular visit by that specific user should be tied to any advertising campaigns running on the Twitter platform. Each pixel, script, and cookie communicates information which is used for meaning-making activity. Each actor in the browser is engaged in its own meaning-making activity, and critical media literacies should focus attention on the minutiae of mediation to ensure that users are aware of the tremendous amount of work happening around online search activity.

As it relates to literacies, it's worth recalling Gee's (1989) focus on literacy as secondary use of language. When it comes to technological literacies like those proposed by Kelli Cargile Cook (2002), one approach to literacies might address secondary uses of technologies. We've studied and practiced our primary use of online research tools to complete the rhetorical task of conducting research. Our secondary use of these online research tools might be to study their rhetoricity, to examine their influence, and to become "literate" in the rhetorical activity that underlies their utility. Such technological literacies would help us better understand our relationship to technologies, their shaping influence on our mundane lives, and the way humans and technologies work together in posthuman assemblages capable of rhetorical agency.

The rhetoric of algorithmic activity in assemblages represents the starting point toward *algorithmic literacy*, an awareness and practical understanding of the way algorithms influence network and human activity. In a posthuman world where cyborgs (Haraway, 1985; Hayles, 1999) regularly engage in computer- and network- mediated rhetorical activities, algorithms play a significant rhetorical role in what Cargile Cook (2002) terms layered literacies, an enfolded and interwoven set of literacies technical communicators should learn and teach: basic, rhetorical, social, technological, ethical, and critical. These computer- and network-mediated activities are regularly influenced by algorithms in minor and significant ways: basic literacies like reading,

writing, and speaking are mediated by electronic amplification, computer programming, and networks of libraries and ebooks; critical literacies like social action on behalf of the silent or muted are enabled, even coordinated, through online social networks.

This literacy work builds on Gee's (1989) representation of literacy as "control of secondary uses of language (i.e., uses of language in secondary discourses)" (p. 23). Algorithmic literacy focuses on ways that users and algorithms activate assemblages that influence options and selections from among search results. It requires meta-knowledge of the primary discourse of search and the secondary literacy of algorithmic activity. Algorithmic literacy may be what Gee calls a "powerful literacy" (p. 23) that could be used to excavate and critique the experience of search and the often-hidden influence algorithms have on search processes and results. This literacy requires opening up the "black boxes," the hidden procedural rhetoric (Bogost, 2010) of algorithmic activity, and visualizing the agentive activity that emerges in the interaction of users and algorithmic processes. It also requires focusing on the ethical implications of studying the rhetoric of algorithms.

As Cargile Cook reiterates, these literacies do not exist, and should not be taught, in isolation from one another. So, too, with algorithms. As scholars seek to understand what's rhetorical about algorithms—which includes their involvement in identity formation, in information flow and activity across networks, and in distributed rhetorical agency—we should seek to understand algorithms as enfolded and implicated in the literate activities of posthuman life. Above all, scholars should begin to understand that what's rhetorical about algorithms is their involvement in the ethical decisions made, in active and passive ways, about what matters in our world. It's vital that technical communicators understand and teach algorithmic literacy; as Ingraham (2014) reminds us, "We all interact with algorithms more often than we probably

realize, and paying more attention to the ways their intervention in our lives makes claims about what matters will help us to attend more critically to their potentially undesirable repercussions" (p. 73). Such critical attention requires developing algorithmic literacies that can be identified, taught, and studied. Table 5.7 applies Cargile Cook's literacies framework to algorithms in research processes to demonstrate the enfolded, interwoven nature of studying algorithmic activities rhetorically.

Table 5.7

Cargile Cook's (2002) layered literacies applied to digital algorithms in the research process.

Literacies	Applied to Algorithms in the Research Process
Basic	Recognize the existence of algorithmic processes in research process
Rhetorical	Understand the potential influence algorithms have on search results
Social	Consider ways interfaces reflect social acceptance (and rejection)
Technological	Be cognizant that technologies interact to generate agency outside user
Ethical	Wonder what inclusions and exclusions algorithms initiate and maintain
Critical	Ask if algorithms may be implicated in exclusions that require remedy

Remembering that literacies are enfolded and interwoven, Brown's (2016) focus on ethical programs governed by laws of hospitality can be seen as one of several components of algorithmic literacy. Since algorithms are involved in making decisions about what matters in the world, they are also involved in defining power differentials. Defining power differentials in distributed digital networks is hierarchical and tiered, implicated in the construction of

postmodern identities of gender, race, and class. Brown confirms this by referring to Galloway's protocology:

> Networks do not merely distribute power horizontally, allowing nodes to freely communicate with one another. They are not rhizomatic spaces in which rhetorical agents act on their own. Rather, Alexander Galloway's work shows us how protocological power operates in networks, coupling rhizomatic distribution with hierarchical organization, (Brown, 2016, loc. 1066)

What's rhetorical about algorithms is that they are involved in emergent agency that defines ethical decisions related to what matters (more) in the world. Whether measured by structure (at the level of code and execution) or by effect (at the level of influence), algorithms are involved in making decisions about what matters. This involvement, in turn, matters to scholars and students seeking to recognize, analyze, and critique the suasive effects of programmed iterative procedures in the world around us, and our role in assemblage agency.

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APPENDICES

APPENDIX A

TESTING INSTRUCTIONS PROVIDED TO PARTICIPANTS

Testing instructions were slightly different for each participant, the result of running the pilot test for P1 in the administrative interface of TryMyUI and running the focus group test for P3 by deploying the usability test by URL.

Participant 1 Instructions

Tracing Students' Research Practices — Instructions
This study comprises three parts, **technical setup**, **usability testing** and **data collection**.

Technical Setup

1. Confirm that your computer's **microphone** works. We can troubleshoot this together.
2. Ensure that you are connected to **MonarchODU** wifi network
3. Install, or confirm installation, of Google **Chrome** browser: google.com/chrome/browser
    a. If you normally sign into your browser using a Google account, please also sign in
    b. Creating a new account and signing in is not required
4. Open Chrome and install the **Ghostery** plugin for Chrome: www.ghostery.com/products
5. Run a connection **speedtest** (PI will record results): www.speedtest.net
6. Visit the DAA WebChoices Browser Check to ensure browser is not opted out of customized ads: optout.aboutads.info
7. Close all Chrome tabs, then open a new Chrome tab
8. Log into **TryMyUI** (www.trymyui.com/login): Username: [redacted], Password: [redacted]
    a. Open **Pilot Test**: ODU Library Research
    b. Scroll to the bottom of the page and select "Take the test yourself"
    c. Download and install the TryMyUIRecoder application as instructed
    d. Select Quick Start, open the test file that downloads. and complete the sound check
    e. Launch the test
9. Start **recording** to initiate Usability Test, following prompts as directed. You should see the ODU Library webpage open in the larger screen.

Note: New windows and tabs will open during the test. For **each new tab** that opens, please ensure that Developer Tools are open. Do not close any browser tabs or windows: **minimize** as needed to return to the testing interface.

- Right click > Inspect
- Network tab > Record set ON
- Network tab > Preserve log set ON

Ethnographic Notes and Observations
During the Usability Test, I will be taking observation notes and recording photos of our session (without showing your face). These notes and photos will be used to describe and measure the surroundings of the test. I will also be conducting regular network speed tests to see if network speeds vary or remain consistent throughout the test.

You are welcome to ask me questions during the Usability Tests about the test or about sources and search processes, but otherwise try to ignore, to the best of your ability, my presence and activity.
I may periodically ask you to check that Developer Tools are still recording your activities.

Research Assignment
It's best if you're able to bring to the study your own research project or assignment. Your goal is to identify one academic source (journal article or book) using Monarch OneSearch. It's best if that source relates to an actual assignment. However, if you need an assignment prompt, use this:

> Research ways to solve a public problem, like poverty or sea water rise or hunger, in a particular region or locale

Usability Testing
Follow the on-screen prompts. Use think-aloud protocol to explain each choice you make during the test. The on-screen prompts will ask you to read all instructions aloud. Please do so.

Think-aloud protocol asks you to narrate aloud your actions throughout the test. Be verbose, and don't be afraid to sound funny. The more information you provide about why you're doing what you're doing, the better.

Scenario: You have been assigned a research project for a class. Use the ODU Library Monarch OneSearch to identify at least one scholarly resource that will help you complete this project.

Research Activities
1. Use Monarch OneSearch to identify at least one relevant scholarly source for your research project.
2. Access and open the full text (if available) of the source you've selected.
    a. Preview the source for relevance.
    b. If still relevant, the research activity is complete.
    c. If not relevant, continue researching to identify a relevant source.
3. End the TryMyUI recording.
4. Complete the post-search survey with verbose written responses.

Data Collection
Once you have finished the post-search survey, I will use a flash drive to collect HTTP archive (HAR) files from Chrome Developer Tools.

I will collect the HAR file from each open browser Developer Tools tab/window.
1. For each open Developer Tools tab/window, right click on Developer Tools > Network content
2. Select "Save as HAR file with content"
3. Save file to the flash drive

Once all HAR files are saved to your computer, your participation is complete. You are welcome to close the Developer Tools window of your browser, delete the TryMyUI recorder, delete the Ghostery plugin, and delete Chrome (if installed for this test).

Thank you for your participation. Retain a copy of the consent document for your files, and contact me if you have questions.

Participant 3 Instructions

Tracing Students' Research Practices — Instructions
This study comprises three parts, technical setup, usability testing and data collection.

Technical Setup

1. Confirm that your computer's microphone works, We can troubleshoot this together.
2. Ensure that you are connected to MonarchODU wifi network
3. Install, or confirm installation, of Google Chrome browser: google.com/chrome/browser
    a. If you normally sign into your browser using a Google account, please also sign in
    b. Creating a new account and signing in is not required
4. Run a connection speedtest (PI will record results): www.speedtest.net
5. Visit the DAA WebChoices Browser Check to ensure browser is not opted out of customized ads: optout.aboutads.info
    a. Print the results as a PDF
    b. Save to your desktop or other memorable location
6. Close all Chrome tabs, then open the usability test in a new Chrome tab using the following URL: http://bit.ly/DissDataHocutt. Complete #7 below before doing anything else.
7. Open Chrome Developer Tools to **Record** and **Preserve Log** of Network activity.
    a. Right click > Inspect
    b. Network tab > Record set ON
    c. Network tab > Preserve log set ON
8. Follow the usability testing instructions
    a. Install software as directed
    b. Watch the 1-minute video illustrating successful think-aloud protocol
    c. Test microphone as directed
    d. Download the recording session
9. New windows and tabs will open during the test. *For each new tab that opens,* repeat #7 above. Do not close browser tabs or windows; minimize as needed to return to the testing interface.
10. Start recording to initiate Usability Test, following prompts as directed. You should see the ODU Library webpage open in the larger screen. Be sure Developer Tools are open with Record and Preserve Log set ON.

Ethnographic Notes and Observations
During the Usability Test, I will be taking observation notes and recording photos of our session (without showing your face). These notes and photos will be used to describe and measure the surroundings of the test. I will also be conducting regular network speed tests to see if network speeds vary or remain consistent throughout the test.

You are welcome to ask me or your peers questions during the Usability Tests about the test or about sources and search processes, but otherwise try to ignore, to the best of your ability, my presence and activity.

I may periodically ask you to check that Developer Tools are still recording your activities.

Research Assignment
It's best if you're able to bring to the study your own research project or assignment. Your goal is to identify one academic source (journal article or book) using Monarch OneSearch. It's best if that source relates to an actual assignment. However, if you need an assignment prompt, use this:

> Research ways to solve a public problem, like poverty or sea water rise or hunger, in a particular region or locale

Usability Testing
Follow the on-screen prompts. Use think-aloud protocol to explain each choice you make during the test. The on-screen prompts will ask you to read all instructions aloud. Please do so.

Think-aloud protocol asks you to narrate aloud your actions throughout the test. Be verbose, and don't be afraid to sound funny. The more information you provide about why you're doing what you're doing, the better..

Scenario: You have been assigned a research project for a class. Use the ODU Library Monarch OneSearch to identify at least one scholarly resource that will help you complete this project.

Research Activities

1. Use Monarch OneSearch to identify at least one relevant scholarly source for your research project.
2. Access and open the full text (if available) of the source you've selected.
    a. Preview the source for relevance.
    b. If still relevant, the research activity is complete.
    c. If not relevant, continue researching to identify a relevant source.
3. End the TryMyUI recording.
4. Complete the post-search survey with verbose written responses.

Data Collection

Once you have finished the post-search survey, I will use a flash drive to collect the DAA WebChoices PDF and the HTTP archive (HAR) files from Chrome Developer Tools.

I will collect the HAR file from each open browser Developer Tools tab/window.

1. For each open Developer Tools tab/window, right click on Developer Tools > Network content
2. Select "Save as HAR file with content"
3. Save file to your computer

Once the DAA PDF and all HAR files are saved to the flash drive, your participation is complete. You are welcome to close the Developer Tools window of your browser, delete the TryMyUI recorder, delete the Ghostery plugin, and delete Chrome (if installed for this test).

Thank you for your participation. Retain a copy of the consent document for your files, and contact me if you have questions.

APPENDIX B

TRANSCRIPT OF ETHNOGRAPHIC OBSERVATION NOTES

Table A2.1

Transcribed ethnographic observations for Participant 1.

Category	Observation
Environment	Cool temperature, makes wearing long sleeves comfortable, no jacket required
Environment	Period rattling noise of refrigerator in background
Environment	Periodic noise of people in hallway
Environment	Cramped working space (see photos)
Environment	Filled with computers, including one on P1 work desk; laptop set in front of computer
Environment	Blinds closed, little outside light; largely artificial fluorescent light
Environment	Consistent sound of computers in background
Participant	Reviewing large number of resources to find a useful source
Participant	Participant sits up in chair
Participant	Participant clearly comfortable with navigating and using multiple windows
Participant	Gets into rhythm of think-aloud protocol after a little bit; acts as if PI not in room
Participant	Comfortable, has experience with user testing
Participant	Punctual, a few minutes early
Participant	Quick to search, sometimes prior to instruction
Participant	Familiar with Chrome developer tools
Participant	Expects search experience to be more predictive and user-friendly like Google
Participant	Expects many more results from Monarch OneSearch
Participant	Surprised there are no CNN articles or other news outlets
Participant	Confused by interface, especially Access It options
Technology	Ad Aware results: status unavailable for many, some yes, most no
Technology	Chrome adblock extension deactivated during test
Technology	Uses Chrome
Technology	Uses ad blocker
Technology	No additional technologies visible besides laptop
Technology	Uses Apple MacBook laptop
Technology	Has never brought laptop to ODU campus - first connection to MonarchODU wifi

Table A2.1 Continued

Category	Observation
Technology	Google remembers username and password; logged into Google Account
Technology	Quick in using Mac, especially multiple windows and using drag and drop
PI Reflection	This test will provide very difficult if participant is not tech or computer literate. Having someone who knows what they are doing is critical to successful testing.
PI Reflection	Student are unclear on "appropriate source" - not an issue for my needs yet, but worthy of a note — should I seek upper level students for this reason?
PI Reflection	Mpark is cold, sterile, and quiet. Good for usability testing, but bad for comfort and "hominess"
PI Reflection	Important to be next to participant to answer questions that arise
PI Reflection	Ghostery may not offer anything useful — need to figure out how to get visible trackers to appear
PI Reflection	Navigating across multiple pages is a real challenge — requires opening Developer Tools and activating recording and logging and refreshing page for every new tab/window. Important to watch testing process carefully.
PI Reflection	Network speeds are quite interesting and variable. May not provide useful date, but interesting baseline.
PI Reflection	20 minute timeline may be more of a potential issue than I expected
PI Reflection	Smart, smart participant — clearly capable of conducting this test on his own.
PI Reflection	Consider shifting Developer Tool setup outside of time limit

Table A2.2

Transcribed ethnographic observations for Participant 3.

Category	Observation
Environment	Muggy and cool, raining outside
Environment	Sound of refrigerator humming in the background, sometimes rattling
Environment	Graduate student working in next room
Environment	Cloudy light from partially closed blinds mixed with fluorescent overhead lights
Environment	Seated at cramped workstation, using personal laptop in front of desktop monitor and keyboard
Environment	Regularly talking at the same time as other participants and principal investigator leading testing session
Participant	Arrived early and left later
Participant	Unsure and nervous at first, but engaged and interested as the project was described
Participant	Conscientious about completing research task
Participant	Asked questions about next steps
Technology	Unable to access MonarchODU network, connected to oduroam, a slower network
Technology	Using Windows, experienced slower experience throughout the testing session, especially on Ad Checker and downloading TryMyUI app
Technology	Unsure how to use flash drive and save files in a known location for retrieval on personal laptop
Technology	Appears to be Chrome user
Technology	Did not have other major apps running or music playing during testing session
PI Reflection	Need to research differences in EduRoam and MonarchODU wireless networks
PI Reflection	Missed Impression Test, resulting in process not finishing, meaning survey questions had to be emailed for responses (rather than through TryMyUI)
PI Reflection	Able to find a source successfully, but may not have captured entire search process in HAR files; hard to keep up with individual progress

APPENDIX C

USABILITY TEST CONTENT

The usability testing software was TryMyUI.com, to which PI had a free educational subscription for a single test. PI deployed the pilot test using the administrative interface of the test to preserve the free test for the focus group deployment. The testing software has a 20-minute time limit on recording results.

Scenario
You are looking for a scholarly source to include in a research project you've been assigned. (If possible, the project should be one you've actually been assigned.) You have come to the ODU Library website to conduct searches to find an appropriate source. In addition to reading aloud the questions as directed during the study, please narrate aloud all search activities for recording—your search terms, your selection of search terms, your review of search results, and your selection of specific links throughout the process. You cannot narrate too much of your activity.

Step 1
Conduct your search by entering your search term(s) in the search box. You may conduct as many different searches as needed in order to identify a source that will address your research needs. NOTE: Results will open in tabs in a new window. Each new tab should show Developer Tools. Be sure Recording is on and that Preserve Log is checked on EACH new tab/window. To return to the test, minimize the results window. DO NOT CLOSE TABS OR WINDOWS until the test is complete.

Did you complete this task successfully? Yes | No
Participant responds; once response is recorded, participant is prompted to move to next task

Step 2
Once you have selected a source, see if you have access to the full text of the source (HTML or PDF). You may need to follow several links to determine if you have access. You should not order via ILLiad.

Did you complete this task successfully? Yes | No
Participant responds; once response is recorded, participant is prompted to move to next task

Step 3
If you have access to the full text, view it (HTML only) or download it (PDF). If you do not have access, skip to the next step.

Did you complete this task successfully? Yes | No
Participant responds; once response is recorded, participant is prompted to move to next task

Step 4
Once you've determined that you DON'T have access to the full text of the source, or you've viewed or dowloaded the full text, you have completed this portion of the test. Do not close any browser tabs or windows.

Did you complete this task successfully? Yes | No
Participant responds; once response is recorded, participant is prompted to end the testing session by ending the recording.

Post Test Survey Questions
Participants were asked to write responses to the following prompts following the usability test. No other instructions other than those presented in the prompts were provided.

1. Have you used the Monarch OneSearch search tool before this activity? If so, characterize your level of experience with this search tool (novice, intermediate, expert).
2. Describe the environment in which you are conducting this activity. Be as descriptive as possible; complete sentences are not required.
3. Were you logged in to a Google account or social media account(s) while using Chrome to complete this activity?
4. Summarize the research assignment or project you used to complete this usability test. Provide as much detail as possible.

APPENDIX D

POST-TEST SURVEY RESPONSES

Have you used the Monarch OneSearch search tool before this activity? If so, characterize your level of experience with this search tool (novice, intermediate, expert).

