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BigDIVA and Networked Browsing: A Case for Generous Interfacing and Joyous Searching

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Abstract

This paper examines the potentialities of *networked browsing*, a form of faceted searching that visualizes digital archives in the form of a force-directed network graph. Using BigDIVA.org as an example of networked browsing, this paper presents the results of a small usability study that compared how participants (N = 8) engaged with BigDIVA's networked browsing in comparison to use of a search engine such as Google. In doing so, we situate our study within performative conceptualizations of human-computer interfaces [Drucker 2013] in order to explore the potential becomings when human and nonhuman machinic component are entangled together. Based on the observations from our usability study, we argue that networked browsing is suggestive of Whitelaw's (2015) "generous interfacing" that emphasizes browsing as a tool for exploring relationships between nodes in archives, as well as Shneiderman's (1996) "joyous experience" for interfacing with the web.

Introduction

Conducting a search query through Google or scholarly archives is a performance. It requires curation of key terms or phrases from memory, fingered articulation upon a keyboard, recall from the database, selection and then uptake from a list of results. This ubiquitous everyday performance, while providing information access and retrieval across the world, is nonetheless a narrowly defined operation in which a given search query is matched to a given resource. As Mitchell Whitelaw (2015) argues, the process of browsing limits a user to understanding and exploring the scores of information available online. If an online archive is analogous to a museum, then Whitelaw argues that starting with a search query is the equivalent to being told to wait at the entrance to the Louvre until you explicitly request to see the Mona Lisa. Citing Ben Shneiderman's two-decade-old appeal to make information exploration a "joyous experience" [Shneiderman 1996] as well as Johanna Drucker's (2013) call for the humanities to take a central role in such endeavors, [Whitelaw 2015] outlines the numerous possibilities for online archives and databases to design "generous interfaces" in order to allow users to explore relationships between nodes of information across the web. This paper examines BigDIVA (short for Big Data Infrastructure Visualization Application) as one such instantiation of a "generous interface" that invokes performative materiality for an online database cataloguing archives in the Advanced Research Consortium (ARC). 1

BigDIVA[1] is a database that visualizes the ARC catalog[2] through an interactive force-directed graph in which network nodes represent specific catalogued archives, collections, or resources (see Figure 1). Its name invokes the concept of Big Data, and as such provides users with visualization of the *entire* ARC catalog, while search queries either narrow or shrink the webbed catalog. This paper argues that searching and browsing online archives through a networked visualization interface (henceforth *networked browsing*) allows users to explore and interpret relations between archived sources (nodes) and to perform contingent in-the-moment search queries outside of the search box. In this sense, networked browsing prioritizes play and meaning-making that is co-constituted with the distributed materiality of the database itself. This turns traditional browsing performances on their heads and downplays the human-centered process that directs a subject from search query to resource, and instead directs the subject(s) to explore and infer 2 relationships between the human user, the machinic components of the interface, and the networked points that make up the archived subjects.

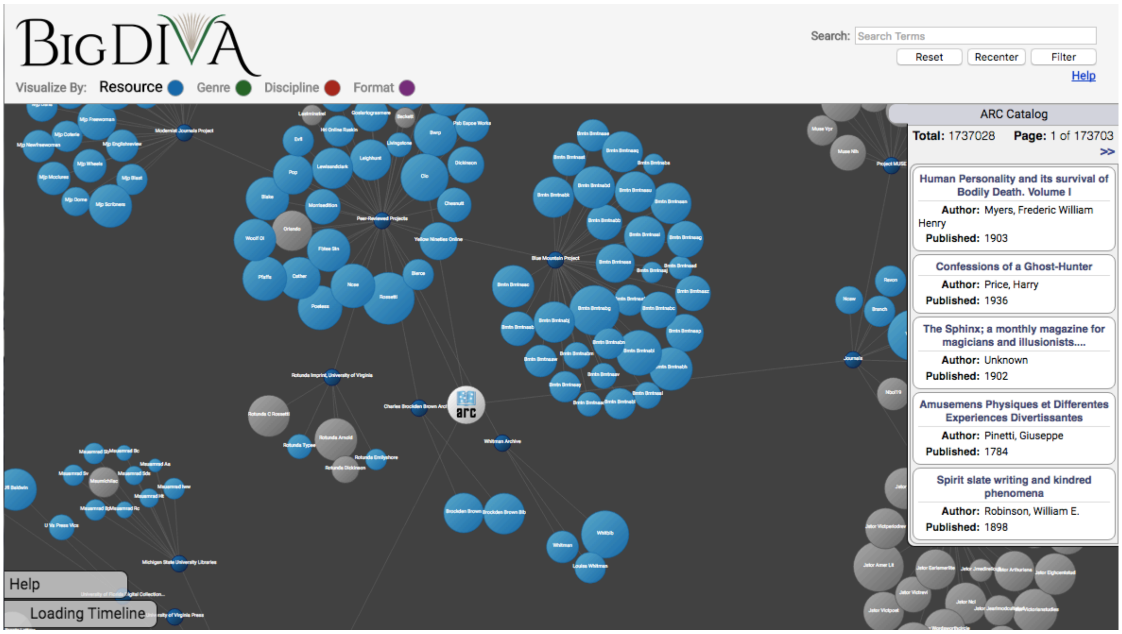

Figure 1. BigDIVA's home screen representing the force-directed graph of the ARC catalog

This paper will explore two questions that situate BigDIVA within ongoing discussions of interfaces (see [Drucker 2013]; 3
[Whitelaw 2015]; and [Schofield et al. 2015] from this journal), performative materialism, and digital archives: First, *how do human participants use BigDIVA in comparison to a more traditional browser interface such as Google*? In the simplest terms, networked browsing disrupts the expectations of traditional web browsing. As such, these disruptions will necessarily manifest behaviorally (i.e., facial gestures, mouse clicks, vocalizations) and temporally (i.e., time spent on each search task). Such distinctions in usage may suggest how new users might interact with BigDIVA's interface as well as networked browsing. Second, *how does usage of BigDIVA's interface (as well as self-reports of usage) afford and evidence generous interfacing or archival liveness*? While design choices may be theoretically grounded, those choices may not always be transparent to the intended users and thus the interface still risks becoming functionally fixed. Thus, we intend to explore how users' experiences — as well as perceptions of their experiences — of BigDIVA may explicitly reflect interfacing that is theoretically grounded in the notion of performative materiality, wherein various bodies and distributed components meet at the point of the interface to perform a search.