> **Participant 1**: No, I have not used the OneSearch tool prior to today. I would have expected slightly improved usability and more relevant search results, but I was able to narrow my search down and find what I was looking for without excessive effort.
>
> **Participant 3**: Yes, I have used this search tool many times, I would say intermediate level.

Describe the environment in which you are conducting this activity. Be as descriptive as possible; complete sentences are not required.

> **P1**: Using my own computer in a formal university computer lab alongside the professor who is here to answer any questions I may have along the way. There is minimal background noise; I am probably the noisiest person around.
>
> **P3**: Small, a little noisy, 4 people with someone working in the other side of the room. Cold, rainy day.

Were you logged in to a Google account or social media account(s) while using Chrome to complete this activity?

> **P1**: I was logged into a few Google accounts; at least one for personal and two for university use. I am naturally logged into my Facebook and Reddit accounts et cetera, but none of these windows were open.
>
> **P3**: ODU Google account

Summarize the research assignment or project you used to complete this usability test. Provide as much detail as possible.

> **P1**: I chose to research the recent Puerto Rico Power Outage crisis as a part of my usability test. I am interested in this topic because I am so incredibly embarrassed by our country's formal(?) response & relief efforts. Potential research into this topic includes, but is not limited to, Hurricane Maria's devastating effects on the island and Elon Musk's incredible PR stunt regarding their power grid restoration efforts.
>
> **P3**: I researched the impacts of deforestation. I searched for a more vague article that broadly shows the details and definitions of deforestation.

APPENDIX E

PARTICIPANT 1 USABILITY TESTING TRANSCRIPT

- Location: MediaPark, ODU
- Date: January 24, 2018
- Computer: Participant's personal laptop

[START OF TRANSCRIPT]

(Introductory smalltalk)

PI: Do you have a topic in mind that you can research? (11 words)

P1: Umm, the topics for our courses were too vague, I think…

PI: If you'd like to, you can solve a public problem, any public problem, just research on solving a public problem. (20 words)

(User test instructions)

> **ODU LIBRARY PAGELOAD TIMESTAMP: 00:49**
> HAR TIMESTAMP: 17:46:26.681 (Z)
> TIE HERE: archive01.har

(Reading): Your frame of mind: You are looking for a scholarly source to include in a research project you've been assigned. (If possible, the project should be one you've actually been assigned.) You have come to the ODU Library website to conduct searches to find an appropriate source. In addition to reading aloud the questions as directed during the study, please narrate aloud all search activities for recording — your search terms, your selection of search terms, your review of search results, and your selection of specific links throughout the process. You cannot narrate too much of your activity. (98 words)

(Reading): Task 1 of 11: Please start by reading the frame of mind directions (above) out loud! Click Next Task when you have done so. Immediately after completing each task click Next Task and read it out loud before performing it. DON'T JUMP AHEAD. (39 words)

(Clicks): Okay. Cool.

(Reading): Before conducting a search, open Developer Tools. RIGHT CLICK anywhere on the browser screen and select "Inspect." The Developer Tools will open in a new window that will likely cover everything else on the screen. You can resize the window so you can see these instructions in addition to the Developer Tools. (52 words)

Could you complete this? Yes. Next task. (Clicks) (7 words)

(Reading): In the Developer Tools interface, select the "Network" tab or link. (11 words)

Boom. Yes. (Clicks)

(Reading): Using the icons that appear under the Network tab, select the "Record Network Log" button (circle icon, should turn red) and the "Capture Screen Shot" button (video icon, should turn blue). Check the "Preserve Log" option, then press Control-R or Command-R (as directed in the Developer Tools). (47 words)

Yes. (Clicks)

(Reading): Reduce the Developer Tools window, return to the main test page (the ODU Library page) and conduct your search. You may conduct as many different searches as needed in order to identify a source that will address your research needs. NOTE: Results will open in tabs in a new window. Each new tab should show Developer Tools. Be sure Recording is on and that Preserve Log is checked on EACH new tab/window. To return to the test, minimize the results window. DO NOT CLOSE TABS OR WINDOWS until the test is complete. (93 words)

Okay. Um.

The public problem that I'm gonna solve is, I would choose the Puerto Rico power crisis that occured in the last hurricane or whatnot. So I'm going to start searching for, I will point to some articles, if I can spell correctly, Puerto Rico power crisis (search terms entered).

SEARCH TIMESTAMP 04:57

HAR TIMESTAMP: 17:50:54.470 (Z)

STRING: puerto rico power crisis

TIE HERE: archive02.har

Cool. Articles. (Reviewing results, muttering)

Well it's, more recently than that.

(Browses back to search page)

Let's see here. I forget the name of the actual hurricane, Hurricane Maria (search terms entered). Okay.

SEARCH TIMESTAMP: 06:46
HAR TIMESTAMP: 17:52:21.584 (Z)
STRING: hurricane maria
TIE HERE: archive03.har

There we go. So. Found articles on, there, healthcare system, but I would like to have articles on their electricity issues.

Pharmaceutical problems.

Let's see. Floor.

Soil nutrition availability. Interesting. I would never expect that. That's really cool, actually. Um..

(Browses back to search page)

(Enters hurricane maria puetro rico power as search string)

Zero results

SEARCH TIMESTAMP: 07:43
HAR TIMESTAMP: 17:53:25.893 (Z)

STRING: hurricane maria puetro rico power
TIE HERE: archive04.har AT 1ST PAGE

(Remains on SERP and enters search using inline tool on page: hurricane maria puerto rico power)

I misspelled Puerto Rico for the third time. (Laughs, hits enter to start search).

SEARCH TIMESTAMP: 08:13
HAR TIMESTAMP: 17:53:49.732 (Z)
STRING: hurricane maria puerto rico power
TIE HERE: archive04.har AT 2ND PAGE

It actually ruined my search, that's really funny, I would expect them to be more Google-esque.

Okay. "Puerto Rico sustains major power outages." That's nice. That helps.

Okay. Details. Definitely recent. SNL?

(muttering under breath, reading part of abstract/detail, then scanning additional titles)

I would expect more than one article to appear. This very particular search criteria.

(Opens "Puerto Rico sustains major power outages after Hurricane Maria" detail in new tab)

SEARCH TIMESTAMP: 09:07
HAR TIMESTAMP: 17:55:01.175 (Z)
SELECTION: "Puerto Rico sustains major power outages after Hurricane Maria" from SNL Energy Power Daily, September 21, 2017
TIE HERE: archive08.har both pages [first page is ProQuest logo, not sure why it's isolated]

(Appears to read details)

I would expect more — well, I guess I'm not familiar enough with this system to understand where it's pulling sources from but when it says articles, for example, I would expect them to have, I mean, everything — CNN, or whatever else, as well, and I, I would just expect way more headlines and what-not to be appearing up here (referring to search results page).

(Under breath, reads title "Hurricane Maria Devastates Puerto Rico" from search results)

(Returns to top of page, adds "outages" to search string which now reads *hurricane maria puerto rico power outages*)

SEARCH TIMESTAMP: 10:01
HAR TIMESTAMP: 17:55:39.089 (Z)
STRING: hurricane maria puerto rico power outages
TIE HERE: archive04.har at 3RD PAGE

(Scrolls new SERP results)

Ah, there we go. "Don't rebuild, redesign."

(Clicks on Details tab)

Oh, nice.

(Clicks on Access It tab)

(Clicks “Open source in a new window” to open a new tab)

> **SEARCH TIMESTAMP: 10:42**
> HAR TIMESTAMP: 17:56:19.093 (Z)
> SELECTION: “Puerto Rico: Don't Rebuild; Redesign the Power System”
> RESULT: Opens the options for accessing the article in separate tab
> TIE HERE: archive07.har

Hmm.

(Returns to SERP tab)

Well, I clicked on Access It > Open source in a new window on this particular link here (pointing to link with mouse).

(Clicks on “Open source in new window” link to open same content in new tab)

> **SEARCH TIMESTAMP: 11:13**
> HAR TIMESTAMP: 17:56:51.475 (Z)
> SELECTION: “Puerto Rico: Don't Rebuild; Redesign the Power System”
> RESULT: Opens the options for accessing the article in separate tab
> TIE HERE: archive05.har

Open source in new window takes me to this strange website, which —

(PI interrupting): Can you make sure developer tools are on that page? (10 words)

Yes. And I’m just super confused because — this resource

(Returns to SERP tab, points to article)

Whoa. Okay. Well the resource itself is from 2017, but when it tells me it’s available from [19]88, I’m like, whoa, what is, what am I looking at?

(Returns to tab where access options are listed. Clicks on LexisNexis Academic option to open new tab)

LexisNexis, okay, that’s cool.

(Old Dominion University Libraries Off-campus Library Resource Login page opens in new tab)

> **SEARCH TIMESTAMP: 11:41**
> HAR TIMESTAMP: 17:57:17.750 (Z)
> SELECTION: “Puerto Rico: Don't Rebuild; Redesign the Power System”
> TIE HERE: archive06.har at 1ST PAGE

Ah, yes.

(Clicks “Click to login using your MIDAS account” to continue. Opens ODU Monarch-Key login page in same tab)

SEARCH TIMESTAMP: 11:52
HAR TIMESTAMP: 17:57:24.157 (Z)
SELECTION: "Click to login using your MIDAS account"
TIE HERE: archive06.har at 2ND PAGE

Good. Good.

(Clicks blue login button. Opens article in LexisNexis in same window)

SEARCH TIMESTAMP: 11:53
HAR TIMESTAMP: 17:57:24.525 (Z)
SELECTION: "Login"
TIE HERE: archive06.har at 3RD PAGE

That's cool that we have access to LexisNexis as students. That's like a very expensive software suite. Um. (Reads) "Puerto Rico: Don't Rebuild." Nice. *Transmission & Distribution World*. I've never heard of this resource, but — clearly it's reputable.

Huh.

Wow. (Laughs) That's really funny! (pointing to Elon Musk among persons listed in the subject information at the bottom of the article)

Elon Musk is mentioned in this article. Priceless.

(Returns to SERP tab)

Okay. Let's see here.

Well, I'm not necessarily only looking for newspaper articles, right? I mean, I know this is a recent event.

PI: All you have to do is, once you feel like you have one that would work for you, you're good to go. (22 words)

Really? Okay. Fair enough. I probably could do with this one (returns to "Puerto Rico: Don't Rebuild; Redesign the Power System" article tab). It just doesn't seem like a long enough resource to base anything off of.

PI: I'm not look at whether you chose a scholarly or cool one. If you felt that it would work for you, that's what I'm looking for. (26 words)

It definitely hits the nail on the head, as far as the topic I was shooting for.

(PI provides instructions for continuing usability test by returning to original tab in which the test remains active.)

(Task 5 of 11 is now visible)

PI: we were able to do that [task]. (6 words)

(Clicks)

(Reading) Once you have selected a source, see if you have access to the full text of the source (HTML or PDF). You may need to follow several links to determine if you have access. You should not order via ILLiad. (40 words)

(Clicks yes and next)

Safe to say that this is an HTML, version, here? (returns to article table to show article text)

PI: Yep. (1 words)

Cool.

(Reading) If you have access to the full text, view it (HTML only) or download it (PDF). If you do not have access, skip to the next step. (27 words)

I was able to complete this.

(Clicks Yes and Next)

(Reading) Once you've determined that you DON'T have access to the full text of the source, or you've viewed or downloaded the full text, you have completed this portion of the test. Continue to the next step. (39 words)

(Clicks Yes and Next)

(Reading) Return to the Developer Tools > Network interface. In the list of resource that should appear at the bottom of the interface, right click on any line. Select "Save as HAR with Content" and save the resulting .har file on your desktop with the file name "archive01.har." Repeat with 02, 03, etc. for each open tab. (56 words)

On the desktop?

PI: Anywhere that you know where it is. (7 words)

Okay. (Reading) Repeat with each open tab.

(Saving all HAR files to desktop)

Did I do that correctly? Yep.

Does the order matter?

PI: No. All of this will be organized by timestamp. (9 words)

Okay. I got all 8 of them.

(Clicks Yes and Next)

(Reading) After you complete the remainder of the test, copy the HAR file(s) to a flash drive provided by the principal investigator. (22 words)

(PI gives flash drive to participant, participant saves HAR files to designated folder in drive)

Completed? Yes, next step

(Clicks Yes and Next)

(Reading) In Developer Tools, deselect "Record Network Log" (round icon, should turn gray) and select the "Clear" option (do not enter icon) to clear your history. (25 words)

Could you complete this? Yes

(Clicks Yes and Next)

(Reading) Please click on Done Recording. (5 words)

Okay

Good?

PI: Yep (1 words)

[END OF TRANSCRIPT]

APPENDIX F

PARTICIPANT 1 HAR FILE TIMELINES

Table A6.1

HAR file overview timelines from Participant 1.

HAR File	Page #	Tab/Browser	Timestamp	Description	Search Information
archive01.har	1 of 1	w1	17:46:26.645	Initial ODU Library page load	
archive02.har	1 of 1	w2 t1 SERP	17:50:53.967	Initial search	puerto+rico+power+crisis
archive03.har	1 of 1	w2 t2 SERP	17:52:21.172	Second search	hurricane+maria
archive04.har	1 of 3	w2 t3 SERP	17:53:25.768	Third search, misspelled	hurricane+maria+puetro+rico+power
archive04.har	2 of 3	w2 t3 SERP	17:53:48.472	Third search, corrected (in-page)	hurricane+maria+puerto+rico+power
archive08.har	1 of 2	w2 t4 detail	17:54:42.974	ProQuest logo call	exlibris-pub.s3.amazonaws.com/PQ_Logo.jpg
archive08.har	2 of 2	w2 t4 detail	17:54:44.076	Article detail viewed	
archive04.har	3 of 3	w2 t3 SERP	17:55:37.647	Fourth search (added term)	hurricane+maria+puerto+rico+power+outages
archive07.har	1 of 1	w2 t5 access	17:56:18.232	Title selection	
archive05.har	1 of 1	w2 t6 access	17:56:51.043	Title selection	
archive06.har	1 of 3	w2 t7 MIDAS	17:57:17.725	Login proxy call	login.proxy.lib.odu.edu
archive06.har	2 of 3	w2 t7 Shibboleth	17:57:24.120	Shibboleth call	login.proxy.lib.odu.edu/login?auth=shibboleth
archive06.har	3 of 3	w2 t7 LexisNexis	17:57:28.153	Shibboleth authentication	login.proxy.lib.odu.edu/Shibboleth.sso/SAML2/POST

APPENDIX G

PARTICIPANT 1 SYNCHRONIZED ACTIVITY TIMELINE

Key to terms

- **UT Elapsed Time**: Usability Test elapsed time, in form hh:mm:ss starting at 00:00:00
- **HAR Timestamp**: Timestamp of HAR file activity, in form hh:mm:ss:mss starting at 16:46:35.126 GMT (Greenwich Mean Time)
- **Activity**: What's happening at moment in the environment, on the browser, and with the participant
- **Content**: When useful, information about the search at that timestamp.

Table A7.1

Timeline of Participant 1 synchronized user and browser activity.

UT Elapsed Time	HAR Timestamp	Activity	Content
00:00:00		Start of Usability Test Recording	
00:49:00	17:46:26.645	Participant 1 opens ODU Library page	
	17:46:26.681	GET http://odu.edu/library	
	17:46:26.703	GET https://code.jquery.com/jquery-3.2.1.min.js	
	17:46:26.704	GET http://odu.edu/etc/designs/odu/clientlibs/libs/slick.min.css	
	17:46:26.704	GET http://odu.edu/etc/designs/odu/clientlibs/libs/fontawesome4.min.css	
	17:46:26.704	GET http://odu.edu/etc/designs/odu/clientlibs/libs/slick.min.js	
	17:46:26.704	GET http://odu.edu/etc/designs/odu/clientlibs.min.js	
	17:46:26.704	GET http://odu.edu/etc/designs/odu.css	
	17:46:26.704	GET http://odu.edu/etc/designs/odu/clientlibs/libs/jquery-migrate-3.0.0.min.js	
	17:46:26.704	GET http://odu.edu/etc/designs/odu/clientlibs.min.css	
	17:46:26.705	GET http://odu.edu/library/_jcr_content/par/columns_2/column_0/image.img.280.jpg/1449783741833.jpg	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:46:26.705	GET http://odu.edu/library/_jcr_content/par/columns_2/column_1/image.img.280.jpg/1449783679618.jpg	
	17:46:26.705	GET http://odu.edu/library/_jcr_content/par/columns_2/column_2/image.img.280.jpg/1403193539167.jpg	
	17:46:26.705	GET http://odu.edu/library/_jcr_content/par/columns_3/column_0/image.img.280.jpg/1499270287471.jpg	
	17:46:26.705	GET http://fonts.googleapis.com/css	
	17:46:26.705	GET http://odu.edu/etc/designs/odu/images/odu-crown-breadcrumb-home.png	
	17:46:26.706	GET http://odu.edu/library/_jcr_content/par/columns_3/column_1/image.img.280.jpg/1449695872727.jpg	
	17:46:26.706	GET http://odu.edu/etc/clientlibs/wcm/foundation/accessibility.min.css	
	17:46:26.706	GET http://odu.edu/library/_jcr_content/par/columns_0/column_0/image.img.280.jpg/1427397845012.jpg	
	17:46:26.706	GET http://odu.edu/library/_jcr_content/par/columns_0/column_1/image.img.280.jpg/1427400245315.jpg	
	17:46:26.706	GET http://odu.edu/library/_jcr_content/par/columns_0/column_2/image.img.280.png/1447370819220.png	
	17:46:26.706	GET http://odu.edu/library/_jcr_content/par/columns_3/column_2/image.img.280.jpg/1485280513691.jpg	
	17:46:26.707	GET http://odu.edu/library/_jcr_content/rightpar/section/columns/column_0/image.img.40.png/1414161379932.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:46:26.707	GET http://odu.edu/library/_jcr_content/rightpar/section/columns/column_1/image.img.40.png/1414161412427.png	
	17:46:26.707	GET http://odu.edu/library/_jcr_content/rightpar/section/columns/column_2/image.img.40.png/1414161438916.png	
	17:46:26.708	GET http://odu.edu/settings/_jcr_content/footer-parsys/columns/column_1/image.img.200.png/1476516137858.png	
	17:46:26.975	GET https://platform.twitter.com/widgets.js	
	17:46:26.976	GET http://connect.facebook.net/en_US/all.js	
	17:46:27.017	GET http://fonts.gstatic.com/s/opensans/v15/cJZKeOuBrn4kERxqtaUH3ZBw1xU1rKptJj_0jans920.woff2	
	17:46:27.017	GET http://odu.edu/etc/designs/odu/images/logo-university.png	
	17:46:27.018	GET http://fonts.gstatic.com/s/opensans/v15/MTP_ySUJH_bn48VBG8sNShampu5_7CjHW5spxoeN3Vs.woff2	
	17:46:27.019	GET http://odu.edu/etc/designs/odu/clientlibs/libs/fontawesome4/fonts/fontawesome-webfont.woff2	
	17:46:27.020	GET http://odu.edu/library/_jcr_content/headerimage.img.1280.jpg	
	17:46:27.038	GET http://odu.edu/etc/designs/odu/images/disc-1.gif	
	17:46:27.039	GET http://fonts.gstatic.com/s/opensans/v15/k3k702ZOKiLJc3WVjuplzBampu5_7CjHW5spxoeN3Vs.woff2	
	17:46:27.044	GET http://odu.edu/content/dam/odu/images/webadmin/images/search.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:46:27.068	GET https://connect.facebook.net/en_US/all.js	
	17:46:27.094	GET http://odu.edu/library/_jcr_content/rightpar/section_1159742434/listplaces.nocache.html	
	17:46:27.096	GET http://odu.edu/library/_jcr_content/rightpar/section_1890638568/listplaces.nocache.html	
	17:46:27.097	GET http://odu.edu/library/_jcr_content/rightpar/section_1390515182/listplaces.nocache.html	
	17:46:27.098	GET http://odu.edu/library/_jcr_content/rightpar/section_1561465455/listplaces.nocache.html	
	17:46:27.099	GET http://odu.edu/library/_jcr_content/rightpar/section_782371188/listplaces.nocache.html	
	17:46:27.100	GET http://odu.edu/library/_jcr_content/rightpar/section_891662689/listplaces.nocache.html	
	17:46:27.158	GET http://www.googletagmanager.com/gtm.js	
	17:46:27.377	GET http://odu.edu/content/odu/search/a-to-z-global.html	
	17:46:27.553	GET http://www.google-analytics.com/analytics.js	
	17:46:27.590	GET https://platform.twitter.com/widgets/widget_iframe.34f1d98fbddc2d328cb7fb206fcd1806.html	
	17:46:27.607	GET https://www.google-analytics.com/analytics.js	
	17:46:27.610	GET http://script.crazyegg.com/pages/scripts/0034/9379.js	
	17:46:27.754	GET https://www.facebook.com/impression.php/f37f23cf7d668b/	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:46:27.779	GET http://www.google-analytics.com/collect	
	17:46:27.817	GET https://syndication.twitter.com/settings	
	17:46:27.869	GET https://www.google-analytics.com/collect	
	17:46:27.956	GET https://staticxx.facebook.com/connect/xd_arbiter/r/lY4eZXm_YWu.js	
	17:46:27.958	GET http://staticxx.facebook.com/connect/xd_arbiter/r/lY4eZXm_YWu.js	
	17:46:27.971	GET https://staticxx.facebook.com/connect/xd_arbiter/r/lY4eZXm_YWu.js	
	17:46:28.079	POST https://syndication.twitter.com/i/jot	
	17:46:28.208	GET https://platform.twitter.com/jot.html	
	17:46:28.460	GET https://www.facebook.com/connect/ping	
	17:46:28.461	GET http://staticxx.facebook.com/connect/xd_arbiter/r/lY4eZXm_YWu.js	
	17:46:28.461	GET https://staticxx.facebook.com/connect/xd_arbiter/r/lY4eZXm_YWu.js	
00:02:11		Participant 1 reads Frame of Mind in UT	You are looking for a scholarly source to include in a research project you've been assigned. (If possible, the project should be one you've actually been assigned.) You have come to the ODU Library website to conduct searches to find an appropriate source. In addition to reading aloud the questions as directed during the study, please narrate aloud all search activities for recording — your search terms, your selection of search terms, your review of search results, and your selection of specific links throughout the process. You cannot narrate too much of your activity.

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
00:02:40		Participant 1 reads Task 1 of 11 in UT	Please start by reading the frame of mind directions (above) out loud! Click Next Task when you have done so. Immediately after completing each task click Next Task and read it out loud before performing it. DON'T JUMP AHEAD.
00:03:00		Participant 1 reads Task 2 of 11 in UT	Before conducting a search, open Developer Tools. RIGHT CLICK anywhere on the browser screen and select "Inspect." The Developer Tools will open in a new window that will likely cover everything else on the screen. You can resize the window so you can see these instructions in addition to the Developer Tools.
00:03:27		Participant 1 reads Task 3 of 11 in UT	In the Developer Tools interface, select the "Network" tab or link.
00:03:35		Participant 1 reads Task 4 of 11 in UT	Using the icons that appear under the Network tab, select the "Record Network Log" button (circle icon, should turn red) and the "Capture Screen Shot" button (video icon, should turn blue). Check the "Preserve Log" option, then press Control-R or Command-R (as directed in the Developer Tools).
00:03:40		Background shuffling noise	
00:03:42		Elevator chimes in background	
00:03:49		Participant 1 reads Task 5 of 11 in UT	Reduce the Developer Tools window, return to the main test page (the ODU Library page) and conduct your search. You may conduct as many different searches as needed in order to identify a source that will address your research needs. NOTE: Results will open in tabs in a new window. Each new tab should show Developer Tools. Be sure Recording is on and that Preserve Log is checked on EACH new tab/window. To return to the test, minimize the results window. DO NOT CLOSE TABS OR WINDOWS until the test is complete.
00:04:11		Clicking/latching sound in background	
00:04:20		Grinding sound in background	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
00:04:22		Participant 1 describes public problem to research	
00:04:26		Clicking/latching sound in background	
00:04:42		Voices in background	
00:04:57	17:50:53.967	Participant 1 initiates first search string	Results open in tab in different window
	17:50:54.470	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/dlSearch.do	
	17:50:54.494	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	17:50:54.494	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	17:50:54.494	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	
	17:50:54.495	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	17:50:54.495	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	17:50:54.495	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	
	17:50:54.495	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	
	17:50:54.495	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	17:50:54.495	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:50:54.692	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	17:50:54.693	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	17:50:54.693	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	17:50:54.693	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	17:50:54.694	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/pixel.png	
	17:50:54.694	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_off.png	
	17:50:54.737	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_open_subMenu.png	
	17:50:54.803	GET https://libraryh3lp.com/js/libraryh3lp.js	
	17:50:54.826	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	
	17:50:54.874	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	
	17:50:54.882	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	17:50:54.886	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:50:54.896	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_article.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:50:54.902	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_book.png	
	17:50:54.903	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	17:50:54.929	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_frbr.png	
	17:50:54.966	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_other.png	
	17:50:54.977	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_newspaper.png	
	17:50:55.056	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:50:55.057	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:50:55.058	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:50:55.059	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:50:55.064	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon-person.png	
	17:50:55.065	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-gear.png	
	17:50:55.065	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-star.png	
	17:50:55.066	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-facet-drawer.png	
	17:50:55.104	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/rta.do	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:50:55.106	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_glass_100_f6f6f6_1x400.png	
	17:50:55.106	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_gloss-wave_35_f6a828_500x100.png	
	17:50:55.137	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:50:55.145	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	17:50:55.587	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:50:55.587	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:50:55.588	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:50:55.588	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:50:55.588	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:50:55.588	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:50:55.592	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	17:50:55.593	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	17:50:55.593	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:50:55.593	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	17:50:55.599	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	17:50:55.796	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books/content	
	17:51:20.278	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:51:20.280	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:51:20.282	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:51:20.282	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	17:51:20.283	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_loading_circle.gif	
	17:51:20.666	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_strip_details_links.png	
	17:51:20.666	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bullet_arrow_grey.png	
	17:51:20.667	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:51:20.667	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_sendTo.png	
	17:51:20.667	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-expand.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:51:20.668	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-close.png	
	17:51:20.684	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_popout_tab.png	
	17:51:20.684	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_close_tabs.png	
00:05:06		Dog barks in background	
00:05:21		Participant 1 begins reviewing search results	
00:05:32		Background shuffling noise	
00:05:33		Participant 1 notes date of 2016 on #1 SERP result	
00:05:41		Participant 1 selects "Details" option for #3 SERP result	Does not generate HAR file entry because information is preloaded but hidden
00:05:52		Participant 1 notes date of 2017 on #3 SERP detail	
00:05:56		Background walking sound from hallway	
00:06:00		Participant 1 states need for more recent results	
00:06:04		Participant 1 returns to search page	Does not generate HAR file entry because page is already open
00:06:15		Participant 1 deletes original search terms, ruminates on hurricane name	
00:06:32		Participant 1 initiates second search string	hurricane+maria
00:06:46	17:52:21.584	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/dlSearch.do	
	17:52:21.596	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	17:52:21.596	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:52:21.597	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	17:52:21.597	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	17:52:21.597	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	
	17:52:21.597	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	
	17:52:21.597	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	
	17:52:21.597	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	17:52:21.597	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	17:52:21.817	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	17:52:21.818	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	17:52:21.818	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	17:52:21.818	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	17:52:21.819	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_off.png	
	17:52:21.819	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/pixel.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:52:21.855	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_open_subMenu.png	
	17:52:21.933	GET https://libraryh3lp.com/js/libraryh3lp.js	
	17:52:21.959	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	
	17:52:21.994	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	
	17:52:22.001	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	17:52:22.005	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:52:22.015	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_article.png	
	17:52:22.026	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_video.png	
	17:52:22.028	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	17:52:22.028	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_frbr.png	
	17:52:22.061	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_book.png	
	17:52:22.183	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:52:22.184	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:52:22.185	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:52:22.185	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:52:22.286	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon-person.png	
	17:52:22.287	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-gear.png	
	17:52:22.287	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-facet-drawer.png	
	17:52:22.287	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-star.png	
	17:52:22.324	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/rta.do	
	17:52:22.325	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_gloss-wave_35_f6a828_500x100.png	
	17:52:22.326	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_glass_100_f6f6f6_1x400.png	
	17:52:22.361	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:52:22.371	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	17:52:22.555	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:52:22.555	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:52:22.555	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:52:22.556	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:52:22.556	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:52:22.557	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:52:22.557	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:52:22.557	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:52:22.560	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	17:52:22.562	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	17:52:22.562	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	17:52:22.562	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	17:52:22.562	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	17:52:22.563	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	17:52:22.563	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	17:52:22.570	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	17:52:22.888	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books/content	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:52:22.888	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books/content	
	17:52:22.889	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books/content	
	17:52:22.941	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books/content	
00:07:04		Participant 1 recognizes lack of electrical focus in search results	
07:24:00		Participant 1 returns to search page	Does not generate HAR files because page is already open
00:07:31	17:53:25.893	Participant 1 initiates third search string	hurricane+maria+puetro+rico+power [sic]
	17:53:25.893	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/dlSearch.do	
	17:53:26.035	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	17:53:26.036	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	
	17:53:26.036	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	17:53:26.036	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	17:53:26.036	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	17:53:26.036	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	17:53:26.036	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:53:26.036	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	
	17:53:26.036	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	
	17:53:26.037	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	17:53:26.037	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	17:53:26.037	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	17:53:26.037	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	17:53:26.402	GET https://libraryh3lp.com/js/libraryh3lp.js	
	17:53:26.421	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	
	17:53:26.455	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	
	17:53:26.465	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bullet_square_orange.png	
	17:53:26.531	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/rta.do	
	17:53:26.548	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:53:26.682	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	17:53:26.685	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	17:53:26.703	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
00:07:35		Particpant 1 realizes search yielded no results	
00:08:10		Participant 1 revises search string in current tab	hurricane+maria+puerto+rico+power
	17:53:49.732	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/search.do	
	17:53:49.952	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	17:53:49.953	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	17:53:49.953	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	17:53:49.953	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	17:53:49.953	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	
	17:53:49.953	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	
	17:53:49.953	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:53:49.954	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	17:53:49.954	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	
	17:53:49.954	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	
	17:53:49.955	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	17:53:49.955	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	17:53:49.955	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	17:53:49.956	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/pixel.png	
	17:53:49.956	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_off.png	
	17:53:49.987	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_open_subMenu.png	
	17:53:50.341	GET https://libraryh3lp.com/js/libraryh3lp.js	
	17:53:50.359	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	
	17:53:50.386	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:53:50.393	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:53:50.399	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	17:53:50.404	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_newspaper.png	
	17:53:50.411	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_article.png	
	17:53:50.414	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	17:53:50.420	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_frbr.png	
	17:53:50.525	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:53:50.526	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:53:50.527	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:53:50.533	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon-person.png	
	17:53:50.533	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-gear.png	
	17:53:50.534	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-star.png	
	17:53:50.535	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-facet-drawer.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:53:50.561	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/rta.do	
	17:53:50.562	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_gloss-wave_35_f6a828_500x100.png	
	17:53:50.563	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_glass_100_f6f6f6_1x400.png	
	17:53:50.593	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:53:50.600	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	17:53:50.752	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	17:53:50.754	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	17:53:50.754	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	17:53:50.757	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	17:54:07.900	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:54:07.901	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:54:07.903	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:54:07.903	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:54:07.903	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_loading_circle.gif	
	17:54:08.148	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_strip_details_links.png	
	17:54:08.149	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bullet_arrow_grey.png	
	17:54:08.149	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_sendTo.png	
	17:54:08.149	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:54:08.150	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-expand.png	
	17:54:08.150	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-close.png	
	17:54:08.162	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_popout_tab.png	
	17:54:08.162	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_close_tabs.png	
	17:54:08.162	GET https://exlibris-pub.s3.amazonaws.com/PQ_Logo.jpg	
	17:54:08.162	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_open_proquestCollections.png	
	17:54:08.163	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_close_proquestCollections.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:54:36.150	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:54:36.152	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:54:36.309	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/error.do	
	17:54:36.431	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/log	
00:08:26		Participant 1 expresses interest in #1 SERP result	
00:08:30		Participant 1 selects "Details" option for #1 SERP result	Does not generate HAR file entry because information is preloaded but hidden
00:09:07	17:54:44.076	Participant 1 selects #1 SERP result	Opens in new tab
	17:54:44.398	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/display.do	
	17:54:44.487	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	17:54:44.487	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	17:54:44.487	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	17:54:44.487	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	
	17:54:44.488	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	17:54:44.488	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:54:44.488	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	
	17:54:44.488	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	17:54:44.488	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	
	17:54:44.489	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	17:54:44.489	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	17:54:44.489	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	17:54:44.501	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_open_proquestCollections.png	
	17:54:44.501	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_close_proquestCollections.png	
	17:54:44.501	GET https://exlibris-pub.s3.amazonaws.com/PQ_Logo.jpg	
	17:54:44.504	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	17:54:44.504	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	17:54:44.759	GET https://libraryh3lp.com/js/libraryh3lp.js	
	17:54:44.762	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:54:44.775	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	
	17:54:44.798	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	17:54:44.809	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:54:44.812	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:54:44.812	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_sendTo.png	
	17:54:44.824	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_strip_details_links.png	
	17:54:44.824	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bullet_arrow_grey.png	
	17:54:45.166	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:54:45.167	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	17:54:45.169	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	17:54:45.187	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	17:54:59.786	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:54:59.786	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:54:59.787	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_loading_circle.gif	
	17:55:01.175	GET https://odu.userservices.exlibrisgroup.com/view/uresolver/01ODU_INST/openurl	
	17:55:01.207	GET https://odu.userservices.exlibrisgroup.com/view/skins/default/css/otb_mashup.css	
	17:55:01.207	GET https://odu.userservices.exlibrisgroup.com/view/branding_skin/css/mashup.css	
	17:55:01.207	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery-mashup.js	
	17:55:01.207	GET https://odu.userservices.exlibrisgroup.com/view/javascript/uresolverScripts.js	
	17:55:01.208	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery.js	
	17:55:01.208	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
00:09:20		Participant 1 expresses confusion about limited article types in results	
00:09:21		Participant 1 selects "Access" option for Result	Does not generate HAR file entry because information is preloaded but hidden
00:09:31		Participant 1 returns to SERP tab	Does not generate HAR files because tab is already open
00:10:01	17:55:37.647	Participant 1 initiates fourth search string	hurricane+maria+puerto+rico+power+outages
	17:55:39.089	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/search.do	
	17:55:39.344	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:55:39.344	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	17:55:39.344	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	17:55:39.344	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	
	17:55:39.345	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	17:55:39.345	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	
	17:55:39.345	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	
	17:55:39.345	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	17:55:39.345	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	
	17:55:39.346	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	17:55:39.346	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	17:55:39.347	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	17:55:39.347	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/pixel.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:55:39.347	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	17:55:39.348	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_off.png	
	17:55:39.369	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_open_subMenu.png	
	17:55:39.381	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	17:55:39.780	GET https://libraryh3lp.com/js/libraryh3lp.js	
	17:55:39.803	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	
	17:55:39.831	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	
	17:55:39.834	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:55:39.840	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_newspaper.png	
	17:55:39.845	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_article.png	
	17:55:39.846	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	17:55:39.954	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:55:39.955	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:55:39.955	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:55:39.961	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-gear.png	
	17:55:39.961	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon-person.png	
	17:55:39.962	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-star.png	
	17:55:39.962	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-facet-drawer.png	
	17:55:40.002	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/rta.do	
	17:55:40.003	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_gloss-wave_35_f6a828_500x100.png	
	17:55:40.004	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_glass_100_f6f6f6_1x400.png	
	17:55:40.046	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:55:40.196	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	17:55:40.199	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	17:55:40.222	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	17:55:49.767	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:55:49.768	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:55:49.769	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:55:49.770	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_loading_circle.gif	
	17:55:49.770	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	17:55:50.022	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bullet_arrow_grey.png	
	17:55:50.022	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_strip_details_links.png	
	17:55:50.023	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:55:50.023	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_sendTo.png	
	17:55:50.023	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-expand.png	
	17:55:50.024	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-close.png	
	17:55:50.034	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_popout_tab.png	
	17:55:50.034	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_close_tabs.png	
	17:55:50.035	GET https://exlibris-pub.s3.amazonaws.com/PQ_Logo.jpg	
	17:55:50.035	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_close_proquestCollections.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:55:50.035	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_open_proquestCollections.png	
	17:56:05.250	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:56:05.252	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:56:05.253	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:56:05.253	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	17:56:06.350	GET https://odu.userservices.exlibrisgroup.com/view/uresolver/01ODU_INST/openurl	
	17:56:06.360	GET https://odu.userservices.exlibrisgroup.com/view/skins/default/css/otb_mashup.css	
	17:56:06.360	GET https://odu.userservices.exlibrisgroup.com/view/branding_skin/css/mashup.css	
	17:56:06.360	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery-mashup.js	
	17:56:06.361	GET https://odu.userservices.exlibrisgroup.com/view/javascript/uresolverScripts.js	
	17:56:06.361	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery.js	
	17:56:06.362	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
00:10:06		Participant 1 appears to identify a qualified result	
00:10:13		Participant 1 selects "Details" option for #3 SERP result	Does not generate HAR file entry because information is preloaded but hidden