This paper will proceed with a background discussion concerning performative materiality and interfaces, the technical 4
background concerning networked browsing and BigDIVA, results from the usability study, and lastly a discussion and conclusion section.

Performative Materiality and Joyous Interfacing

A performative conception of human and machine interfacing places the utmost importance on what subjects are doing 5
in a given assemblage, and how their actions co-constitute one another. Questions are more concerned with what a subject does, rather than what it is [Drucker 2013]. Karen Barad argues that

> The move toward performative alternatives to representationalism shifts the focus from questions of correspondence between descriptions and reality (e.g., do they mirror nature or culture?) to matters of practices/doings/actions. [Barad 2003, 802]

This move away from representationalism (i.e., concern with what subjects are) is an effort to grant and explore the agency of subjects that are otherwise agentless through practices that seek understandings of definitions and boundaries. For example, a representationalist understanding would render a BigDIVA user's keyboard as an input apparatus that is acted upon by human agents. While not necessarily inaccurate, this definition is necessarily based upon a priori knowledge of the keyboard (i.e., how it *has been used*), and subsequently obscures its infinite range of potentialities (i.e., how it *could be used*). However, as argued by [Kittler 1999], keyboards, which were originally designed as writing devices for the blind, were not necessarily intended as primary input devices for computers. The agentive trajectory of components in a cybernetic assemblage are thus not pre-determined. Interfaces are therefore an exemplary site to explore such cybernetic performances since multiple bodies constituting multiple agencies and materialities meet at the point of interface.

Barad argues that in casting aside representational concerns about "inherent boundaries and properties," bodies are instead "material-discursive phenomena" that engage in unique performances that create meaning through their performances [Barad 2003, 823]. She elaborates that "'Human' bodies are not inherently different from 'nonhuman' ones. What constitutes the 'human' (and the 'nonhuman') is not a fixed or pregiven notion, but nor is it a free-floating ideality" [Barad 2003, 823]. In this way, what a subject does in constellation with other subjects is what continually configures and reconfigures the notion of that subject. In Barad's framework, which she terms *agential realism*, meaning is made in the spaces in which these bodies come to meet together, which she calls *intra-activity*. 6

Barad's framework, which draws attention to how meaning is made through bodies performing together, is crucial for digital media scholars in order to understand that when humans and technology intra-act that the range of potential meanings, realities, and uses are not predetermined. Drawing on groundbreaking principles of quantum physics, particularly the philosophy-physics of Niels Bohr, Barad uses the term *apparatus* to describe the site of human and nonhuman bodies coming together: 7

> apparatuses are not mere static arrangements in the world, but rather apparatuses are dynamic (re)configurings of the world, specific agential practices/intra-actions/performances through which specific exclusionary boundaries are enacted. [Barad 2003, 816]

Whether a factory floor, scientific instrument, or a typewriter keyboard, when humans act with any apparatus they — together — create new potential meanings. Barad's framework therefore reminds us that understanding and studying digital media apparatuses requires attention to how they are made meaningful *through use*.

To return to our previous question: how does a performative materiality reveal the material-discursive phenomena at play within the interface? First, it is worth noting that Johanna Drucker (2013) argues that the interface should be conceptualized as a *space* rather than a *thing*, specifically, "a space of affordances and possibilities structured into organization for use" [Drucker 2013, para. 31]. Thinking of an interface in terms of a space therefore entangles more than just the machinic components, but enfolds the multiple bodies and agencies that organize around possibilities of use. Alexander Galloway (2012) has similarly argued that an interface, like that of a computer, "is a process or active threshold mediating between two states" [Galloway 2012, 23], and thus an *effect* of the meeting of bodies. Understanding an interface as a *space* and an *effect* of the meeting between bodies therefore requires attention to the numerous distributed components — on both sides of the threshold — that meet at the point of interface, from the human user to the device to the networked archive. 8

Drucker (2013), drawing upon JeanFrançois Blanchette, argues that all of these components that meet in digital media interfaces are complex cybernetic assemblages that constitutes a *distributed materiality* in which multiple components are "locked into relations with each other that are governed by their material design and constraints in ways that have an effect on the costs and efficient operation of the system" [Drucker 2013, para. 6]. Such an assemblage's operation (i.e., *performance*) might be most evident at the point of interface, but Drucker argues that the various components that are "locked into" that performance may be distributed at points quite distant from the point of interface. This is not so surprising considering that ergonomic design traditions for complex computer interfaces frequently encourage concealment of the elaborate distributed components that make up the machine [Harwood 2011], as well as how they often draw upon adjacent cultural metaphors (e.g., the computer "desktop"). 9

In the case of a website, then, the distributed components include the computer screen, the mouse, the site interface, 10 the network that connects the computer to the site, the server that hosts the site, the cooling system that prevents the servers from overheating, etc. With so many components locked together in play, Drucker argues that “[e]very person produces a work as an individual experience, according to their disposition and capacity” [Drucker 2013, para. 22]. This performance may thus occur at various points of distribution in contributing to what [Schofield et al. 2015] termed *archival liveness*. In this way, an empirical investigation of the unique reconfigurations at play when a human accesses a website requires attention to multiple agentive components.

Between Barad’s conceptualization of the apparatus, which emphasizes meaning-making through intra-activity, and Drucker’s conceptualization of the interface, which emphasizes cybernetic assemblages as a space that enfolds a distributed materiality, it is possible to understand the potentialities of human interaction with digital media through attention to *use*. As we hope to demonstrate in this paper, observing these interactions by concentrating on use may allow for observation of how the bodies (human and distributed nonhuman components) performatively materialize one another, specifically by concentrating observation on the point of contact — the interface. In the case of BigDIVA, we specifically wish to understand how a shift in the design of an online browsing interface engenders new performances and understandings of the components on either side of the interface. In the following section, we detail how the design of online browsing interfaces, as well as attempts to understand the *usability* of these interfaces, have thus far contributed to understanding these relationships in terms of performative materialities. 11

Web Browsing, Interfaces, and Usability

In this section we provide background into discussions about the application of design principles to web browsing and online interfaces — much of which comes from fields such as design, human-computer interaction (HCI), and user experience (UX). We additionally make an attempt to couch this material within the contexts of ongoing discussions in the digital humanities about how to understand how individuals experience and *use* digital media within DH contexts, as well as the application of theory in these contexts. While these discussions certainly draw upon the aforementioned disciplines, similarly as we do, our primary intention in discussing them in the first place is to bring to the fore the tension between understandings of *use* and *usability* across various disciplines. 12

Designing Data Types

In 1996, Brian Shneiderman made a plea to designers that “information exploration should be a joyous experience” [Shneiderman 1996, 336]. Noting the rising demand for information-seeking online services in the days before Google’s ubiquity, Shneiderman argued that as online archives expanded that the “visual presentation” as well as “direct-manipulation” of information would be critical for users to be able to deliberately sort through the slew of search results without experiencing cognitive overload. The “visual presentation” of different types of data would therefore be critical to managing user experience, and Shneiderman outlined several data types in order to aide how designers conceptualized the user’s relationship between data and directly manipulating this data. His taxonomy included data that he considered 1-dimensional (e.g., textual data), 2-dimensional (e.g. maps), 3-dimensional (e.g., “real-world” objects like the human body), temporal (e.g., timelines), multi-dimensional (e.g., combination of multiple data types), treed (e.g., hierarchical tree-structured data), and networked (e.g., network visualizations that show relationships between data)[3] [Shneiderman 1996, 337]. Shneiderman (1996) insisted that accommodating several data types simultaneously would be necessary to design information search interfaces, and further suggested that the goals and interests of users conducting searches would likely affect the use of visualization/manipulation tools such as filtering [Shneiderman 1996, 339]. 13

In the last two decades, much of Shneiderman’s taxonomy is highly visible in various iterations of web-based browsing applications and design literature, particularly dynamic queries which are frequently represented as faceted searching. Fagan (2010) noted that contemporary instantiations of faceted search tools aimed to represent data types and provide tools for users to narrow information search results. A typical example might start with a single search term, and then facet by the type or resource, the date range, or even availability of digitized copies (see Figure 2 for an example of faceted search). After examining numerous studies that empirically investigated faceted searching, Fagan (2010) reported on a bevy of benefits to faceted search, perhaps most notably that faceted search may contribute to users 14 finding a greater amount of relevant results as well as creating mental navigation structures and specifically benefits user's ability to search within specific time-frames or by specific authors [Fagan 2010, 62–63].

Xiao et al. (2009) demonstrated that successfully navigating and interacting with an online search tool, such as Yahoo.com, on a mobile device stresses the importance of *limiting* the available visual real estate by stacking blocks of space horizontally, and limiting the amount of text simultaneously visible on-screen. Faceted search interfaces, as shown in Figure 2, represent significant obstacles to such challenges from a visual perspective. While designers and scholars have explored mobile-specific interfaces for faceted search, the challenges outlined by [Xiao et al. 2009] are pervasive. For example, [Schneider, Scherp, and Hunz 2013] finds that certain modifications, such as presenting facets in a list or a grid, might significantly improve usability but not necessarily user enjoyability of the search experience. Incorporating lessons from [Shneiderman 1996] and [Xiao et al. 2009], [Kleinen, Scherp, and Staab 2014] designed a custom mobile application that combined text and visuals to conduct faceted search tasks, so that a user might begin by entering or selecting text based on prior knowledge, and then selecting the next facet through a map with geographically specific "points of interest." In this way, at each point of faceting the user is presented with a different dimensionality of the interface so that they may go from map, to list, to detailed visual, to detailed text. Such an example of faceted searching that incorporates multidimensional data, Kleinen et al. argue, may yield more enjoyable search experiences. 15

Regardless of the device, it is apparent that online activities like web-browsing and searching are unique performances that are configured with the apparatus that user and site interface through (as well as how that interface is reconfigured with the apparatus). These usability studies further reveal representations and visualizations of dimensions of faceted searching may inhibit or encourage alternate forms of exploration. In particular, an undercurrent of the studies reported in [Fagan 2010] as well as [Schneider, Scherp, and Hunz 2013] is that faceted search interfaces are intended to guide users to specific information based on *a priori* knowledge or data type dimensions. Kleinen et al. (2014) caution that as online data types, sources, devices, and interfaces increase in size and complexity faceted search interfaces will need to accommodate an "a-priori *unknown* number of data categories and data instances" [Kleinen, Scherp, and Staab 2014, 57, emphasis ours]. Therefore, the concern is not simply a matter of device- and screen-size, but rather, a concern of the relationship between what the user wants — in terms of inquiry and affect — and what the archive wants — in terms of liveness and data dimensionality. 16

Use and Usability in DH

Our study is not the first within the digital humanities to draw upon the idea of usability and to consider user experience in ways similar to the studies described in the previous section. For example, [Gibbs and Owens 2012] incorporated a series of virtual panels, much like a focus group, to discuss online tools with historians, and [Warwick 2012] incorporated a usability study to observe novice and expert users of an online archeological database. While both of these studies used methods familiar to UX studies, an emphasis on users with specific background knowledge, expertise, and scholarly practices (i.e., historians or archeologists) suggests greater consideration for *use* and *users* in addition to *usability*. 17

Since the DH ethos values both the evolution of traditional research practices from humanities scholars as well as knowledge production in humanities classrooms, it is reasonable that DH scholars seeking better understanding and improved designs of digital media are concerned with a wider context than that of the interface. Burkick & Willis (2011) have argued that 21st-century literacy practices are *design* practices, which transforms digital scholarship and knowledge production into a process of thinking through designing. This *user-oriented* approach "takes into account not only how an application is used but also the kinds of subject positions, world-views, and models it affords" [Burdick and Willis 2011, 550]. User-oriented designs would account for Gibbs & Owens's (2012) recommendation that DH tools be designed more holistically for the needs of humanities scholars and students, specifically tools that are "more transitory than revolutionary" [Gibbs and Owens 2012, para. 35]. 18

Warrick (2012) has additionally argued that studying users in context is key to understanding how scholars and students of varying expertise use digital tools and media as part of their broader scholarly practices. This encourages *use* in addition to *usability*, and attention to what users (i.e., scholars) *want* and how they might engage in practice with digital 19 tools — regardless of usability [Kemman and Kleppe 2014]. By focusing on the user in context, Kemman & Kleppe (2014) argue that observations will inform design, which may then result in a feedback loop between design and use. This user-centered design process requires iterative attention to use in context, such as through extended and longitudinal usability studies [Warwick 2012].