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
00:10:28		Participant 1 selects "Access It" option for #3 SERP result	
00:10:31		Participant 1 selects "Open source in a new window" option	Opens detail in new tab
	17:56:19.093	GET https://odu.userservices.exlibrisgroup.com/view/uresolver/01ODU_INST/openurl	
	17:56:19.102	GET https://odu.userservices.exlibrisgroup.com/view/skins/default/css/otb_mashup.css	
	17:56:19.102	GET https://odu.userservices.exlibrisgroup.com/view/branding_skin/css/mashup.css	
	17:56:19.102	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery-mashup.js	
	17:56:19.190	GET https://odu.userservices.exlibrisgroup.com/view/javascript/uresolverScripts.js	
	17:56:19.190	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery.js	
	17:56:19.190	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
00:10:45		Participant 1 appears confused about options to access selected result	
00:10:45		Participant 1 returns to SERP tab	Does not generate HAR file entry because tab is already loaded
00:10:55		Participant 1 selects "Open source in a new window" option	Opens detail in new tab
	17:56:51.475	GET https://odu.userservices.exlibrisgroup.com/view/uresolver/01ODU_INST/openurl	
	17:56:51.487	GET https://odu.userservices.exlibrisgroup.com/view/skins/default/css/otb_mashup.css	
	17:56:51.487	GET https://odu.userservices.exlibrisgroup.com/view/branding_skin/css/mashup.css	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:56:51.487	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery-mashup.js	
	17:56:51.724	GET https://odu.userservices.exlibrisgroup.com/view/javascript/uresolverScripts.js	
	17:56:51.724	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery.js	
	17:56:51.724	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
00:11:18		Participant 1 returns to SERP tab	Does not generate HAR file entry because tab is already loaded
00:11:28		Participant 1 returns to #3 SERP result detail	Does not generate HAR file entry because tab is already loaded
00:11:32		Participant 1 selects "LexisNexis Academic" access option	Opens in same tab
	17:57:17.750	GET https://login.proxy.lib.odu.edu/login	
00:11:46		Participant 1 selects "Click to login using your MIDAS account"	Opens in same tab
	17:57:24.157	GET https://login.proxy.lib.odu.edu/login	Generates call to Shibboleth login
00:11:47		Previous selection automatically generates Shibboleth page	
	17:57:24.525	POST https://shibboleth.odu.edu/idp/profile/SAML2/POST/SSO	
	17:57:24.544	GET https://shibboleth.odu.edu/idp/profile/SAML2/POST/SSO	
	17:57:24.558	GET https://shibboleth.odu.edu/css/main.css	
	17:57:24.558	GET https://shibboleth.odu.edu/css/mediaqueries.css	
	17:57:24.558	GET https://shibboleth.odu.edu/libs/bootstrap-3.3.6/css/bootstrap.min.css	
	17:57:24.559	GET https://shibboleth.odu.edu/libs/font-awesome-4.6.3/css/font-awesome.min.css	
	17:57:24.559	GET https://shibboleth.odu.edu/img/logo.png	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:24.559	GET https://shibboleth.odu.edu/img/header_images/0.jpg	
	17:57:24.835	GET https://shibboleth.odu.edu/fonts/OpenSans-Regular.ttf	
	17:57:24.837	GET https://shibboleth.odu.edu/fonts/OpenSans-Bold.ttf	
	17:57:24.856	GET https://shibboleth.odu.edu/libs/font-awesome-4.6.3/fonts/fontawesome-webfont.woff2	
	17:57:25.106	GET https://shibboleth.odu.edu/idp/profile/SAML2/POST/img/favicon.ico	
00:11:50		Previous selection automatically generates an approval page	Opens in the the same tab
	17:57:29.185	POST https://shibboleth.odu.edu/idp/profile/SAML2/POST/SSO	
	17:57:29.436	GET https://shibboleth.odu.edu/favicon.ico	
00:11:53		Approval page automatically redirects to selected resource	Opens resource in same tab
	17:57:29.764	POST https://login.proxy.lib.odu.edu/Shibboleth.sso/SAML2/POST	
	17:57:29.765	GET https://login.proxy.lib.odu.edu/connect	
	17:57:29.766	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/	
	17:57:29.766	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic	
	17:57:29.775	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/js/utilsStatless.js	
	17:57:29.775	GET http://www-lexisnexis-com.proxy.lib.odu.edu/clients/jslib/jquery/jquery-1.2.6.min.js	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:29.775	GET http://www-lexisnexis-com.proxy.lib.odu.edu/clients/jslib/popups.js	
	17:57:29.775	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/Home_files/axurerp_pagespecificstyles.css	
	17:57:29.775	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/js/jquery-latest.min.js	
	17:57:29.775	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/cssFramework.css	
	17:57:29.775	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/_stylesheet.css	
	17:57:29.850	GET http://www-lexisnexis-com.proxy.lib.odu.edu/clients/controls/MasterQuery/MQInclude.asp	
	17:57:29.850	GET http://www-lexisnexis-com.proxy.lib.odu.edu/clients/jslib/utils.js	
	17:57:29.850	GET http://www-lexisnexis-com.proxy.lib.odu.edu/clients/controls/fusion/FusionInclude.asp	
	17:57:29.851	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/js/cookies.js	
	17:57:29.851	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/js/RestoreSearch.js	
	17:57:29.851	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/js/commonForm.js	
	17:57:29.851	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/js/common.js	
	17:57:29.852	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/js/jquery-ui-1.7.2.custom.min.js	
	17:57:29.852	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/js/jquery-1.3.2.min.js	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:29.852	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/new_stylesheet.css	
	17:57:29.852	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/images_date/jquery-1.9.1.js	
	17:57:29.852	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/js/IFrameResizer.js	
	17:57:29.852	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/new_Jscript.js	
	17:57:29.853	GET http://www-lexisnexis-com.proxy.lib.odu.edu/clients/shared/images/popup_arrowUp.gif	
	17:57:29.853	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/js/GAnalytics.js	
	17:57:30.761	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/newimages/ProductName.png	
	17:57:30.773	GET http://www-lexisnexis-com.proxy.lib.odu.edu/clients/shared/images/connectorFade.jpg	
	17:57:30.776	GET http://www.googletagmanager.com/gtm.js	
	17:57:30.886	GET http://js.bizographics.com/insight.min.js	
	17:57:30.887	GET http://www.googleadservices.com/pagead/conversion_async.js	
	17:57:30.888	GET http://www.google-analytics.com/analytics.js	
	17:57:30.891	GET http://platform.twitter.com/oct.js	
	17:57:30.892	GET https://connect.facebook.net/en_US/fbevents.js	
	17:57:30.893	GET https://b2btagmgr.azalead.com/tag	
	17:57:30.897	GET https://www.google-analytics.com/analytics.js	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:30.950	GET https://googleads.g.doubleclick.net/pagead/viewthroughconversion/994977571/	
	17:57:30.955	GET https://googleads.g.doubleclick.net/pagead/viewthroughconversion/978398205/	
	17:57:30.960	GET https://googleads.g.doubleclick.net/pagead/viewthroughconversion/1047685741/	
	17:57:30.962	GET https://static.ads-twitter.com/oct.js	
	17:57:30.971	GET https://connect.facebook.net/signals/config/154315271664076	
	17:57:30.996	GET http://www.google-analytics.com/r/collect	
	17:57:31.099	GET https://www.google-analytics.com/r/collect	
	17:57:31.112	GET https://www.facebook.com/tr/	
	17:57:31.169	POST http://www-lexisnexis-com.proxy.lib.odu.edu/clients/controls/fusion/GetRosettaSourceInfo.aspx	
	17:57:32.102	GET http://www-lexisnexis-com.proxy.lib.odu.edu/hottopics/lnacademic/properties.txt	
	17:57:32.344	GET https://bid.g.doubleclick.net/xbbe/pixel	
	17:57:32.433	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/api/version1/sr	
	17:57:32.563	GET http://www-lexisnexis-com.proxy.lib.odu.edu/favicon.ico	
	17:57:33.270	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/api/version1/sr	
	17:57:33.271	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/auth/checkbrowser.do	
	17:57:33.306	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/googleFontOpenSans.css	
	17:57:33.310	GET https://www.facebook.com/tr/	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:33.409	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/webfonts/OpenSans-Regular.ttf	
	17:57:34.609	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/auth/checkbrowser.do	
	17:57:34.616	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/results/resultsInclude.js	
	17:57:34.616	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/results/results.js	
	17:57:34.617	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/djs/results/results1_en_US_enAcademic.js	
	17:57:34.617	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/djs/results/results2_en_US_enAcademic.js	
	17:57:34.617	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/common.js	
	17:57:34.617	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/dojo/dojo.js	
	17:57:34.617	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/djs/results/results_en_US_enAcademic.js	
	17:57:35.271	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/frame.do	
	17:57:35.277	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/frame.do	
	17:57:35.277	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/subModal.css	
	17:57:35.277	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/Global.css	
	17:57:35.277	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/Styles.css	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:35.278	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/results/results.js	
	17:57:35.278	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/djs/history/searchHistoryJS_en_US_enAcademic.js	
	17:57:35.278	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/djs/results/results_en_US_enAcademic.js	
	17:57:35.278	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/visualdesign.css	
	17:57:35.315	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/frame.do	
	17:57:35.316	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/frame.do	
	17:57:35.321	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/mynexis/subModalcommon.js	
	17:57:35.321	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/djs/results/resultsDateValidations_en_US_enAcademic.js	
	17:57:35.321	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/dwr/interface/MyNexisManagerAjaxService.js	
	17:57:35.321	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/common.js	
	17:57:35.321	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/mynexis/subModal.js	
	17:57:35.322	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/dojoSubmit.js	
	17:57:35.322	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/dojo/dojo.js	
	17:57:35.322	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/djs/cart/addToCartJS_en_US_enAcademic.js	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:35.323	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/ButGoSec.gif	
	17:57:35.323	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/ButGoDis.gif	
	17:57:35.323	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconPaginationPreviousDis.gif	
	17:57:35.323	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/s.gif	
	17:57:35.324	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconInfo.gif	
	17:57:35.324	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconPaginationNextDis.gif	
	17:57:35.324	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/djs/cart/cartJS_en_US_enAcademic.js	
	17:57:35.325	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconDeliveryPrint.gif	
	17:57:35.325	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconDeliveryEmail.gif	
	17:57:35.325	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconDeliveryDownload.gif	
	17:57:35.325	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconBibliography.gif	
	17:57:35.325	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconCopyUrl.gif	
	17:57:35.325	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/Icon-Cloud.png	
	17:57:35.337	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/results/results.js	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:35.337	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/djs/results/results1_en_US_enAcademic.js	
	17:57:35.337	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/djs/results/results_en_US_enAcademic.js	
	17:57:35.337	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/results/annotations.js	
	17:57:35.337	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/results/casebase.js	
	17:57:35.337	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/results/xmlCross.js	
	17:57:35.338	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/mynexis/subModalcommon.js	
	17:57:35.338	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/mynexis/subModal.js	
	17:57:35.338	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/dojo/dojo.js	
	17:57:35.338	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/dojoSubmit.js	
	17:57:35.338	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/Global.css	
	17:57:35.338	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/djs/results/resultsDateValidations_en_US_enAcademic.js	
	17:57:35.339	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/CommonStyles.css	
	17:57:35.339	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/Crosslinking.css	
	17:57:35.339	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/subModal.css	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:35.339	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/Styles.css	
	17:57:35.339	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/ltnStyles.css	
	17:57:35.340	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/wordwheel/jquery-1.4.3.min.js	
	17:57:35.340	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/wordwheel/jquery-ui-1.8.custom.min.js	
	17:57:35.340	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/common.js	
	17:57:35.340	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/wordwheel/legaltermsnav.js	
	17:57:35.340	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/annotations.css	
	17:57:35.340	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/wordwheel/tools.tooltip-1.1.3.js	
	17:57:35.341	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/JQueryHighlight.js	
	17:57:35.341	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/ButShowOriginalEnglish.gif	
	17:57:35.341	GET https://translate-google-com.proxy.lib.odu.edu/translate_a/element.js	
	17:57:35.342	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconCloseX.gif	
	17:57:35.342	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconInfo.gif	
	17:57:35.342	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/arrow_blue.gif	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:35.451	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/plugins/jquery-1.6.2.js	
	17:57:35.451	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/Styles.css	
	17:57:35.451	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/Cvd.css	
	17:57:35.451	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/common.js	
	17:57:35.451	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/bct.js	
	17:57:35.451	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/Global.css	
	17:57:35.452	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/s.gif	
	17:57:35.452	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/djs/cadmin/cadmin_en_US_enAcademic.js	
	17:57:35.452	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/djs/common/common_en_US_enAcademic.js	
	17:57:35.452	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/mynexis/subModalcommon.js	
	17:57:35.452	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/mynexis/subModal.js	
	17:57:35.452	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/subModal.css	
	17:57:35.452	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/otherbrowsers.css	
	17:57:35.453	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/waResource.js	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:35.485	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/subModal.css	
	17:57:35.485	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/Cvd.css	
	17:57:35.485	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/mynexis/subModalcommon.js	
	17:57:35.486	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/js/mynexis/subModal.js	
	17:57:35.486	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/Global.css	
	17:57:35.486	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/visualdesign.css	
	17:57:35.486	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/stylesheets/Styles.css	
	17:57:35.486	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/FirstPrevMapGryd.gif	
	17:57:35.486	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/s.gif	
	17:57:35.487	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/NextLastMapOn.gif	
	17:57:35.516	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/s.gif	
	17:57:35.517	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/ButNarrowSearchWithIndexTermsDis.gif	
	17:57:35.517	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/ButNarrowSearchWithIndexTermsSec.gif	
	17:57:35.517	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/ButModifySearchWithSelectionsDis.gif	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:35.517	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/ButModifySearchWithSelectionsSec.gif	
	17:57:35.518	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/ButClose.gif	
	17:57:35.518	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconInfo.gif	
	17:57:35.518	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconPaginationFirstDis.gif	
	17:57:35.519	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconPaginationNextDis.gif	
	17:57:35.519	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconPaginationLastDis.gif	
	17:57:35.519	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/IconPaginationPreviousDis.gif	
	17:57:35.519	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/re-logo.png	
	17:57:35.519	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/LexisNexisFooter.png	
	17:57:36.055	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/s.gif	
	17:57:36.530	GET https://translate.googleapis.com/translate_static/css/translateelement.css	
	17:57:36.530	GET https://translate.googleapis.com/translate_static/js/element/main.js	
	17:57:36.531	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/s.gif	
	17:57:36.544	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/GradIntermediaryScreens.gif	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:36.659	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/s.gif	
	17:57:36.670	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/TabBG.gif	
	17:57:36.671	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/TabLeftBG.gif	
	17:57:36.671	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/TabRightBG.gif	
	17:57:36.687	GET https://translate.googleapis.com/element/TE_20170911_00/e/js/element/element_main.js	
	17:57:36.690	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/s.gif	
	17:57:36.733	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/s.gif	
	17:57:36.756	GET http://webanalytics.lexisnexis.com.proxy.lib.odu.edu/wa_rosettaacademic.watag	
	17:57:36.847	GET https://translate.googleapis.com/translate_a/l	
	17:57:36.850	GET https://www.gstatic.com/images/branding/product/2x/translate_24dp.png	
	17:57:36.856	GET https://www.gstatic.com/images/branding/product/1x/translate_24dp.png	
	17:57:36.856	GET https://www.gstatic.com/images/branding/googlelogo/1x/googlelogo_color_42x16dp.png	
	17:57:37.072	GET https://translate.googleapis.com/translate_static/css/translateelement.css	
	17:57:37.074	GET https://translate.googleapis.com/translate_static/img/te_ctrl3.gif	
	17:57:37.077	GET http://translate.google.com/gen204	

Table A7.1 continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:57:37.078	GET https://www.gstatic.com/images/branding/googlelogo/1x/googlelogo_color_68x28dp.png	
	17:57:37.078	GET https://www.google.com/images/cleardot.gif	
	17:57:37.078	GET https://translate.googleapis.com/translate_static/img/loading.gif	
	17:57:37.084	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/FirstPrevMapGryd.gif	
	17:57:37.084	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/NextLastMapOn.gif	
	17:57:37.085	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/FirstPrevMapOn.gif	
	17:57:37.085	GET http://www-lexisnexis-com.proxy.lib.odu.edu/lnacui2api/images/NextLastMapGryd.gif	
	17:57:37.312	GET https://translate.googleapis.com/translate_static/css/translateelement.css	
	17:57:37.320	GET https://translate.googleapis.com/translate_static/css/translateelement.css	
	17:57:37.333	GET https://translate.googleapis.com/translate_static/img/te_bk.gif	
00:12:34		Participant 1 returns to SERP tab	Does not generate HAR file activity because content is preloaded
00:13:30		Participant 1 concludes UT	

APPENDIX H

PARTICIPANT 3 USABILITY TESTING TRANSCRIPT

Participant 3 (also includes exchanges with P4 and P5, indicated by blue indented text)

Word Counts

- *P4 & P5: Blue*
- *Commentary (not think-aloud): Green*
- *Think-Aloud: Red*
- *Reading: Aqua*

[START OF TRANSCRIPT]

P3: Okay

PI: Alright, did it, the thing I want to check, did it open in the browser? It did not. (18 words)

P3 and P4: No

PI: <to both P3 & P4> So it is — uh, would you scroll down there? No, on this side. (14 words)

P4: Oh, there.

PI: Um. (1 words)

P4: Um.

PI: <to both P3 & P4> Yes, Click the, that little button there, see if it'll open. Seems like it's opening, and it's hiding. <clicks, sucking teeth> I don't know why. <mumbles> That's the right size. So you can just copy and paste that directly into there. <To P3> Same thing with you. Um. This. What I want to do is make sure that this window isn't covered over there. So if you would, I think it — yeah. (67 words)

P4: In the same tab, or a new tab? Um.

PI: It doesn't — same tab is fine. And then, so are we clicking more down here? Can you scroll down? It's that little thing right there. (26 words)

P4: Oh here.

PI: Yeah, is there something? Pull that out back, to the right. To the right. (14 words)

P4: Here?

PI: Just press it. Okay. That's good. And let it go. (18 words)

<incoherent mumbling>

PI: Go ahead and click that. So preserve log. Would you refresh that, double check, to be sure it's doing everything it needs to be. Okay. Good. (26 words)

P3: Should I just copy this and put it in the browser? (11 words)

PI: Yes. (1 words)

P3 computer time: 12:46 PM (on P3 computer)

HAR timestamp: 16:46:35.126

Opens: in current tab, ODU Library Page [Developer Tools already on and recording]
Corresponds to: page 2 in p3-archive01.har

HAR timestamp: 16:46:43.060
Refreshes: in current tab, ODU Library Page [Developer Tools capture this as a second page load]
Corresponds to: page 3 in p3-archive01.har

P4: It won't let me go there…

PI: It won't let you go there. — Hmm. — It may be case sensitive. Upper case D, upper case T, upper case H. (23 words)

P4: Oh, okay.

PI: I think. I think that's what the deal is. So it's doing an impression test. And it should be, I think, and it should, get rid of it and ask you some questions. Did it do that yet? (38 words)

P3 & P4: No. (1 words)

PI: It's recording. Alright. So click Next Task. So remember to read information at the top, read each task, then go and click the next task, once you've finished doing the task, it says to do. (35 words)

P3: <reading> Look at the site for about 15 seconds… (8 words)

PI: <to P5> Name and email address, if you would. (7 words)

P4: <in background> You are looking for a scholarly…

P3: <reading> Please start by reading the frame of mind directions (above) out loud (12 words)

<P4 or P5 asking question in the background>

P3: <reading> Click next task when you have done so. (8 words)

<PI and P4 speaking in background>

P3: <inaudible whispering to self>

<PI and P4 speaking in background throughout>

P3: <reading frame of mind directions> You are looking for a scholarly source to include in a research project you've been assigned. (If possible, the project should be one you've actually been assigned.) You have come to the ODU Library website to conduct searches to find an appropriate source. In addition to reading aloud the questions as directed during the study, please narrate aloud all search activities for recording — your search terms, your selection of search terms, your review of search results, and your selection of specific links throughout the process. You cannot narrate too much of your activity. (94 words)

PI: <in background to P5> An unusual dissertation topic, but — as soon as, there it goes, go ahead and install it, if you would. (20 words)

P3: <reading quietly> Conduct your search by… <appears to continue reading, too quiet to be heard> (4 words)

P5: <inaudible question while P3 reads>

PI: <while P3 reads> Yes, please, go ahead and read, all the tasks (9 words)

P3: <reading> Conduct your search by entering your search term(s) in the search box. You may conduct as many different searches as needed in order to identify a source that will address your research needs. NOTE: Results will open in tabs in a new window. Each new tab should show Developer Tools. Be sure Recording is on and that Preserve Log is checked on EACH new tab/window. To return to the test, minimize the results window. DO NOT CLOSE TABS OR WINDOWS until the test is complete. (87 words)

<P5 and PI hold unintelligible conversation in background while P3 reads; PI providing instructors to P5 since P5 arrived to testing session late and P3 and P4 had already started testing.>

P5: So return to, minimize <unintelligible>

PI: Oh, we didn't install it. (5 words)

P5: <unintelligible>

PI: You are free to ask me questions, don't feel like you have to— (13 words)

P3: Should I— us, sorry, should I go ahead and like put it in the search now, or keep doing this? (20 words)

PI: <stuttering> If we're at the point where you are starting your search, from now on, you just search. So you don't have to do anything until you're finished with that, but do read that at some point. (36 words)

P3: Yeah, I read it, I just read it out loud, uh— (11 words)

PI: In that case, it's— (4 words)

P3: Yeah (1 words)

PI: So you haven't been able to because — you haven't done your search. (13 words)

P3: So just, start— (3 words)

PI: This is where start your— (5 words)

P3: Okay. Alright, so, I'm going to put in my topic into the search bar, I think I'm going to search <typing as she speaks> "the effects of deforestation" <hits enter>. (24 words)

P3 computer time: 12:50 PM (on P3 computer)
Opens: SERP in new tab

HAR timestamp: None (Developer Tools not running in new tab)

Corresponds to: Nothing captured in HAR file yet

<P3 appears confused by the lack of developer tools at the bottom of the tab that opens with the search results. She requests assistance from PI. While P3 expresses confusion by shifting from the search interface tab to the results tab and back, PI is talking with P4 and P5.>

P3: Refresh this tab. (3 words)

PI <to P4>: If you'll go back. So. Keep going back. What I'd like for you to do is… you've read that already? (20 words)

P4: Yep.