While this surely requires an extended discussion on its own, it is worth noting that the tension between a *user* and *use* for DH scholars and *usability* from UX approaches are not mutually exclusive, and, as suggested by [Warwick 2012], the two can inform one another. Software and methods intended for usability studies, which may include screen capture, log-file data, and even front-facing cameras to capture facial expressions, may well yield rich and well-rounded understandings of *use* as well as *usability*. In our study of BigDIVA, we therefore sought to further understand how new ways of visualizing and encountering data types may serve as a “transitory” practice for humanities scholars, and our use of a usability study may be seen as an intervention to elicit not only potential understandings of how users initially use BigDIVA, but also how they may perceive its potential use in their own practices. In the following section we provide details of BigDIVA’s configuration. 20

Networked Browsing and BigDIVA

In Shneiderman’s (1996) taxonomy of data types, network data accounts for relationships between and among items in an online archive. The configuration of these relationships, or *network topologies*, are commonly visualized through force-directed graphs in which items are nodes and lines connect related nodes [Galloway and Thacker 2007]. Shneiderman cautions that network representations risk overwhelming complexity (particularly as archives access large amounts of items), as can be seen in attempts to document the topology of the internet. However, he does suggest that network representation may allow users the opportunity to find the shortest routes between nodes in order to establish mental representations of relationships between items and clusters of items. 21

BigDIVA operationalizes faceted searching through presenting a model of the network through one of four user-defined facets: *resource*, *genre*, *discipline*, and *format*. While *resource* is the primary representation by default, users can choose to begin with one of the other three. This is accomplished without extensive revision to the existing schema because the ARC catalog is a fairly shallow example of faceted search, with its categories largely existing as sister nodes under a central tree. The tool takes advantage of this functionality to create ad-hoc trees based on the user’s defined needs and ARC catalog schema. 22

Once a user has selected their initial facet, they are then presented with a group of sub-nodes that consist of the various recognized categories in the schema. For example, a user that selects *Genre* as their initial limitation will be presented with sub-nodes with categories such as Law, Scripture, and Drama. From there, they can select the desired category, whereupon they are presented with the total number of items under that category in a sidebar and the ability to refine further based on either the remaining categories or the individual records. This refinement can be narrowed further by repeating the process with the newly-refined category until all four aspects of the site have been selected upon. 23

Regardless of the level at which they are selected, the individual resources provide a truncated version of the catalog information and, most importantly, a link for the user to go to that resource, which will then appear in a new window. At the same time, the user can see the entire path between their initial category and the individual item, maintaining a visual representation of the mental model they were operating under while making that selection. Furthermore, they can select different nodes and combinations of categories to visualize multiple mental pathways at the same time, a functionality that is not possible in most faceted search systems. In all instances, the nodes are color-coded to help the user to understand at a glance what selections have been made, while unavailable choices are greyed out. This maintains both the full picture of the ARC catalog while simultaneously foregrounding those items that are of most import to the researcher. Finally, because the ARC catalog deals with historical objects, a timeline is provided at the bottom of the workspace, which allows a user who works in a particular period to view only those items of interest within that period. 24

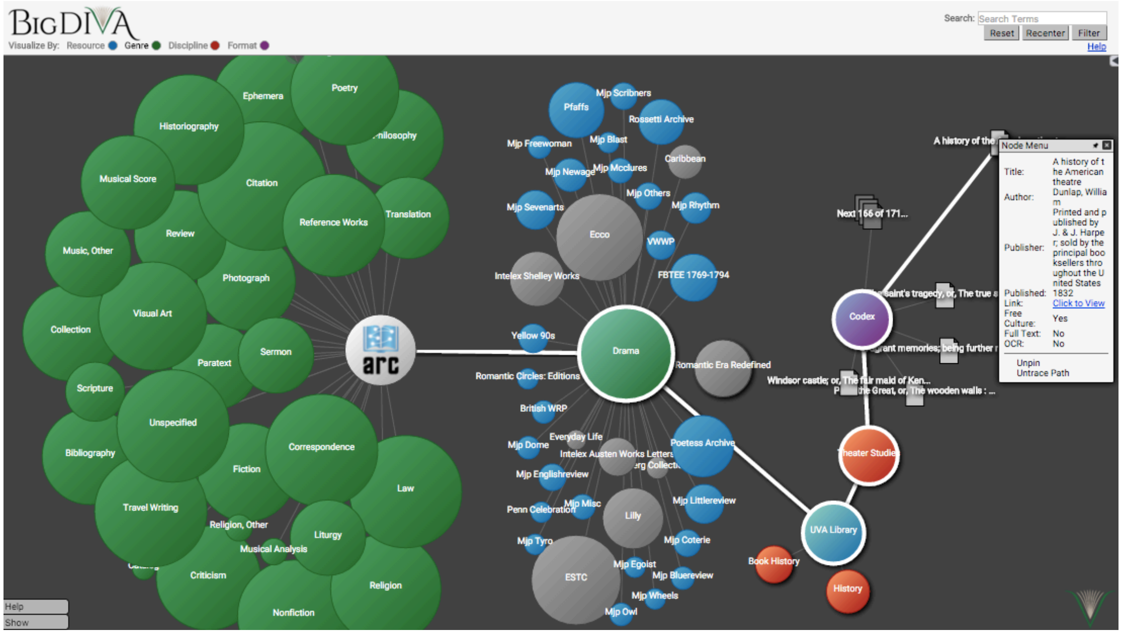

Figure 2. Faceting by Genre, to Resource, to Discipline, to Format, to individual result

Since BigDIVA therefore allows users to manipulate the data visualizations through multiple means simultaneously, i.e., 25
the user-defined facets, a timeline, as well as more direct manipulation of the network nodes, it may afford a unique browsing experience. While simply overlaying multiple types of interactive data is not alone a cure-all, the combination of a networked graph of the entire catalogue, combined with the ability to expand the network graph through faceting based on category as well as time-line may serve as complementary tasks. However, the inclusion of a standard search bar as a way to filter out archival items from the network visual may serve as a source of confusion since one is a standard search feature while the other is not. In other words, a key aspect of understanding BigDIVA's usability as well as the experiences of users will be the perceived relationship between these starkly different data types, in Shneiderman's terms.

BigDIVA Usability Study

In order to take first steps to understand the potential uses and experiences that BigDIVA's networked browsing has to 26
offer, we designed a usability study intended to compare networked browsing with more traditional web browsing. In doing so, we hoped to observe not only whether individuals could successfully use BigDIVA as a search tool without any training, but also how BigDIVA's networked browsing engaged individuals in unique acts of online information searching. In short, we sought to understand BigDIVA's operational *usability*, but also the potential user experience it may engender. Our resulting study design therefore compared search tasks using Google and BigDIVA, tracked the timing patterns for each task as well as input-related actions, and elicited self-reported perceptions by first-time users. The study design will be briefly discussed below, followed by discussion of our results.

Study Design

This study was conducted entirely within a labspace designed specifically for usability studies in the library of a Mid- 27
Atlantic U.S.-based university. This lab was outfitted with a desktop computer running Morae software[4], designed for computer-based usability testing, and a Logitech C920 webcam with stereo microphones. Morae was able to simultaneously record on-screen video (including highlighting of cursor actions), audio-video footage from the webcam, and log-file data from the keyboard, mouse, and onscreen applications. The resulting recording (see Figure 3 below) could then be viewed and analyzed with Morae software.

Participants were guided through the study tasks through a Google Forms file that provided instructions for, as well as 28
logged performance of, each task. First, participants were asked to complete a brief pre-study questionnaire to self-

report expertise with generic information search, as well as fields of expertise. Next, participants were guided through three search tasks that required using Google to find a famous work by William Blake, a relief etching by William Blake, and an etching of Blake's "Milton: a Poem." These three tasks in particular were intended for participants to find increasingly specialized information and to use Google's faceting feature for searching via dimensions such as Image, Web, or Video. Following these three tasks, participants were then required to use BigDIVA to identify collections with large results for "William Blake," an individual result from this search, meta-data from a specific result for Blake's "Night Thoughts," and an example search result that contains the text string "chastity." It should be noted that all of the search tasks are listed in the Appendix, and that the BigDIVA search tasks were intentionally longer simply to observe users interacting with BigDIVA for longer. Following the search tasks, the first author engaged the participants in a brief follow-up interview to solicit self-reported experiences with BigDIVA.

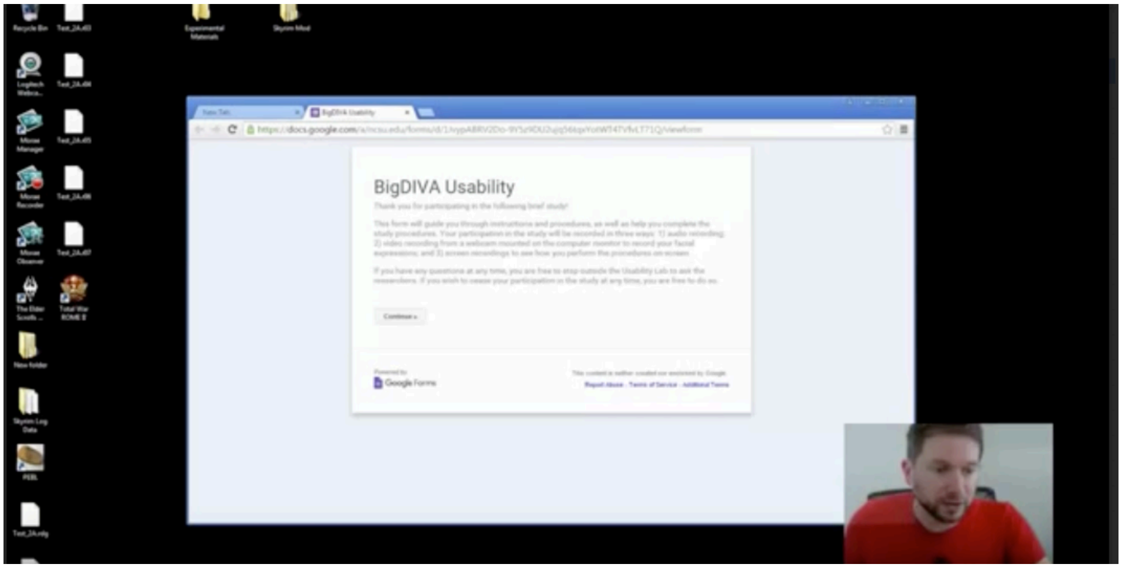

Figure 3. Still frame from the Morae recording overlaying webcam and screen-capture video footage

Results

Participants (*N* = 13) were recruited from networks connected to a Mid-Atlantic university in order to engage participants 29
that were likely familiar with web-based archival search tools beyond Google. All participants were currently enrolled in graduate coursework or had completed graduate coursework, and were from a variety of fields and academic positions including tenured professors, graduate teaching/research assistants, library & information scientists, industry workers, and one individual currently between jobs. A small group of participants (*N* = 5) piloted the study design during the spring of 2015, which led to subsequent adjustments to the study's task design (i.e., particular phrasing of task instructions, and streamlining of the Google Forms interface). The remaining participants (*N* = 8) engaged in the study between late 2015 and early 2016, and will make up the primary participant pool to be discussed throughout the remainder of this paper.

Analysis was conducted using Morae Manager to code and extract data, and visualizations were produced in R Studio 30
[RStudio Team 2015]. Participant usability sessions were analyzed according to three dimensions: Time On Tasks (TOT), Actions Within Tasks (AWT), and Log-File data (primarily Mouse and cursor actions). TOT data was primarily continuous, i.e., based upon duration of time a participant spent on each individual task, whereas AWT and Log File data were discrete, i.e., a specific type of action that occurred at a specific moment of time. Table 1 below outlines each specific dimension along with its corresponding codes.