PI <to P4>: So now is where you actually do a search. (9 words)

P4: Ohhh.

PI <to P4>: Once you've finished with that, go ahead and do a search. Perfectly fine. (13 words)

P3: I need to make sure (5 words)

P4: Oh. Ah. Okay.

PI <to P4>: So just do your search, but tell me about what you're entering, why you're entering it. (16 words)

P3 <to PI>: Is it supposed to come up at the bottom when I put in a new… (15 words)

PI <to P3>: It should have. (3 words)

P3: Yeah, I was confused about that. (6 words)

PI: Right, so if you'll go back to that tab <pointing to results tab>— (9 words)

P3: This one? (2 words)

PI: Mmhmm, right click anywhere… Thank you so much for checking. (10 words)

P3: Inspect? (1 words)

PI: Mmhmm. And go to the Network tab, and let's be sure that Preserve Log is set to on; it is recording. And then refresh. (24 words)

P3: Okay. (1 words)

PI: Thank you. (2 words)

P3: No problem. <Mumbling>. Okay, here we go. (6 words)

P3 computer time: 12:51 PM (on P3 computer)
Opens: Refreshes SERP in current tab

HAR timestamp: 16:51:21.439

Corresponds to: page 1 in p3-archive02.har

PI <to P5>: Just find where that is, and then hit next. Just find the application… <PI continues talking indistinctly with P5 throughout the next P3 think-aloud browsing session, sometimes interspersed with distinct words and phrases>. (13 words)

P3: Alright. So, it shows me the ecology of mosquitoes under climate change, so that's not really what I'm looking for, um, <reading> "volume two applying forest science," "Quantifying…" So I'm going to click this "Quantifying the effects of deforestation" because it seems like it might be the closest thing to what I'm looking for. <clicks title> (53 words)

P3 computer time: 12:51 PM (on P3 computer)
Opens: in current tab, detail for "Quantifying the effects of deforestation" article

HAR timestamp: 16:51:59.074

Corresponds to: page 2 in p3-archive02.har

PI <continuing in background to P5>: I'm not looking at how you choose to do your search, I'm looking at the data that gets generated by the search. So to me the search is… <inaudible as P3 continues think-aloud session> (28 words)

P3: So I'm going to read the description to see if it's anything of what I'm looking for. Ummm. <reading> "The impact of extensive changes in land use and climate on species has led to an increasing focus on large-scale conservation planning. However, these plans are often static conservation prescriptions…" So this is focusing… I'm going to "Access It" and see if it has any more, um, in it, but— <clicks "Open source in a new window" link>. (68 words)

<"Access it" link opens in new tab on which developer tools are not running. This is the exlibrisgroup access page>

P3 computer time: 12:52 PM (on P3 computer)
Opens: Access options in new tab

HAR timestamp: None (Developer Tools not running in new tab)

Corresponds to: Nothing captured in HAR file

P3: Okay, so then I have to access it… again <clicks on "Elsevier SD Freedom Collection" link> (9 words)

<Elsevier collection link opens in new tab on which developer tools are not running. This is the ODU Midas Account Access page>

P3 computer time: 12:52 PM (on P3 computer)
Opens: ODU Midas Account Access page in new tab

HAR timestamp: None (Developer Tools not running in new tab)

Corresponds to: Nothing captured in HAR file

P3: It's going to make me log in, because I guess I'm not logged in <clicks "Click to login using your MIDAS account" button> (14 words)

<Login button link opens in new tab on which developer tools are not running. This is the Monarch-Key MIDAS ID and Password page>

P3 computer time: 12:52 PM (on P3 computer)
Opens: Monarch-Key MIDAS ID and Password entry page in new tab

HAR timestamp: None (Developer Tools not running in new tab)

Corresponds to: Nothing captured in HAR file

<After successful login, tab redirects to article page>

P3 computer time: 12:52 PM (on P3 computer)
Opens: Shibboleth success followed by article in new tab

HAR timestamp: None (Developer Tools not running in new tab)

Corresponds to: Nothing captured in HAR file

P3: It's redirecting me. Okay. So it's brought me back to another abstract, so I'm just going to read. This is more of an <unintelligible>. I'm going to close this ad out. I don't need that. Um. <reading from abstract> "The impact of… okay. So I'm going to download the PDF, so I can see what— (51 words)

<Suddenly returns to "Access it" link page tab, appears to realize developer tools are not open and data has not been collected. Clicks refresh button in browser.>

<Shifts to article tab (4th tab from left on screen), closes Advertisement popup box ["Other users also viewed these articles" with list of articles below, then right clicks, selects Inspect, then check Preserve Log option>

P3: I have to click Inspect, because it keeps doing that. Make sure it's still going on. <clicks browser refresh button> (16 words)

P3 computer time: 12:54 PM (on P3 computer)
Opens: in tab 4, refreshes article page

HAR timestamp: 16:54:08.789

Corresponds to: page 1 on p3-archive03.har

<shifts to PDF tab (5th tab from left on screen), right clicks, selects "inspect" option to open developer tools, which open in a new window rather than at the bottom of the page>

P3: Got to inspect, I don't know what just happened <closed inspector tools window> (9 words)

P3: <right clicks on page again> Inspect <developer tools open in new window as before> (1 words)

PI <in background, to P5, as P3 is working on developer tools in tab 5>: So, if you go to network tab, you want to be sure on every page that the recording button is on <unintelligible> and that Preserve log is working. (28 words)

P3: <selects network tab and checks preserve log button, then closes developer tools window on tab 5 and tries to refresh, but does not see refresh option [it's replaced with Chrome's PDF reader options]>

PI <to P5>: So the thing that's going to happen, is when you open the next page, you're going to want to be sure that every new tab, every new page— (28 words)

P3: Um. <minimizes window and reveals TryMyUI Impression Test window; uses taskbar to bring up active window with tab 5 PDF showing. Selects tab 4 (article tab). Does not appear to see what P3 is seeking, so returns to taskbar. Returns to active tab 4 (article tab), closes Activate ScienceDirect popup ad, then returns to tab 5 (PDF tab).> (1 words)

PI <to P5, continuing>: —has those settings in place: inspect is on, recording, preserve log checked. So let's go back to that window you were at before, probably minimize this window <unintelligible>. Okay, start. You can start the test, when you're ready— (38 words)

P3: Aaaand. <Right clicks on page, selects Inspect to open Developer Tools, selects Network tab, checks record but not preserve log, refreshes tab using the keyboard (presumably control+R). Closes Developer Tools, sees "Error: Failed to load PDF document" message in window, selects "Refresh" button. However, none of these actions appears to have generated any HAR file activity, according to the HAR files saved by P3 following the testing session. While P3 performs these tasks, PI and P5 continue conversing in background.> (1 words)

P5 <to PI>: How long will it take?

PI <to P5, louder>: It will only take, we'll be doing this about, no more than about 15 minutes. (15 words)

P5 <to PI>: Wow, I'll be speaking the whole time?

PI <to P5>: You'll speak as— all you'll want to do is tell you, what you're doing on the screen. If you're not doing anything, you don't have to speak. Does that make sense? So. Sorry. So this impression test, you don't have to, when you start the test, you don't have to— (50 words)

P3: Okay. (1 words)

PI <to P5>: —it is recording you. <PI continues providing instruction in P5 in background as P3 returns to foreground> (4 words)

P3: <returns to second tab from left (tab 2, access it)> I am going to go back to University Libraries <selects tab 1, search page> because that PDF was not helpful, and I'm just going to search, revise my search, and make it more broad— (29 words)

PI <to P5>: Not yet, so it's giving you, ask you some questions about that, after you look at it your going to say— (21 words)

P3: <enters "deforestation" as search term, SERP opens in tab 2>

P3 computer time: 12:56 PM (on P3 computer)
Opens: in tab 2, loads new SERP

HAR timestamp: None (Developer Tools not running in new tab)

Corresponds to: Nothing captured in HAR file yet

P3: —just make it deforestation so I can maybe find a more broad, um… (13 words)

PI <to P5>: So follow the instructions and record that, it'll record your answers. (11 words)

P5 <to PI>: Do I do it now?

PI <to P5>: Before you do that, just answer those questions— (8 words)

P3: So I'm going to refine my date— (7 words)

PI: <P4 asks unintelligible question, PI exhales loudly, then responds to P4>: Okay (1 words)

P3: —of search (2 words)

<Lots of background noise as P4 asked PI questions, PI responds, and P5 starts think-aloud session>

PI <to P4>: Yes (1 words)

P4 <to PI>: Yeah, because I tried that…

P3: <remembers to open developer tools and refreshes SERP>

P3 computer time: 12:56 PM (on P3 computer)
Opens: in tab 2, loads new SERP

HAR timestamp: 16:56:43.473

Corresponds to: page 1 in p3-archive04.har

PI <to P4>: Did that open a new tab, would you check, yep. (10 words)

P3: Alright, so I'm going to go down. Hmm, deforestation. <clicks on result> (9 words)

P3 computer time: 12:57 PM (on P3 computer)
Opens: in same tab (tab 2), loads article detail

HAR timestamp: 16:57:01.251

Corresponds to: page 2 in p3-archive04.har

PI <to P4 or P5>: I guess. (2 words)

P4 or **P5**: Okay that's <unintelligible>

PI: Okay <unintelligible, then continues in background as P3 conducts think-aloud session> (1 words)

P3: And I'm going to access this one to see... <clicks Access it tab> (9 words)

PI <to P4>: —If it's a source that will work for you, then you should be done, and you can say did you complete that task, and you can go on to the next step. (31 words)

P3: <clicks on source link under Access it tab, opens new results tab>

P3 computer time: 12:57 PM (on P3 computer)
Opens: in new tab 3, loads article from Encyclopedia of Global Studies

HAR timestamp: None (Developer Tools not running in new tab)

Corresponds to: Nothing captured in HAR file

P3: Um, so I'm looking here, and I don't see— it's not a good— so let me keep looking— <returns to source detail tab> and search it again <clicks Search button> (22 words)

P3 computer time: 12:57 PM (on P3 computer)
Opens: in current tab (tab 2), reloads SERP

HAR timestamp: 16:57:41.275

Corresponds to: page 3 on p3-archive04.har

P3: <returns to tab 3 results tab and activates developer tools to capture activity and refreshes> Got to make sure this is on. <Does not result in capturing HAR file, see below.> (7 words)

P3 computer time: 12:57 PM (on P3 computer)
Opens: in new tab 3, loads article from Encyclopedia of Global Studies

HAR timestamp: None (Developer Tools not running in new tab)

Corresponds to: Nothing captured in HAR file *** BAD HAR FILE, zero bytes saved

P3: <reviewing reloaded SERP> So now I'm looking for a different source— (8 words)

PI <to P5>: Anytime it opens in a new window or browser, just be sure that you right click and be sure that the inspect tab is open, and that you can see that recording is happening, and preserve log. Click network, and then recording, and then preserve log, and then refresh the page using the refresh button— (55 words)

P3: So I'm going to try this one <clicks a result> (7 words)

P3 computer time: 12:58 PM (on P3 computer)
Opens: in current tab (tab 2), loads article detail

HAR timestamp: 16:58:34.582

Corresponds to: page 4 on p3-archive04.har

P3: And access it <clicks Access it (no HAR file activity since tab content is already loaded)>. I'm going to try and open this source in a new window <clicks "Open source in new window"> (15 words)

P3 computer time: 12:58 PM (on P3 computer)
Opens: in new tab 3, loads access options

HAR timestamp: None (Developer Tools not running in new tab)

Corresponds to: Nothing captured in HAR file

P3: <activating Developer Tools and refreshing>

PI <to P4>: You're just looking for one article that would work, so one source that you think would work, and once you find it, access it, but remember, if it opens in a new tab or window, be right that developer tools is open and it's recording. (45 words)

P3 computer time: 12:59 PM (on P3 computer)
Opens: in current tab (tab 3), loads access options

HAR timestamp: 16:59:06.832

Corresponds to: page 1 on p3-archive05.har

P3: <clicks "view full text">

P3 computer time: 12:59 PM (on P3 computer)
Opens: in current tab (tab 3), loads article

HAR timestamp: None (Developer Tools not running in new tab)

Corresponds to: Nothing captured in HAR file

P4 <to PI>: Wait, on the last task, if I don't have access, but if I do… <trailing away, unintelligible>.

PI <to P4>: —If you did, once you determine you have, so, if you do, this was sort of an if/then— (18 words)

P3: So I'm not sure why— <loads developer tools and refreshes> (5 words)

P3 computer time: 12:59 PM (on P3 computer)
Opens: in current tab (tab 3), loads article from Green Politics: An A-to-Z Guide

HAR timestamp: None (Developer Tools not running in new tab)

Corresponds to: Nothing captured in HAR file *** BAD HAR FILE, zero bytes saved

PI <to P4>: So the theory is, you're done. So you did a search and found a source. So you can now click done recording. (22 words)

P3: Hmmm. Now my network's being slow. (6 words)

PI <to P4>: So now what's going to happen, is it's going to ask you four questions, which you'll write answers to. (19 words)

P4: Okay.

PI <to P4>: And then we'll go and collect all this data. (9 words)

P3: But, now my network is so <unintelligible>. (6 words)

<Largely unintelligible background conversation between PI and P4>

PI <to P4, reading from screen>: Continue the survey on the browser— (6 words)

P3: <clicks on DOI link in article to reload page>

P3 computer time: 12:59 PM (on P3 computer)
Opens: in current tab (tab 3), reloads same article from Green Politics: An A-to-Z Guide

HAR timestamp: None

Corresponds to: Nothing captured in HAR file *** BAD HAR FILE, zero bytes saved

PI <to P4>: So it's sure not opening the survey… That's very challenging. (10 words)

P3: So I'm going to go back because I don't think these are working <unintelligible> <clicks on tab 2, where the source detail Access it tab is active; no HAR file activity because tab content already loaded; not calls to server> (13 words)

<Largely unintelligible background conversation between PI and P4>

P3: I'm going to change my search again <types "deforestation impacts on the environment" and hits enter> (7 words)

P3 computer time: 1:00 PM (on P3 computer)
Opens: in current tab (tab 2), loads search results

HAR timestamp: 17:00:41.817

Corresponds to: page 5 on p3-archive04.har

PI <to P4>: No, it should have opened a new browser window. [P4], I'm going to give you the questions—I'm going to ask you to... (22 words)

P3 <reviewing SERP>: I'm going to try this one <clicks on result, opens details tab> (6 words)

P3 computer time: 1:00 PM (on P3 computer)
Opens: in current tab (tab 2), loads detail for Deforestation - The Impact on the Environment: Romania's Case

HAR timestamp: 17:00:56.923

Corresponds to: page 6 on p3-archive04.har

PI <to P4>: I don't have them printed out. I'm going to ask you to just type answers into a document to send to me. (22 words)

P3 <reading from detail>: … refers to one of the greatest threats (7 words)

PI <to P4>: Let me get those questions first. (6 words)

P3: So this one looks like it is my, something that might work for me. <clicks "View record in ProQuest (subscribers only)" link, which opens in a new window> (14 words)

P3 computer time: 1:01 PM (on P3 computer)
Opens: in new window, its own tab, loads full text of Deforestation - The Impact on the Environment: Romania's Case

HAR timestamp: None (Developer Tools not yet running in new window)

Corresponds to: Nothing captured in HAR file

P3: <checks developer tools and refreshes> So I'm going to access it— (6 words)

P3 computer time: 1:01 PM (on P3 computer)
Opens: in current tab (tab 2), reloads detail for Deforestation - The Impact on the Environment: Romania's Case

HAR timestamp: 17:01:21.551

Corresponds to: page 7 on p3-archive04.har

P3: <browses to new window where full text is loaded, opens developer tools and ensures recording, then refreshes>

P3 computer time: 1:01 PM (on P3 computer)
Opens: in new window, its own tab, loads full text page of Deforestation - The Impact on the Environment: Romania's Case

HAR timestamp: None (Developer Tools not yet running in new window)

Corresponds to: Nothing captured in HAR file

PI: Okay, where am I? <to P4> I'm going to send them as emails to you, is that okay? (16 words)

P4: Yeah, okay.

P3 computer time: 1:01 PM (on P3 computer)
Opens: in new window, its own tab, reloads full text page of Deforestation - The Impact on the Environment: Romania's Case

HAR timestamp: 17:01:51.233

Corresponds to: page 1 on p3-archive01.har

P3: <selects "Full Text - PDF" tab in article full text>

P3 computer time: 1:01 PM (on P3 computer)
Opens: in same tab, loads PDF of Deforestation - The Impact on the Environment: Romania's Case

HAR timestamp: 17:01:59.561

Corresponds to: page 2 on p3-archive01.har

P3: So, this article looks like one that would work for me. It explains the impact on the environment, and that is exactly what I'm looking for. (26 words)

PI <to P4>: [P4], can you tell my your email address? (8 words)

P4: It's [P4 email address spelled out]

PI: Thank you. You can actually answer in response to this, on this email, if that's OK. (16 words)

P3 <to PI>: And when I find it, I just click access and— (10 words)

PI <to P3>: Mmhmm. Once you have access to it, then you can finish that portion of it. Go back to the— do be sure that, if it opened in a new window— (30 words)

P3: Yeah, I keep doing it, and for these it's doing something weird. (12 words)

PI: It's putting it in a new window, and that okay, just be sure to click network, and don't close anything, so, cause we'll— (23 words)

P3: I'm just going to refresh it. (6 words)

PI: Yeah. Sorry. (2 words)

P3: No, you're fine. (3 words)

PI: So, it's funny. Every person who's done it— what? <unintelligible, to another participant> Every time, every person I do this with, it's a slightly different experience. Of course, that's not at all unusual, and that's really part of my dissertation. It's the fact that— oh, this is different. Every single person. (51 words)

P5 <to PI>: What? Are you in English?

PI <to P5>: I am. (2 words)

P5 <to PI>: Doesn't seem like <unintelligible> like research?

PI <to P5>: Yeah. (1 words)

P5 <to PI>: Here?

PI <to P5>: Mmhmm. Yeah. So I'm, I work at University of Richmond but this is my dissertation. Okay. (16 words)

P3: <clicks next task, then reads> "Once you have selected a source, see if you have access to the full text of the source. You may need to follow several links." Okay. Yes. <clicks Yes, then next task, then reads instructions for next under breath, unintelligible.> (25 words)

P3: <clicks yes, then next task> Reads "Once you've determined you don't have access to the text of the source…" <clicks yes, then done>. (13 words)

[END OF TRANSCRIPT]

APPENDIX I

PARTICIPANT 3 HAR FILE TIMELINES

Table A9.1

HAR file overview timelines from Participant 3

HAR File	Page #	Tab/Browser	Timestamp	Description	Search Information
p3-archive01.har	2 of 3	w1 t1 Library	16:46:35.126	Initial ODU Library page load	
p3-archive01.har	3 of 3	w1 t1 Library	16:46:43.060	ODU Library page refresh	
p3-archive02.har	1 of 2	w1 t2 SERP	16:51:21.439	Search results	the+effects+of+deforestation
p3-archive02.har	2 of 2	w1 t2 detail	16:51:59.074	Result detail	the+effects+of+deforestation
p3-archive03.har	1 of 1	w1 t4 article	16:54:08.789	Article	
p3-archive04.har	1 of 7	w1 t2 SERP	16:56:43.473	Search results	deforestation
p3-archive04.har	2 of 7	w1 t2 detail	16:57:01.251	Result detail	deforestation
p3-archive04.har	3 of 7	w1 t2 SERP	16:57:41.275	Search results	deforestation
p3-archive04.har	4 of 7	w1 t2 detail	16:58:34.582	Result detail	deforestation
p3-archive05.har	1 of 1	w1 t3 access	16:59:06.832	Access page	
p3-archive04.har	5 of 7	w1 t2 SERP	17:00:41.817	Search results	deforestation+impacts+on+the+environment
p3-archive04.har	6 of 7	w1 t2 detail	17:00:56.923	Result detail	deforestation+impacts+on+the+environment
p3-archive04.har	7 of 7	w1 t2 detail	17:01:21.551	Result detail (refresh)	deforestation+impacts+on+the+environment

APPENDIX J

PARTICIPANT 3 SYNCHRONIZED ACTIVITY TIMELINE

Key to terms

- **UT Elapsed Time**: Usability Test elapsed time, in form hh:mm:ss starting at 00:00:00
- **HAR Timestamp**: Timestamp of HAR file activity, in form hh:mm:ss:mss starting at 16:46:35.126 GMT (Greenwich Mean Time)
- **Activity**: What's happening at moment in the environment, on the browser, and with the participant
- **Content**: When useful, information about the search at that timestamp.

Table A10.1

Timeline of Participant 3 synchronized user and browser activity.

UT Elapsed Time	HAR Timestamp	Activity	Content
00:00:00		Start of Usability Test Recording	
00:00:01		P3 starts arranging windows, struggling with P4 and PI to get library window open and loaded. Caused by skipping Impression Test	
00:01:37	16:46:35.126	Opens ODU Library webpage	
	16:46:35.326	GET http://www.odu.edu/library	
	16:46:35.356	GET https://code.jquery.com/jquery-3.2.1.min.js	
	16:46:35.356	GET http://www.odu.edu/etc/designs/odu/clientlibs/libs/jquery-migrate-3.0.0.min.js	
	16:46:35.357	GET http://www.odu.edu/etc/designs/odu/clientlibs/libs/fontawesome4.min.css	
	16:46:35.357	GET http://www.odu.edu/etc/designs/odu/clientlibs.min.css	
	16:46:35.357	GET http://www.odu.edu/etc/designs/odu/clientlibs.min.js	
	16:46:35.357	GET http://www.odu.edu/etc/designs/odu.css	
	16:46:35.357	GET http://www.odu.edu/etc/designs/odu/clientlibs/libs/slick.min.css	
	16:46:35.357	GET http://www.odu.edu/etc/designs/odu/clientlibs/libs/slick.min.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:46:35.358	GET http://www.odu.edu/etc/designs/odu/images/odu-crown-breadcrumb-home.png	
	16:46:35.358	GET http://www.odu.edu/library/_jcr_content/par/columns_2/column_1/image.img.280.jpg/1449783679618.jpg	
	16:46:35.358	GET http://www.odu.edu/library/_jcr_content/par/columns_2/column_2/image.img.280.jpg/1403193539167.jpg	
	16:46:35.358	GET http://www.odu.edu/library/_jcr_content/par/columns_3/column_0/image.img.280.jpg/1499270287471.jpg	
	16:46:35.358	GET http://fonts.googleapis.com/css	
	16:46:35.358	GET http://www.odu.edu/library/_jcr_content/par/columns_2/column_0/image.img.280.jpg/1449783741833.jpg	
	16:46:35.359	GET http://www.odu.edu/library/_jcr_content/par/columns_3/column_1/image.img.280.jpg/1449695872727.jpg	
	16:46:35.359	GET http://www.odu.edu/library/_jcr_content/par/columns_3/column_2/image.img.280.jpg/1485280513691.jpg	
	16:46:35.359	GET http://www.odu.edu/etc/clientlibs/wcm/foundation/accessibility.min.css	
	16:46:35.359	GET http://www.odu.edu/library/_jcr_content/par/columns_0/column_1/image.img.280.jpg/1427400245315.jpg	
	16:46:35.359	GET http://www.odu.edu/library/_jcr_content/par/columns_0/column_2/image.img.280.png/1447370819220.png	
	16:46:35.359	GET http://www.odu.edu/library/_jcr_content/par/columns_0/column_0/image.img.280.jpg/1427397845012.jpg	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:46:35.360	GET http://www.odu.edu/library/_jcr_content/rightpar/section/columns/column_0/image.img.40.png/1414161379932.png	
	16:46:35.360	GET http://www.odu.edu/library/_jcr_content/rightpar/section/columns/column_2/image.img.40.png/1414161438916.png	
	16:46:35.360	GET http://www.odu.edu/library/_jcr_content/rightpar/section/columns/column_1/image.img.40.png/1414161412427.png	
	16:46:35.361	GET http://www.odu.edu/settings/_jcr_content/footer-parsys/columns/column_1/image.img.200.png/1476516137858.png	
	16:46:35.850	GET https://platform.twitter.com/widgets.js	
	16:46:35.854	GET http://connect.facebook.net/en_US/all.js	
	16:46:35.917	GET http://www.odu.edu/library/_jcr_content/headerimage.img.1280.jpg	
	16:46:35.923	GET http://www.odu.edu/etc/designs/odu/images/logo-university.png	
	16:46:35.954	GET http://fonts.gstatic.com/s/opensans/v15/mem8YaGs126MiZpBA-UFVZ0b.woff2	
	16:46:35.956	GET http://fonts.gstatic.com/s/opensans/v15/mem5YaGs126MiZpBA-UNirkOUuhp.woff2	
	16:46:35.957	GET http://www.odu.edu/etc/designs/odu/clientlibs/libs/fontawesome4/fonts/fontawesome-webfont.woff2	
	16:46:36.024	GET https://connect.facebook.net/en_US/all.js	
	16:46:36.054	GET http://www.odu.edu/etc/designs/odu/images/disc-1.gif	
	16:46:36.068	GET http://fonts.gstatic.com/s/opensans/v15/mem5YaGs126MiZpBA-UN7rgOUuhp.woff2	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:46:36.072	GET http://www.odu.edu/content/dam/odu/images/webadmin/images/search.png	
	16:46:36.220	GET http://www.odu.edu/library/_jcr_content/rightpar/section_1159742434/listplaces.nocache.html	
	16:46:36.222	GET http://www.odu.edu/library/_jcr_content/rightpar/section_1890638568/listplaces.nocache.html	
	16:46:36.224	GET http://www.odu.edu/library/_jcr_content/rightpar/section_1390515182/listplaces.nocache.html	
	16:46:36.225	GET http://www.odu.edu/library/_jcr_content/rightpar/section_1561465455/listplaces.nocache.html	
	16:46:36.227	GET http://www.odu.edu/library/_jcr_content/rightpar/section_782371188/listplaces.nocache.html	
	16:46:36.228	GET http://www.odu.edu/library/_jcr_content/rightpar/section_891662689/listplaces.nocache.html	
	16:46:36.339	GET http://www.googletagmanager.com/gtm.js	
	16:46:36.521	GET http://www.odu.edu/content/odu/search/a-to-z-global.html	
	16:46:36.556	GET https://platform.twitter.com/widgets/widget_iframe.1966f64be47cf16b7a48642c76cc6202.html	
	16:46:36.609	GET http://www.google-analytics.com/analytics.js	
	16:46:36.674	GET https://www.google-analytics.com/analytics.js	
	16:46:36.675	GET http://script.crazyegg.com/pages/scripts/0034/9379.js	
	16:46:36.748	GET https://syndication.twitter.com/settings	
	16:46:36.918	GET https://www.facebook.com/impression.php/f2c367db86d0948/	
	16:46:37.279	GET http://www.google-analytics.com/r/collect	
	16:46:37.426	GET http://staticxx.facebook.com/connect/xd_arbiter/r/JW5GlLnAsFw.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:46:37.428	GET https://staticxx.facebook.com/connect/xd_arbiter/r/JW5GlLnAsFw.js	
	16:46:37.435	GET https://gtrk.s3.amazonaws.com/s	
	16:46:37.436	GET https://www.google-analytics.com/r/collect	
	16:46:37.534	GET https://staticxx.facebook.com/connect/xd_arbiter/r/JW5GlLnAsFw.js	
	16:46:37.563	GET https://stats.g.doubleclick.net/r/collect	
	16:46:37.891	POST https://syndication.twitter.com/i/jot	
	16:46:37.976	GET https://platform.twitter.com/jot.html	
	16:46:38.992	GET https://www.facebook.com/connect/ping	
	16:46:38.996	GET http://staticxx.facebook.com/connect/xd_arbiter/r/JW5GlLnAsFw.js	
	16:46:38.997	GET https://staticxx.facebook.com/connect/xd_arbiter/r/JW5GlLnAsFw.js	
00:01:44	16:46:43.060	Reloads Library Webpage	
	16:46:43.098	GET http://www.odu.edu/library	
	16:46:43.178	GET https://code.jquery.com/jquery-3.2.1.min.js	
	16:46:43.179	GET http://www.odu.edu/etc/designs/odu/clientlibs/libs/slick.min.css	
	16:46:43.179	GET http://www.odu.edu/etc/designs/odu/clientlibs/libs/fontawesome4.min.css	
	16:46:43.179	GET http://www.odu.edu/etc/designs/odu/clientlibs/libs/jquery-migrate-3.0.0.min.js	
	16:46:43.179	GET http://www.odu.edu/etc/designs/odu/clientlibs.min.css	
	16:46:43.180	GET http://www.odu.edu/etc/designs/odu/clientlibs/libs/slick.min.js	
	16:46:43.181	GET http://www.odu.edu/etc/designs/odu/clientlibs.min.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:46:43.182	GET http://www.odu.edu/etc/designs/odu.css	
	16:46:43.182	GET http://fonts.googleapis.com/css	
	16:46:43.182	GET http://www.odu.edu/library/_jcr_content/par/columns_2/column_0/image.img.280.jpg/1449783741833.jpg	
	16:46:43.182	GET http://www.odu.edu/library/_jcr_content/par/columns_2/column_1/image.img.280.jpg/1449783679618.jpg	
	16:46:43.182	GET http://www.odu.edu/etc/designs/odu/images/odu-crown-breadcrumb-home.png	
	16:46:43.190	GET http://www.odu.edu/library/_jcr_content/par/columns_2/column_2/image.img.280.jpg/1403193539167.jpg	
	16:46:43.191	GET http://www.odu.edu/etc/clientlibs/wcm/foundation/accessibility.min.css	
	16:46:43.191	GET http://www.odu.edu/library/_jcr_content/par/columns_3/column_0/image.img.280.jpg/1499270287471.jpg	
	16:46:43.192	GET http://www.odu.edu/library/_jcr_content/par/columns_3/column_1/image.img.280.jpg/1449695872727.jpg	
	16:46:43.193	GET http://www.odu.edu/library/_jcr_content/par/columns_3/column_2/image.img.280.jpg/1485280513691.jpg	
	16:46:43.194	GET http://www.odu.edu/library/_jcr_content/par/columns_0/column_0/image.img.280.jpg/1427397845012.jpg	
	16:46:43.196	GET http://www.odu.edu/library/_jcr_content/par/columns_0/column_1/image.img.280.jpg/1427400245315.jpg	
	16:46:43.196	GET http://www.odu.edu/library/_jcr_content/rightpar/section/columns/column_0/image.img.40.png/1414161379932.png	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:46:43.196	GET http://www.odu.edu/library/_jcr_content/par/columns_0/column_2/image.img.280.png/1447370819220.png	
	16:46:43.197	GET http://www.odu.edu/library/_jcr_content/rightpar/section/columns/column_1/image.img.40.png/1414161412427.png	
	16:46:43.198	GET http://www.odu.edu/library/_jcr_content/rightpar/section/columns/column_2/image.img.40.png/1414161438916.png	
	16:46:43.198	GET http://www.odu.edu/settings/_jcr_content/footer-parsys/columns/column_1/image.img.200.png/1476516137858.png	
	16:46:43.613	GET http://www.odu.edu/etc/designs/odu/clientlibs/libs/fontawesome4/fonts/fontawesome-webfont.woff2	
	16:46:43.662	GET https://platform.twitter.com/widgets.js	
	16:46:43.666	GET http://connect.facebook.net/en_US/all.js	
	16:46:43.670	GET http://fonts.gstatic.com/s/opensans/v15/mem8YaGs126MiZpBA-UFVZ0b.woff2	
	16:46:43.671	GET http://fonts.gstatic.com/s/opensans/v15/mem5YaGs126MiZpBA-UNirkOUuhp.woff2	
	16:46:43.671	GET http://fonts.gstatic.com/s/opensans/v15/mem5YaGs126MiZpBA-UN7rgOUuhp.woff2	
	16:46:43.721	GET http://www.odu.edu/library/_jcr_content/headerimage.img.1280.jpg	
	16:46:43.725	GET http://www.odu.edu/etc/designs/odu/images/logo-university.png	
	16:46:43.739	GET https://connect.facebook.net/en_US/all.js	
	16:46:43.752	GET http://www.odu.edu/etc/designs/odu/images/disc-1.gif	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:46:43.763	GET http://www.odu.edu/content/dam/odu/images/webadmin/images/search.png	
	16:46:43.796	GET http://www.odu.edu/library/_jcr_content/rightpar/section_1159742434/listplaces.nocache.html	
	16:46:43.798	GET http://www.odu.edu/library/_jcr_content/rightpar/section_1890638568/listplaces.nocache.html	
	16:46:43.799	GET http://www.odu.edu/library/_jcr_content/rightpar/section_1390515182/listplaces.nocache.html	
	16:46:43.802	GET http://www.odu.edu/library/_jcr_content/rightpar/section_1561465455/listplaces.nocache.html	
	16:46:43.803	GET http://www.odu.edu/library/_jcr_content/rightpar/section_782371188/listplaces.nocache.html	
	16:46:43.805	GET http://www.odu.edu/library/_jcr_content/rightpar/section_891662689/listplaces.nocache.html	
	16:46:43.852	GET http://www.googletagmanager.com/gtm.js	
	16:46:44.037	GET http://www.odu.edu/content/odu/search/a-to-z-global.html	
	16:46:44.076	GET https://platform.twitter.com/widgets/widget_iframe.1966f64be47cf16b7a48642c76cc6202.html	
	16:46:44.120	GET http://www.google-analytics.com/analytics.js	
	16:46:44.185	GET https://www.google-analytics.com/analytics.js	
	16:46:44.186	GET http://script.crazyegg.com/pages/scripts/0034/9379.js	
	16:46:44.296	GET https://syndication.twitter.com/settings	
	16:46:44.418	GET https://www.facebook.com/impression.php/f173b28d4059aac/	
	16:46:44.846	GET http://www.google-analytics.com/collect	
	16:46:45.007	GET http://staticxx.facebook.com/connect/xd_arbiter/r/JW5GlLnAsFw.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:46:45.010	GET https://staticxx.facebook.com/connect/xd_arbiter/r/JW5GlLnAsFw.js	
	16:46:45.018	GET https://www.google-analytics.com/collect	
	16:46:45.128	GET https://staticxx.facebook.com/connect/xd_arbiter/r/JW5GlLnAsFw.js	
	16:46:45.581	POST https://syndication.twitter.com/i/jot	
	16:46:45.816	GET https://platform.twitter.com/jot.html	
	16:46:46.128	GET https://www.facebook.com/connect/ping	
	16:46:46.138	GET http://staticxx.facebook.com/connect/xd_arbiter/r/JW5GlLnAsFw.js	
	16:46:46.138	GET https://staticxx.facebook.com/connect/xd_arbiter/r/JW5GlLnAsFw.js	
00:01:45		PI and P3 and P4 converse	
00:01:45		Reads task 1	[This should be the Impression Test, but it's been skipped earlier in the test without PI recognizing it.]
00:02:30		Reads task 2	Please start by reading the frame of mind directions (above) out loud
00:02:51		Reads frame of mind	You are looking for a scholarly source to include in a research project you've been assigned. (If possible, the project should be one you've actually been assigned.) You have come to the ODU Library website to conduct searches to find an appropriate source. In addition to reading aloud the questions as directed during the study, please narrate aloud all search activities for recording — your search terms, your selection of search terms, your review of search results, and your selection of specific links throughout the process. You cannot narrate too much of your activity.