<table>
<tr><th>Time on Tasks</th><th>Actions Within Tasks</th><th>Log File</th></tr>
<tr><td>Google Tasks:
Task 1_1
Task 1_2
Task 1_3
BigDIVA Tasks:
Task 2_1a
Task 2_1b
Task 2_2a
Task 2_2b
Task 2_3a
Task 2_3b
Task 2_4</td><td>SEARCH: enters or modifies a search query in the search bar
OPENSRESULT: clicks on an individual result
NODEPLAY: Highlights, pins, or moves around a node
FACETS: uses faceting after a search query has been entered
DIMENSIONSWITCH: facets prior to a search query has been entered
ENTERSTASK: enters or modifies an answer for a search task
QUITS: abandons the search task, typically marked by entering “Not found” or such into the answer for a search task
CHEATS: uses an alternative method to complete a search task (e.g., prior knowledge, another search engine)
CTRLF: uses the Control+F search function within a page</td><td>Mouse Actions:
Movement
Scrolling
Cursor Actions:
Right click
Left click
Double left click
Keystroke Actions:
Alphanumeric keys
Functions keys</td></tr>
</table>

Table 1. Dimensions of Analysis

Participants spent a total of 30.51 minutes on the three Google tasks, and 144.78 minutes on the seven BigDIVA tasks (see Table 2 for breakdown of TOT). When looking at TOT for each individual task, as shown in Figure 4 below, we can see that, while in many cases the TOT for BigDIVA tasks varied within the same range as the Google tasks, the BigDIVA tasks witnessed greater variability in terms of TOT. In particular, the two BigDIVA tasks that required the most specific information (Task 2_3a and Task2_4) generally took the longest. A paired samples *t*-test comparing participants' mean TOT for Google and BigDIVA tasks demonstrated that mean TOT for BigDIVA was significantly longer (t (6) = -2.85, p = .029). 31

Task	*Total TOT (min)*	*Mean TOT (min)*	*Median TOT (min)*
1_1	7.59	0.95	0.95
1_2	10.64	1.33	1.12
1_3	12.28	1.54	1.53
All Google Tasks	***30.51***	***1.27***	***1.11***
2_1a	18.18	2.27	1.73
2_1b	22.68	2.84	1.39
2_2a	26.08	3.26	1.89
2_2b	7.60	0.95	0.78
2_3a	29.69	3.71	3.57
2_3b	7.60	0.95	0.48
2_4	32.95	4.12	3.53
All BigDIVA Tasks	***144.78***	***2.59***	***1.80***

Table 2. TOT for all tasks

Since all participants self-assessed themselves as “Very Good” or “Excellent” Google-users, it is certainly reasonable that they would need to spend less time on the Google search tasks. Directly comparing aggregate TOT for Google and BigDIVA tasks does not account for time necessary to adapt to an unfamiliar search tool; therefore, understanding the value of aggregating TOT across tasks and search platforms requires more nuance. For example, based on comparison of TOT for BigDIVA tasks only, it becomes apparent that following the first BigDIVA task (Task 2_1a), some participants appeared to become more time-efficient (particularly for Task 2_2b and 2_3b), which suggests that they overcame a learning curve and adjusted to aspects of networked browsing. Further, some participants that exhibited similar difficulties with search tasks (particularly Task 2_3a-b and 2_4) spent more time on each task. For example, participant B06 and B08 were both unable to complete these three tasks for similar reasons (as will be discussed below), but B06 spent much longer (5.66 minutes on all three tasks) than B08 (3.74 minutes on all three tasks). This suggests that successful or unsuccessful adaptation to BigDIVA is not necessarily dependent on how much time a user spends on task. 32

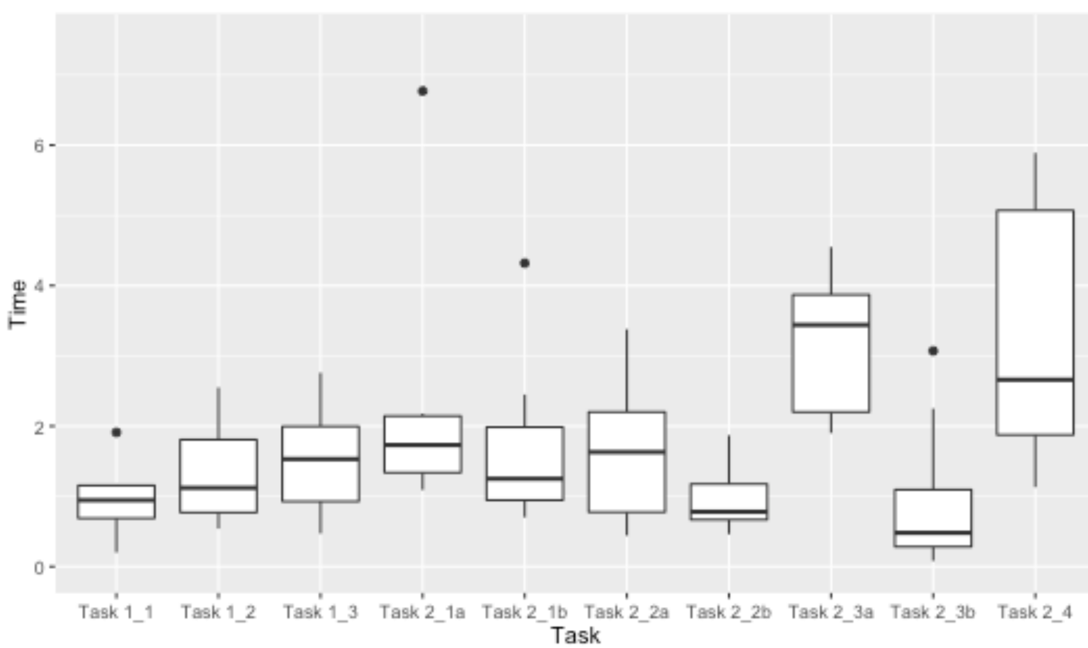

Figure 4. A boxplot for Time on Task for each task

In order to look deeper than TOT data, the AWT data is able to provide more fine-grained comparisons of what participants did for each task with the time allotted. Figure 5 provides a timeline for each participant colored for any occurrence of an AWT action type. This provides a window into the interplay and sequencing between multiple action types over the course of the entire study, and shows that a typical action sequence for Google tasks involved entering a search query, adjusting for search dimension (i.e., Image, News, Scholarly), opening a result (maybe two), and then eventually entering an answer for the task. For BigDIVA, these sequences were more complex as participants were required to explore and manipulate interface elements they were previously unfamiliar with. Interestingly, at first glance of BigDIVA's force-directed network, all participants found the search bar and entered a query in a matter of seconds. However, once a search query was entered, participants variably played with the network nodes, switched dimensions (e.g., *Genre* or *Format*), enlarged the screens, faceted, etc. In other words, the sequence from search query to facet to search result was broken. Entering or modifying the search query makes up a much smaller portion of AWT actions for BigDIVA tasks (with the exception of Tasks 2_3a and 2_4), while experimenting and playing with the faceting features and the nodes were much more frequent. The greater frequency of these action types suggests that participants' unfamiliarity with BigDIVA — specifically the aspects of networked browsing — are likely indicative of a sense of fascination and playfulness, or even confusion and frustration, with these features in order to understand their function. The novelty of these features may have encouraged participants to spend time playing with these features in order to better understand them, which may explain how some participants spent less time for later tasks.