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
00:03:30		Clicks next task	
00:03:33		Reads task 3	Conduct your search by entering your search term(s) in the search box. You may conduct as many different searches as needed in order to identify a source that will address your research needs. NOTE: Results will open in tabs in a new window. Each new tab should show Developer Tools. Be sure Recording is on and that Preserve Log is checked on EACH new tab/window. To return to the test, minimize the results window. DO NOT CLOSE TABS OR WINDOWS until the test is complete.
00:03:37		PI and P4 converse loudly in background	
00:04:15		PI and P5 converse loudly in background	
00:04:34		PI and P3 talk through testing and search procedure	
00:05:06		P3 enters topic in search bar	the+effects+of+deforestation
00:05:20		P3 enters search and SERP opens in new tab	
00:05:20-00:06:22		Delay between SERP opening and setting Developer Tools and refreshing page	
00:05:26		PI and P4 converse loudly in background	
00:05:58		P3 asks about Developer Tools on SERP page	
00:06:22	16:51:21.439	P3 refreshes SERP tab	the+effects+of+deforestation
	16:51:21.848	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/dlSearch.do	
	16:51:21.926	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	16:51:21.927	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	
	16:51:21.930	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:51:22.101	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	16:51:22.101	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	16:51:22.101	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	16:51:22.102	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	
	16:51:22.102	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	
	16:51:22.102	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	
	16:51:22.105	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	16:51:22.106	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	16:51:22.107	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	16:51:22.110	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	16:51:22.231	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/pixel.png	
	16:51:22.232	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_off.png	
	16:51:22.408	GET https://libraryh3lp.com/js/libraryh3lp.js	
	16:51:22.451	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:51:22.476	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	
	16:51:22.551	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_article.png	
	16:51:22.555	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	16:51:22.571	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_book.png	
	16:51:22.574	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_frbr.png	
	16:51:22.575	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	16:51:22.586	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_open_subMenu.png	
	16:51:22.624	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	16:51:22.641	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_video.png	
	16:51:22.791	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:51:22.792	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:51:22.794	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:51:22.795	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:51:22.807	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-gear.png	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:51:22.808	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-facet-drawer.png	
	16:51:22.819	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-star.png	
	16:51:22.820	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon-person.png	
	16:51:22.871	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/rta.do	
	16:51:22.872	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_gloss-wave_35_f6a828_500x100.png	
	16:51:22.872	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_glass_100_f6f6f6_1x400.png	
	16:51:22.921	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	16:51:22.963	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	16:51:23.078	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	16:51:23.079	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	16:51:23.080	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	16:51:23.090	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	16:51:23.095	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:51:23.096	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	16:51:23.096	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	16:51:23.097	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	16:51:23.097	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	16:51:23.109	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	16:51:23.118	GET http://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_DigitalCommonsIcon.jpg	
	16:51:23.119	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	16:51:23.120	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	16:51:23.121	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	16:51:23.129	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	16:51:23.213	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books/content	
	16:51:23.337	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books/content	
	16:51:59.057	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	16:51:59.062	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:51:59.291	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/error.do	
	16:51:59.406	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/log	
00:06:35		P3 shares about quality of results	
00:07:00	16:51:59.074	P3 clicks on result	Article detail: "Quantifying the Effects of Deforestation and Fragmentation on a Range-Wide Conservation Plan for Jaguars"
	16:51:59.548	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/display.do	
	16:51:59.743	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	16:51:59.744	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	
	16:51:59.748	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	16:51:59.846	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	16:51:59.846	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	16:51:59.846	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	
	16:51:59.846	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	16:51:59.847	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	
	16:51:59.847	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:51:59.848	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	16:51:59.849	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	16:51:59.849	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	16:51:59.867	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_prev.png	
	16:51:59.867	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	16:51:59.868	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	16:52:00.038	GET https://libraryh3lp.com/js/libraryh3lp.js	
	16:52:00.075	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	
	16:52:00.106	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	
	16:52:00.149	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_frbr.png	
	16:52:00.151	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	16:52:00.164	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:52:00.189	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	16:52:00.194	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_sendTo.png	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:52:00.215	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_strip_details_links.png	
	16:52:00.216	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bullet_arrow_grey.png	
	16:52:00.354	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	16:52:00.366	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	16:52:00.500	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	16:52:00.501	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	16:52:00.506	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	16:52:39.848	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	16:52:39.849	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	16:52:39.853	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_loading_circle.gif	
	16:52:41.019	GET https://odu.userservices.exlibrisgroup.com/view/uresolver/01ODU_INST/openurl	
	16:52:41.038	GET https://odu.userservices.exlibrisgroup.com/view/skins/default/css/otb_mashup.css	
	16:52:41.039	GET https://odu.userservices.exlibrisgroup.com/view/branding_skin/css/mashup.css	
	16:52:41.040	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery-mashup.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:52:41.041	GET https://odu.userservices.exlibrisgroup.com/view/javascript/uresolverScripts.js	
	16:52:41.041	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery.js	
	16:52:41.042	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
00:07:16		Reads article abstract	
00:07:41		Clicks "Access It" tab	No HAR file - tab content already loaded
00:07:45		Clicks "Open source in new window" link	New tab loads with access options; Developer Tools not active, so no HAR file captured
00:07:52		Clicks "Access it here: Elsevier SD Freedom Collection" link	New tab loads with MIDAS account login option; Developer Tools not active, so no HAR file captured
00:07:56		Clicks "Click to login using your MIDAS account" button	New tab loads with Monarch-Key login for SSO (also passes through a redirect page); Developer Tools no active, so no HAR file captured
00:08:00		Logs in using SSO on Monarch-Key page	Same tab loads shibboleth, quickly redirected to full text of article
00:08:00-00:09:10		Delay between article full text opening and refreshing with Developer Tools	
00:08:11		Reviews article content, refers to full text as "another, like, abstract"	
00:08:22		Closes Elsevier popup window ("ad")	Register to receive personalized recommendations based on your recently signed-in activity"
00:08:44		Clicks "Download PDF > Article" link to access PDF	New tab loads with PDF; Developer Tools not active, so no HAR file captured
00:08:48		P3 returns to Access it here... tab (3rd from left) and refreshes	Developer Tools not active, so no HAR file captured
00:08:54		P3 returns to full text tab (4th from left) and closed popup that appears on page	"Other users also viewed these articles" (3 PDFs listed)
00:09:02		P3 activate Developer Tools and refreshes	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
00:09:10	16:54:08.789	P3 refreshes full text tab (4th from left) with Developer Tools active and recording	
	16:54:09.281	GET https://www-sciencedirect-com.proxy.lib.odu.edu/science/article/pii/S0006320716303482	
	16:54:09.444	GET https://sdfestaticassets-us-west-2.sciencedirectassets.com/prod/21ce29fe309c58bf5f7567c32bcb7171d4947705/arp.css	
	16:54:09.444	GET https://sdfestaticassets-us-west-2.sciencedirectassets.com/prod/1b5d53798ae880c9bfb368d680f1d23e4319d8ed/style.css	
	16:54:09.445	GET https://cdn.optimizely.com/js/204774041.js	
	16:54:09.453	GET https://sdfestaticassets-us-west-2.sciencedirectassets.com/prod/21ce29fe309c58bf5f7567c32bcb7171d4947705/image/elsevier-non-solus.png	
	16:54:09.455	GET https://ars-els-cdn-com.proxy.lib.odu.edu/content/image/1-s2.0-S0006320716X00092-cov150h.gif	
	16:54:09.455	GET https://www.googleadservices.com/pagead/conversion.js	
	16:54:09.457	GET https://assets.adobedtm.com/376c5346e33126fdb6b2dbac81e307cbacfd7935/satelliteLib-b7cfe8df39a4e5eec5536bba80e13f4b6fa0dd7c.js	
	16:54:09.457	GET https://sdfestaticassets-us-west-2.sciencedirectassets.com/prod/1b5d53798ae880c9bfb368d680f1d23e4319d8ed/client.js	
	16:54:09.458	GET https://sdfestaticassets-us-west-2.sciencedirectassets.com/shared-assets/10/js/babel-polyfill/6.26.0/babel-polyfill.min.js	
	16:54:09.458	GET https://sdfestaticassets-us-west-2.sciencedirectassets.com/prod/21ce29fe309c58bf5f7567c32bcb7171d4947705/arp.js	
	16:54:09.458	GET https://cdnjs.cloudflare.com/ajax/libs/mathjax/2.7.3/MathJax.js	
	16:54:09.458	GET https://www.googletagservices.com/tag/js/gpt.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:54:09.458	GET https://sdfestaticassets-us-west-2.sciencedirectassets.com/shared-assets/9/js/react/16.2.0/react.production.min.js	
	16:54:09.458	GET https://sdfestaticassets-us-west-2.sciencedirectassets.com/shared-assets/9/js/react-dom/16.2.0/react-dom.production.min.js	
	16:54:09.787	GET https://cdn3.optimizely.com/js/geo2.js	
	16:54:09.920	GET https://204774041.log.optimizely.com/event	
	16:54:09.920	GET https://204774041.log.optimizely.com/event	
	16:54:10.102	GET https://connect.facebook.net/en_US/fbevents.js	
	16:54:10.141	GET https://204774041.log.optimizely.com/event	
	16:54:10.144	GET https://204774041.log.optimizely.com/event	
	16:54:10.149	GET https://c.go-mpulse.net/boomerang/2FBN2-NKMGU-EJKY8-ZANKZ-SUJZF	
	16:54:10.180	GET https://googleads.g.doubleclick.net/pagead/viewthroughconversion/1017027555/	
	16:54:10.298	GET https://assets.adobedtm.com/376c5346e33126fdb6b2dbac81e307cbacfd7935/scripts/satellite-565e008964746d4385002642.js	
	16:54:10.302	GET https://assets.adobedtm.com/376c5346e33126fdb6b2dbac81e307cbacfd7935/scripts/satellite-5964b08664746d3292014dba.js	
	16:54:10.740	GET https://d39af2mgp1pqhg.cloudfront.net/widget-summary.js	
	16:54:10.747	GET https://assets.adobedtm.com/376c5346e33126fdb6b2dbac81e307cbacfd7935/s-code-contents-9c0358adbc3b5986e210099b3bf1d427fc5bd286.js	
	16:54:10.773	GET https://www-sciencedirect-com.proxy.lib.odu.edu/sdfe/arp/pii/S0006320716303482/recommendations	
	16:54:10.774	GET https://www-sciencedirect-com.proxy.lib.odu.edu/sdfe/arp/pii/S0006320716303482/citingArticles	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:54:10.777	GET https://www-sciencedirect-com.proxy.lib.odu.edu/sdfe/arp/eid/1-s2.0-S0006320716303482/referredToBy	
	16:54:10.781	GET https://www-sciencedirect-com.proxy.lib.odu.edu/sdfe/arp/pii/S0006320716303482/body	
	16:54:10.783	GET https://www-sciencedirect-com.proxy.lib.odu.edu/sdfe/arp/pii/S0006320716303482/references	
	16:54:10.785	GET https://www-sciencedirect-com.proxy.lib.odu.edu/sdfe/arp/pii/S0006320716303482/toc	
	16:54:10.788	GET https://www-sciencedirect-com.proxy.lib.odu.edu/sdfe/arp/issue/S0006320716X00092/article/S0006320716303482/siblings	
	16:54:10.794	GET https://www-sciencedirect-com.proxy.lib.odu.edu/sdfe/ears/pii/S0006320716303482/2017-09-06T20%3A44%3A17.524681-04%3A00/10.1016%2Fj.biocon.2016.08.037/00063207/enriched-content	
	16:54:10.826	GET https://cdnjs.cloudflare.com/ajax/libs/mathjax/2.7.3/config/MML_SVG.js	
	16:54:10.837	GET https://adservice.google.com/adsid/integrator.js	
	16:54:10.839	GET https://securepubads.g.doubleclick.net/gpt/pubads_impl_196.js	
	16:54:10.959	GET https://www.google.com/ads/user-lists/1017027555/	
	16:54:11.028	GET https://c.go-mpulse.net/api/config.json	
	16:54:11.128	POST https://smetrics.elsevier.com/b/ss/elsevier-sd-prod,elsevier-global-prod/1/JS-2.6.0-D7QN/s52541997829237	
	16:54:11.154	GET https://d39af2mgp1pqhg.cloudfront.net/summary.css	
	16:54:11.155	GET https://ajax.googleapis.com/ajax/libs/jquery/1.10.2/jquery.min.js	
	16:54:11.156	GET https://d39af2mgp1pqhg.cloudfront.net/extjs/xss.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:54:11.182	GET https://w.usabilla.com/eb1c14a91932.js	
	16:54:11.243	GET https://ars-els-cdn-com.proxy.lib.odu.edu/content/image/1-s2.0-S0006320716303482-gr1.sml	
	16:54:11.243	GET https://ars-els-cdn-com.proxy.lib.odu.edu/content/image/1-s2.0-S0006320716303482-gr2.sml	
	16:54:11.244	GET https://ars-els-cdn-com.proxy.lib.odu.edu/content/image/1-s2.0-S0006320716303482-gr3.sml	
	16:54:11.244	GET https://ars-els-cdn-com.proxy.lib.odu.edu/content/image/1-s2.0-S0006320716303482-gr4.sml	
	16:54:11.534	GET https://204774041.log.optimizely.com/event	
	16:54:11.539	GET https://204774041.log.optimizely.com/event	
	16:54:11.858	GET https://ars-els-cdn-com.proxy.lib.odu.edu/content/image/1-s2.0-S0006320716303482-gr1.jpg	
	16:54:11.859	GET https://ars-els-cdn-com.proxy.lib.odu.edu/content/image/1-s2.0-S0006320716303482-gr2.jpg	
	16:54:11.860	GET https://ars-els-cdn-com.proxy.lib.odu.edu/content/image/1-s2.0-S0006320716303482-gr3.jpg	
	16:54:11.861	GET https://ars-els-cdn-com.proxy.lib.odu.edu/content/image/1-s2.0-S0006320716303482-gr4.jpg	
	16:54:11.865	GET https://www-sciencedirect-com.proxy.lib.odu.edu/topics/annotations/S0006320716303482	
	16:54:11.870	GET https://www-sciencedirect-com.proxy.lib.odu.edu/sdfe/arp/pii/S0006320716303482/references/links/61	
	16:54:11.871	GET https://www-sciencedirect-com.proxy.lib.odu.edu/sdfe/arp/pii/S0006320716303482/references/external-links/61	
	16:54:12.413	GET https://cdnjs.cloudflare.com/ajax/libs/mathjax/2.7.3/jax/output/SVG/jax.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:54:12.567	GET https://d6tizftlrpuof.cloudfront.net/live/resources/buttons/feedback_button_elsevier_desktop_bottom_retina.png	
	16:54:12.593	GET https://api.plu.mx/widget/elsevier/artifact	
	16:54:12.673	GET https://cdnjs.cloudflare.com/ajax/libs/mathjax/2.7.3/jax/output/SVG/fonts/TeX/fontdata.js	
	16:54:12.731	GET https://d39af2mgp1pqhg.cloudfront.net/2e9971b1fdcd89dc49349f95aa214ae5/plumx-inverse-logo.png	
	16:54:12.732	GET https://d39af2mgp1pqhg.cloudfront.net/2e9971b1fdcd89dc49349f95aa214ae5/plumx-logo.png	
	16:54:12.951	GET https://cdnjs.cloudflare.com/ajax/libs/mathjax/2.7.3/jax/output/SVG/fonts/TeX/Main/Regular/BasicLatin.js	
	16:54:58.925	GET https://d6tizftlrpuof.cloudfront.net/live/scripts/campaign-include/877e180121823ebaa1e7396dca2328dc/v2/slideout.coffee	
	16:54:59.005	GET https://w.usabilla.com/a/t	
	16:54:59.006	GET https://smetrics.elsevier.com/b/ss/elsevier-sd-prod,elsevier-global-prod/1/JS-2.6.0-D7QN/s53260383748908	
	16:54:59.029	GET https://d6tizftlrpuof.cloudfront.net/live/i/55916fbcd35022ea0d5790ff/62c8bae6ebf9a5761ae7e418a36bcd64435b5224.html	
	16:54:59.055	GET https://d6tizftlrpuof.cloudfront.net/live/resources/campaign/css/theme-elsevier.scss	
	16:54:59.055	GET https://d6tizftlrpuof.cloudfront.net/vendor/1.6.5/angular.min.js	
	16:54:59.056	GET https://d6tizftlrpuof.cloudfront.net/live/campaign/js/940f0eaed3.campaign.js	
	16:55:03.046	GET https://w.usabilla.com/a/t	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
00:09:14		Returns to article PDF tab (5th from left) and tries to open Developer Tools and refresh	
00:09:51		P3 returns to article full text tab (4th from left) and appears to check Developer Tools on that page, troubleshooting lack of Developer Tools on PDF tab	
00:10:03		P3 closes popup that opens ("Access your ScienceDirect content everywhere" with "Activate Now" button)	
00:10:05		P3 returns to article PDF tab and tries once again to open Developer Tools and refresh	
0:10:13		PI and P5 converse loudly in background	
00:10:26		P3 encounters and clears error message, "Failed to load PDF document"	
00:10:45		P3 returns to library search page (tab 1) to repeat search	
00:11:03		P3 revises search	deforestation
00:11:06		SERP loads in new tab (now tab 2)	deforestation; Developer Tools not active, so no HAR file generated
00:11:06-00:11:44		Delay between SERP load and refresh with Developer tools	
00:11:10		P3 reviews SERP results	
00:11:12		PI converses with P4 and P5 quietly in background	
00:11:25		P3 starts refining date range using sliders on SERP	
00:11:44	16:56:43.473	P3 activate Developer Tools and refreshes	
	16:56:43.965	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/dlSearch.do	
	16:56:44.098	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	16:56:44.099	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	16:56:44.099	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:56:44.099	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	16:56:44.100	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	16:56:44.101	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	16:56:44.102	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	
	16:56:44.102	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	
	16:56:44.103	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	
	16:56:44.103	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	16:56:44.103	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	16:56:44.104	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	16:56:44.104	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	16:56:44.328	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/pixel.png	
	16:56:44.330	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_off.png	
	16:56:44.510	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_open_subMenu.png	
	16:56:44.647	GET https://libraryh3lp.com/js/libraryh3lp.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:56:44.683	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	
	16:56:44.705	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	
	16:56:44.746	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_book.png	
	16:56:44.752	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	16:56:44.775	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	16:56:44.778	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	16:56:44.846	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_article.png	
	16:56:44.903	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_frbr.png	
	16:56:45.023	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:56:45.025	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:56:45.029	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:56:45.035	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:56:45.051	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-gear.png	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:56:45.053	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-facet-drawer.png	
	16:56:45.067	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-star.png	
	16:56:45.068	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon-person.png	
	16:56:45.127	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/rta.do	
	16:56:45.128	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_gloss-wave_35_f6a828_500x100.png	
	16:56:45.129	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_glass_100_f6f6f6_1x400.png	
	16:56:45.201	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	16:56:45.216	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	16:56:45.304	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	16:56:45.307	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	16:56:45.308	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	16:56:45.319	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	16:56:45.420	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books/content	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:57:01.239	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	16:57:01.241	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	16:57:01.292	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/error.do	
	16:57:01.393	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/log	
00:11:53		PI and P5 converse loudly in background	
00:12:02	16:57:01.251	P3 clicks on result	Deforestation
	16:57:01.534	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/display.do	
	16:57:01.870	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	16:57:01.871	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	16:57:01.871	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	
	16:57:01.871	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	16:57:01.872	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	16:57:01.873	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	16:57:01.873	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	
	16:57:01.874	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:57:01.876	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	
	16:57:01.878	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	16:57:01.879	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	16:57:01.880	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	16:57:01.910	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_prev.png	
	16:57:01.911	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	16:57:01.911	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	16:57:02.065	GET https://libraryh3lp.com/js/libraryh3lp.js	
	16:57:02.105	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	
	16:57:02.124	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:57:02.135	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	16:57:02.136	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_sendTo.png	
	16:57:02.141	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	16:57:02.147	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:57:02.194	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_strip_details_links.png	
	16:57:02.285	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	16:57:02.297	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	16:57:02.373	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	16:57:02.375	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	16:57:02.382	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	16:57:09.047	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	16:57:09.047	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	16:57:09.050	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_loading_circle.gif	
	16:57:09.862	GET https://odu.userservices.exlibrisgroup.com/view/uresolver/01ODU_INST/openurl	
	16:57:09.874	GET https://odu.userservices.exlibrisgroup.com/view/skins/default/css/otb_mashup.css	
	16:57:09.874	GET https://odu.userservices.exlibrisgroup.com/view/branding_skin/css/mashup.css	
	16:57:09.875	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery-mashup.js	
	16:57:09.875	GET https://odu.userservices.exlibrisgroup.com/view/javascript/uresolverScripts.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:57:09.875	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery.js	
	16:57:09.876	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
00:12:09		P3 clicks "Access It" tab in results	No HAR file generated, since tab content is preloaded but hidden
00:12:23		P3 clicks "Sage Knowledge Reference Collection" link to access "Deforestation" article	Opens in new tab, but developer tools are not active and does not generate HAR file
00:12:29		P3 determines source does not meet research needs	
00:12:37		P3 returns to SERP/details tab (2nd from left) to repeat search	
00:12:42	16:57:41.275	P3 repeats search to review results again	deforestation
	16:57:43.082	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/search.do	
	16:57:43.483	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	16:57:43.484	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	
	16:57:43.485	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	16:57:43.490	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	16:57:43.491	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	16:57:43.491	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	16:57:43.492	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:57:43.492	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	
	16:57:43.492	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	
	16:57:43.493	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	16:57:43.494	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	16:57:43.495	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	16:57:43.496	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/pixel.png	
	16:57:43.496	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	16:57:43.497	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_off.png	
	16:57:43.755	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_open_subMenu.png	
	16:57:43.876	GET https://libraryh3lp.com/js/libraryh3lp.js	
	16:57:43.918	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	16:57:43.976	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:57:43.977	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:57:43.978	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:57:43.980	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:57:43.993	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-gear.png	
	16:57:43.994	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-facet-drawer.png	
	16:57:44.002	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-star.png	
	16:57:44.004	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon-person.png	
	16:57:44.005	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	16:57:44.007	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	16:57:44.008	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_book.png	
	16:57:44.020	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_frbr.png	
	16:57:44.021	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_article.png	
	16:57:44.044	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	
	16:57:44.047	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	
	16:57:44.096	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/rta.do	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:57:44.097	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_gloss-wave_35_f6a828_500x100.png	
	16:57:44.098	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_glass_100_f6f6f6_1x400.png	
	16:57:44.152	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	16:57:44.908	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books	
	16:57:44.917	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	16:57:44.919	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/syndetics.com/index.aspx	
	16:57:44.938	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	16:57:45.143	GET https://proxy-na.hosted.exlibrisgroup.com/exl_rewrite/books.google.com/books/content	
	16:58:34.561	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	16:58:34.563	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	16:58:34.778	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/error.do	
	16:58:34.894	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/log	
00:12:45		Returns to full text tab (3rd from left) to activate Developer Tools and refresh	Refreshes, but HAR file is bad and contains 0 bytes
00:13:05		Returns to SERP tab and starts reviewing results	deforestation
00:13:13		PI and P5 converse in background	
00:13:36	16:58:34.582	P3 selects result	"Deforestation"

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:58:35.031	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/display.do	
	16:58:35.055	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	16:58:35.056	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	
	16:58:35.058	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	16:58:35.058	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	16:58:35.058	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	16:58:35.058	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	16:58:35.059	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	
	16:58:35.060	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	
	16:58:35.061	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	
	16:58:35.467	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	16:58:35.468	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	16:58:35.468	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:58:35.476	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_prev.png	
	16:58:35.476	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	16:58:35.477	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	16:58:35.627	GET https://libraryh3lp.com/js/libraryh3lp.js	
	16:58:35.669	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	
	16:58:35.689	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	16:58:35.704	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	16:58:35.706	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_sendTo.png	
	16:58:35.711	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	16:58:35.720	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	
	16:58:35.727	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_strip_details_links.png	
	16:58:35.854	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	16:58:35.872	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	16:58:36.075	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:58:36.077	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	16:58:36.083	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	16:58:39.757	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	16:58:39.758	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	16:58:39.761	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_loading_circle.gif	
	16:58:40.629	GET https://odu.userservices.exlibrisgroup.com/view/uresolver/01ODU_INST/openurl	
	16:58:40.652	GET https://odu.userservices.exlibrisgroup.com/view/skins/default/css/otb_mashup.css	
	16:58:40.653	GET https://odu.userservices.exlibrisgroup.com/view/branding_skin/css/mashup.css	
	16:58:40.654	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery-mashup.js	
	16:58:40.655	GET https://odu.userservices.exlibrisgroup.com/view/javascript/uresolverScripts.js	
	16:58:40.655	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery.js	
	16:58:40.777	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
00:13:40		P3 clicks "Access It" tab in results	No HAR activity as tab content is hidden and preloaded
00:13:52		P3 clicks "Open source in a new window" link	Options for access open in new tab. No HAR activity as Developer Tools not activated
00:14:08	16:59:06.832	P3 activate Developer Tools and refreshes	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	16:59:07.894	GET https://odu.userservices.exlibrisgroup.com/view/uresolver/01ODU_INST/openurl	
	16:59:07.959	GET https://odu.userservices.exlibrisgroup.com/view/skins/default/css/otb_mashup.css	
	16:59:07.960	GET https://odu.userservices.exlibrisgroup.com/view/branding_skin/css/mashup.css	
	16:59:07.962	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery-mashup.js	
	16:59:07.962	GET https://odu.userservices.exlibrisgroup.com/view/javascript/uresolverScripts.js	
	16:59:07.962	GET https://odu.userservices.exlibrisgroup.com/view/javascript/jquery.js	
	16:59:07.963	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
00:14:13		P3 clicks "View full text" link	Opens "Deforestation" in new tab; Developer Tools not active so no HAR file generated
00:15:00		P3 realizes network has slowed, and she can't refresh after opening Developer Tools	
00:15:13		P3 clicks DOI link	Page didn't refresh, but clicking on DOI link in page forces new page load. But HAR file is bad and contains 0 bytes
00:15:21		P3 returns to SERP/details tab (2nd from left)	
00:15:45	17:00:41.817	P3 revises search terms and initiates search	deforestation+impacts+on+the+environement (does not request revision of typo)
	17:00:43.065	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/search.do	
	17:00:43.495	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	17:00:43.495	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:00:43.495	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	17:00:43.496	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	17:00:43.496	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	17:00:43.497	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	17:00:43.497	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	
	17:00:43.497	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	
	17:00:43.498	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	
	17:00:43.499	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	17:00:43.499	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	17:00:43.503	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	17:00:43.503	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	17:00:43.504	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/pixel.png	
	17:00:43.504	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_off.png	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:00:43.546	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_open_subMenu.png	
	17:00:43.885	GET https://libraryh3lp.com/js/libraryh3lp.js	
	17:00:43.925	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	
	17:00:43.940	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	17:00:43.959	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:00:43.966	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	
	17:00:44.063	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_book.png	
	17:00:44.071	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	17:00:44.145	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_article.png	
	17:00:44.166	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_frbr.png	
	17:00:44.220	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_other.png	
	17:00:44.426	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:00:44.429	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:00:44.430	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:00:44.431	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:00:44.441	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-gear.png	
	17:00:44.443	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-facet-drawer.png	
	17:00:44.455	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/images/icon-star.png	
	17:00:44.456	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon-person.png	
	17:00:44.510	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/rta.do	
	17:00:44.512	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_gloss-wave_35_f6a828_500x100.png	
	17:00:44.512	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/ui-bg_glass_100_f6f6f6_1x400.png	
	17:00:44.610	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:00:44.625	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	17:00:44.775	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	17:00:44.780	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	17:00:56.910	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:00:56.912	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:00:56.962	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/error.do	
	17:00:57.051	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/log	
00:15:58	17:00:56.923	P3 selects result: "Deforestation - The Impact on the Environment: Romania's Case"	HAR file does not include page content, but it appears on screen
	17:00:57.352	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/display.do	
	17:00:57.383	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	17:00:57.383	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	
	17:00:57.385	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	17:00:57.578	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	
	17:00:57.579	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	17:00:57.580	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	17:00:57.580	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	
	17:00:57.580	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	
	17:00:57.581	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:00:57.586	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	17:00:57.586	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	17:00:57.587	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	17:00:57.785	GET https://exlibris-pub.s3.amazonaws.com/PQ_Logo.jpg	
	17:00:57.785	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_open_proquestCollections.png	
	17:00:57.786	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_close_proquestCollections.png	
	17:00:57.792	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	17:00:57.793	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	17:00:58.022	GET https://libraryh3lp.com/js/libraryh3lp.js	
	17:00:58.066	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	
	17:00:58.099	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:00:58.134	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:00:58.134	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_sendTo.png	
	17:00:58.141	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	17:00:58.147	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:00:58.152	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_strip_details_links.png	
	17:00:58.153	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bullet_arrow_grey.png	
	17:00:58.261	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:00:58.270	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	17:00:58.333	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:00:58.335	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	17:00:58.342	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
	17:01:15.942	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
00:16:22	17:01:21.551	P3 refreshes result detail for "Deforestation - The Impact on the Environment: Romania's Case"	
	17:01:22.169	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/display.do	
	17:01:22.310	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.css	
	17:01:22.311	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_wro_01ODU_en_US.js	
	17:01:22.312	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/wro/primo_library_web.js	
	17:01:22.320	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/ODU-Logo-240.png	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:01:22.321	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/green-chat-now.png	
	17:01:22.322	GET https://s3.amazonaws.com/libraryh3lp.com/us/buttons/grey-chat-offline-125x48.png	
	17:01:22.323	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.css	
	17:01:22.323	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom_handheld.css	
	17:01:22.323	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/odu_primo_custom.js	
	17:01:22.325	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_sendTo.png	
	17:01:22.326	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/banner.png	
	17:01:22.326	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/primo_boomerang.js	
	17:01:22.482	GET https://exlibris-pub.s3.amazonaws.com/PQ_Logo.jpg	
	17:01:22.482	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_open_proquestCollections.png	
	17:01:22.482	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_close_proquestCollections.png	
	17:01:22.483	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_arrow_next.png	
	17:01:22.484	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/javascript/pleaseWait.js	
	17:01:23.325	GET https://libraryh3lp.com/js/libraryh3lp.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:01:23.372	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_star_on.png	
	17:01:23.401	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_clear_search.png	
	17:01:23.461	POST https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/ajaxFetchServlet	
	17:01:23.469	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/icon_available.png	
	17:01:23.494	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:01:23.495	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_diagonal_sendTo.png	
	17:01:23.526	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bg_strip_details_links.png	
	17:01:23.536	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/images/bullet_arrow_grey.png	
	17:01:23.648	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/uploaded_files/01ODU/icon-arrow-down.png	
	17:01:23.663	GET https://libraryh3lp.com/presence/jid/odumain/chat.libraryh3lp.com/js	
	17:01:23.724	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/expand.do	
	17:01:23.726	GET https://odu-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/extensions.do	
	17:01:23.735	GET https://beacon01.alma.exlibrisgroup.com/boom/apache_pb.gif	
00:16:54	17:01:51.233	P3 opens (refreshes) article page that opened in new window (arch6.p1)	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:01:51.585	GET https://search-proquest-com.proxy.lib.odu.edu/docview/1220671951	
	17:01:51.605	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/stack/en/core.js	
	17:01:51.605	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/stack/en/pqcore.js	
	17:01:51.606	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/stack/en/os-std.js	
	17:01:51.606	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/base/DocViewBase.js	
	17:01:51.606	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/GoogleAnalytics.js	
	17:01:51.606	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/myresearch/CreateProfileOverlay.js	
	17:01:51.606	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/validation/usernameValidator.js	
	17:01:51.607	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/pqc/mixins/ZoneUpdater.js	
	17:01:51.607	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/DonorBranding.js	
	17:01:51.607	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/docview/Tab.js	
	17:01:51.607	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/pqc/javascript/prototip/js/prototip.js	
	17:01:51.607	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/extras/imageviewer/viewer.js	
	17:01:51.608	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/js/jquery.unveil.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:01:52.554	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/fonts/Roboto-Light-webfont.woff	
	17:01:52.659	GET https://dev.visualwebsiteoptimizer.com/track/va-ca51627560295d1d25e5676cd91d85d0.js	
	17:01:52.659	GET https://dev.visualwebsiteoptimizer.com/track/track-ca51627560295d1d25e5676cd91d85d0.js	
	17:01:52.660	GET https://dev.visualwebsiteoptimizer.com/analysis/opa-1b829bce79fbb94ca7fcfd0fbed69853.js	
	17:01:52.660	GET https://dev.visualwebsiteoptimizer.com/v.gif	
	17:01:52.665	GET https://pq-static-content.proquest.com/shared/images/pub/1606337.gif	
	17:01:52.705	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/fonts/RobotoSlab-Regular-webfont.woff	
	17:01:52.732	POST https://search-proquest-com.proxy.lib.odu.edu/docview.headertitle:imagecheck	
	17:01:52.855	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/images/pagelayout/pipe.png	
	17:01:53.015	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/images/pq-logo-footer.png	
	17:01:53.017	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/core/field-error-marker.gif	
	17:01:53.018	GET https://search-proquest-com.proxy.lib.odu.edu/images/pagelayout/ajax-loader.gif	
	17:01:53.227	GET https://dev.visualwebsiteoptimizer.com/analysis/worker-68f4c079a93008e8e04f81f6476e5cc4.js	
	17:01:53.440	POST https://search-proquest-com.proxy.lib.odu.edu/docview.similardocuments.progressivedisplay	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:01:53.442	POST https://search-proquest-com.proxy.lib.odu.edu/docview.ebraryrelateddocs.display	
	17:01:51.608	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/docview/AccessToFullTextLinks.js	
	17:01:51.608	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/toolssection/ShareToGoogleDrive.js	
	17:01:51.608	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/docview/SimilarDocuments.js	
	17:01:51.609	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/visualdesign/MainContentLeft.js	
	17:01:51.613	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/extras/analytics/GTMContainerProd.js	
	17:01:51.614	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/core/spacer.gif	
	17:01:52.226	GET https://pq-static-content.proquest.com/shared/images/pub/1606337.gif	
	17:01:52.227	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/images/brandingLogos/logo_LEC.gif	
	17:01:52.462	GET https://dev.visualwebsiteoptimizer.com/j.php	
	17:01:52.510	GET https://www.googletagmanager.com/gtm.js	
	17:01:52.548	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/images/pq-logo.png	
	17:01:52.549	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/fonts/Roboto-Regular-webfont.woff	
	17:01:52.549	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/fonts/aleo-regular-webfont.woff	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:01:53.578	GET https://www.google-analytics.com/analytics.js	
	17:01:53.613	GET https://www.google-analytics.com/collect	
	17:01:54.082	GET https://ebookcentral.proquest.com/covers/1165085-m.jpg	
	17:01:54.082	GET https://ebookcentral.proquest.com/covers/4459487-m.jpg	
	17:01:54.083	GET https://ebookcentral.proquest.com/covers/1730887-m.jpg	
	17:01:59.542	GET https://www.google-analytics.com/collect	
00:17:02	17:01:59.561	P3 selects Full Text - PDF tab in current window to access PDF	
	17:01:59.913	GET https://search-proquest-com.proxy.lib.odu.edu/docview/1220671951/fulltextPDF/3FC3615017DF4148PQ/1	
	17:01:59.935	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/stack/en/core.js	
	17:01:59.935	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/stack/en/pqcore.js	
	17:01:59.935	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/stack/en/os-std.js	
	17:01:59.935	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/pages/pdfobject.js	
	17:01:59.935	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/base/DocViewBase.js	
	17:01:59.935	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/GoogleAnalytics.js	
	17:01:59.935	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/myresearch/CreateProfileOverlay.js	
	17:01:59.936	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/validation/usernameValidator.js	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:01:59.936	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/pqc/mixins/ZoneUpdater.js	
	17:01:59.936	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/DonorBranding.js	
	17:01:59.936	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/docview/Tab.js	
	17:01:59.936	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/toolssection/EmailItem.js	
	17:01:59.937	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/toolssection/ShareToGoogleDrive.js	
	17:01:59.937	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/docview/SimilarDocuments.js	
	17:01:59.938	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/app/components/visualdesign/MainContentLeft.js	
	17:01:59.938	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/core/default.css	
	17:01:59.938	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/core/tapestry-console.css	
	17:01:59.938	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/core/t5-alerts.css	
	17:01:59.938	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/core/tree.css	
	17:01:59.938	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/styles/citethis.css	
	17:01:59.938	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/pqc/javascript/tinybox2/tinybox.css	
	17:01:59.939	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/styles/PageLayout.css	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:01:59.939	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/styles/ContentLayout.css	
	17:01:59.940	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/css/uxf-1.0.0-teal.min.css	
	17:01:59.940	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/styles/overRide.css	
	17:01:59.942	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/styles/media-queries.css	
	17:01:59.942	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/extras/analytics/GTMContainerProd.js	
	17:01:59.943	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/core/spacer.gif	
	17:02:00.374	GET https://dev.visualwebsiteoptimizer.com/j.php	
	17:02:00.598	GET https://pq-static-content.proquest.com/shared/images/pub/1606337.gif	
	17:02:00.668	GET https://dev.visualwebsiteoptimizer.com/track/va-ca51627560295d1d25e5676cd91d85d0.js	
	17:02:00.668	GET https://dev.visualwebsiteoptimizer.com/track/track-ca51627560295d1d25e5676cd91d85d0.js	
	17:02:00.671	GET https://dev.visualwebsiteoptimizer.com/analysis/opa-1b829bce79fbb94ca7fcfd0fbed69853.js	
	17:02:00.671	GET https://dev.visualwebsiteoptimizer.com/v.gif	
	17:02:00.845	GET https://www.googletagmanager.com/gtm.js	
	17:02:00.859	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/fonts/Roboto-Regular-webfont.woff	
	17:02:00.859	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/fonts/Roboto-Light-webfont.woff	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:02:00.860	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/fonts/aleo-regular-webfont.woff	
	17:02:00.866	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/fonts/RobotoSlab-Regular-webfont.woff	
	17:02:00.917	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/images/pq-logo.png	
	17:02:01.020	GET https://pq-static-content.proquest.com/shared/images/pub/1606337.gif	
	17:02:01.365	GET https://dev.visualwebsiteoptimizer.com/analysis/worker-68f4c079a93008e8e04f81f6476e5cc4.js	
	17:02:01.438	POST https://search-proquest-com.proxy.lib.odu.edu/pagepdf.headertitle:imagecheck	
	17:02:01.560	GET https://media.proquest.com/media/pq/classic/doc/2827708261/fmt/pi/rep/NONE	
	17:02:01.562	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/ctx/uxframework/images/pq-logo-footer.png	
	17:02:01.563	GET https://search-proquest-com.proxy.lib.odu.edu/assets/r20181.3.0.487.2315/core/field-error-marker.gif	
	17:02:01.567	GET https://search-proquest-com.proxy.lib.odu.edu/images/pagelayout/ajax-loader.gif	
	17:02:01.711	POST https://search-proquest-com.proxy.lib.odu.edu/pagepdf.similardocuments.progressivedisplay	
	17:02:01.713	POST https://search-proquest-com.proxy.lib.odu.edu/pagepdf.ebraryrelateddocs.display	
	17:02:01.928	GET https://www.google-analytics.com/analytics.js	
	17:02:01.995	GET https://www.google-analytics.com/collect	
	17:02:02.551	GET https://ebookcentral.proquest.com/covers/1165085-m.jpg	

Table A10.1 Continued

UT Elapsed Time	HAR Timestamp	Activity	Content
	17:02:02.551	GET https://ebookcentral.proquest.com/covers/4459487-m.jpg	
	17:02:02.552	GET https://ebookcentral.proquest.com/covers/1730887-m.jpg	
	17:02:04.216	GET https://www.google-analytics.com/collect	
00:17:16		P3 determines article will suffice to complete the testing session	
00:17:54		P3 asks PI what to do after finding a good article	
00:18:54		P3 selects next task	
00:18:58		P3 reads next task	
00:19:05		P3 indicates completion of task	
00:19:30		P3 reads next task	
00:19:36		P3 indicates completion of task	
00:19:37		P3 ends test	

VITA

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Daniel L. Hocutt earned a B.A. in English at the University of Richmond in Richmond, Virginia, in May 1992. After graduating *summa cum laude*, earning both the Charles T. Norman Award for English in Richmond College and the Mary Madison Bowen Award for Proficiency in Latin, he taught high school English, beginning Latin, and yearbook journalism in Chesapeake, Virginia, from September 1992 to June 1996. Hocutt returned to the University of Richmond in 1996 where he earned an M.A. in English with a thesis studying non-linear narrative in Laurence Sterne's *The Life and Opinions of Tristram Shandy, Gentleman*, titled: "'A tolerable straight line': Non-Linear Narrative in *Tristram Shandy.*"

Upon graduating, Hocutt took over full-time directorship of the Virginia Summer Residential Governor's Schools for Humanities and Visual & Performing Arts at the University of Richmond, a program of the university's School of Professional & Continuing Studies (SPCS). While serving in this role, he took over responsibility for the SPCS website in 1999 and began teaching as an adjunct instructor of English in 2000. He continued serving the University of Richmond as part-time web manager and adjunct instructor after leaving full-time employment as director of the Governor's Schools in August 2001. Hocutt developed a free-lance web development business serving writers and literacy organizations. He continued his free-lance roles through 2011, when he returned to full-time employment at the University of Richmond as web manager on the school's marketing team. He began doctoral studies in 2013 while working full-time and continuing his adjunct teaching work at the University of Richmond. Hocutt received the inaugural ODU English Doctoral Award for Distinction in Research in 2016.