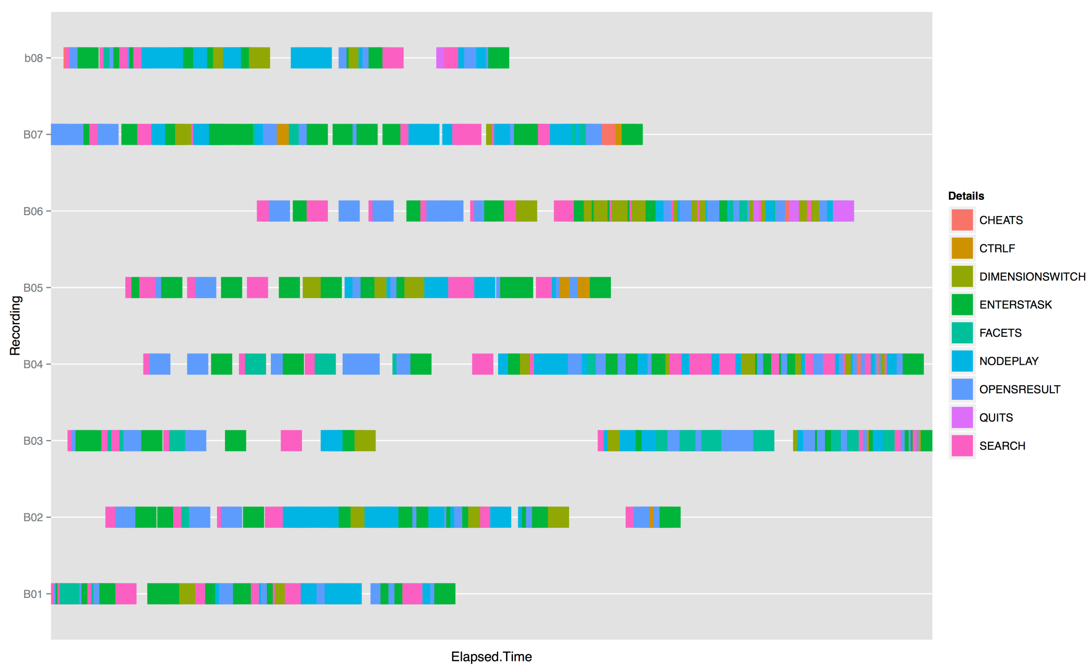

Figure 5. A timeline for each participant based upon AWT action types. (Note that sessions for participants B02 and B03 included server interruptions which explain the large gaps in action)

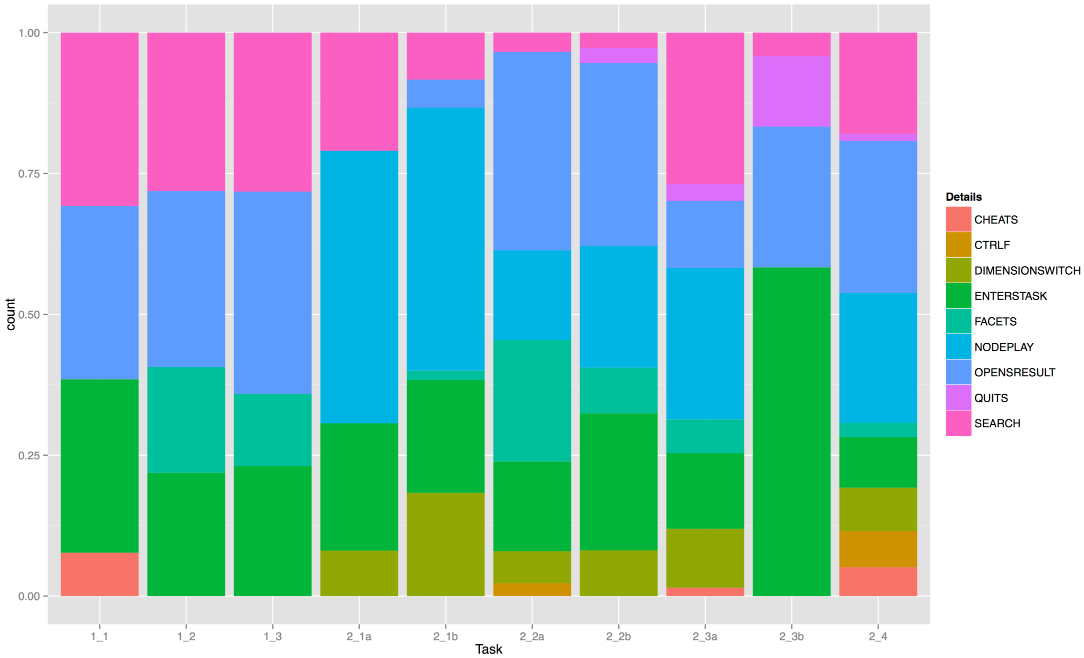

Figure 6. Distribution of AWT action types for each task

Log-File actions additionally present a complex picture. While Mouse and cursor actions dominate input actions during the Google tasks, the first four BigDIVA tasks witnessed a steady decrease in mouse action as participants engaged with the keyboard and various other AWT action types more frequently. While Tasks 2_3a-b appear to revert to Google-like behavior, the frequency of mouse and cursor actions glaringly decreases for the BigDIVA tasks, despite the fact that BigDIVA's functionality is primarily dependent on the cursor (with the exception of the search bar). 34

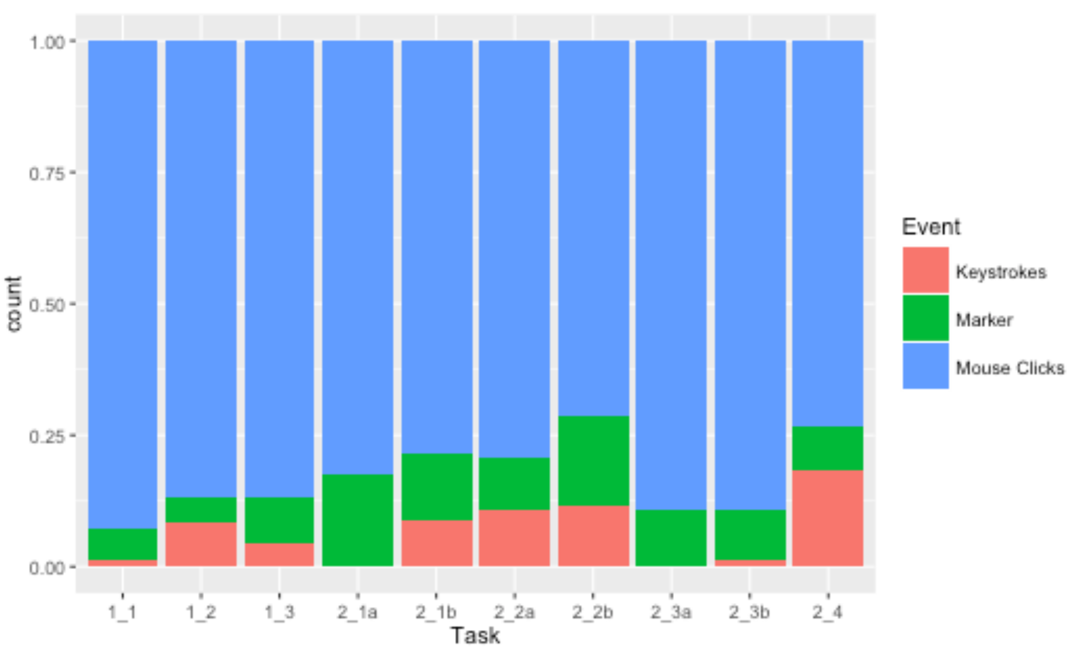

Figure 7. Distribution of Log-File actions plus all AWT actions for each task

Lastly, since not all participants were able to complete every search task, it is worth looking more closely at those participants and what their actions were. Furthermore, in order to have a comparison of these Non-Finisher participants to those that did, we made a subgroup of the two Non-Finishers (B06 and B08) and two Finishers (B01 and B04). This 35 sub-group was determined by developing a rudimentary scoring system for each task in which participants received 1 point for completing the task as designed, 0.5 points for completing the task not as designed, and 0 points for not completing the task at all. After rating all participants, B06 and B08 scored the lowest, while B01 and B04 scored the highest.

In terms of AWT action types, Figure 8 demonstrates both groups overall were not strikingly different. Besides the action type QUIT, both the Finishers and Non-Finishers engaged in similar distribution of AWTs as the Finishers. The primary distinction is for the action type DIMENSIONSWITCH, as the Finishers switched dimensions in BigDIVA more than half as much as the Non-Finishers. After looking more closely at when and how these participants switched dimensions, it was observed that both groups had developed distinct understandings of this feature's function: the Finishers would switch dimensions and then enter a search query, whereas the Non-Finishers would enter a search query and then switch dimensions. While a seemingly inconsequential distinction in Google, this sequence of action in BigDIVA is the difference between filtering results based on a search query and resetting the force-directed network visualization of the archive to another dimension. Thus, when the Non-Finishers entered a search query, and then switched dimensions, they effectively negated their query and reset the visualization to view all archive content — albeit in a different dimension. In other words, the Non-Finishers were very likely unable to finish all of the BigDIVA tasks because they had failed to adjust to this specific feature of BigDIVA's functionality, and instead appeared to transfer their understanding of this functionality directly from Google. 36

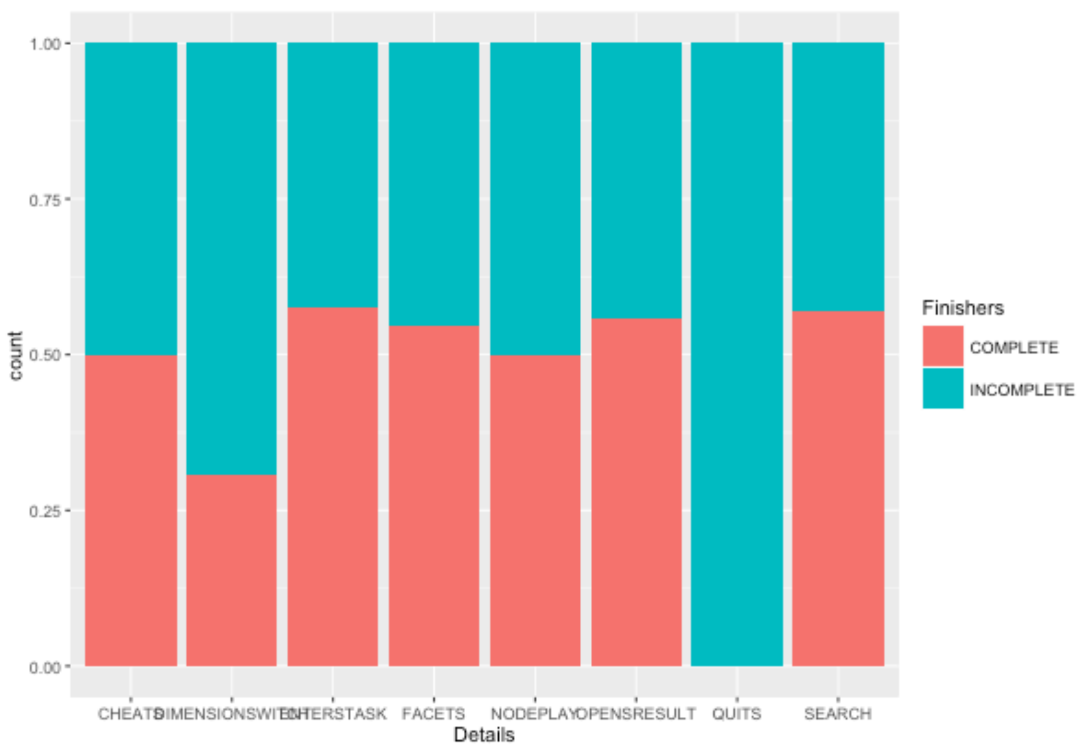

Figure 8. Distribution of AWT action types for Finisher and Non-Finisher sub-groups

Furthermore, when comparing TOT data for the Finishers and Non-Finishers, the Non-Finishers appear to take more time in general to adjust to BigDIVA search tasks. Indeed, by Task 2_3a, the Non-Finishers demonstrated so much difficulty in using BigDIVA in order to complete each search task that they appeared more inclined to abandon the tasks rather than adjust their understanding of the functionality; whereas the Finishers — who had done a better job of understanding the functionality — were willing to spend more time in order to complete the tasks. 37

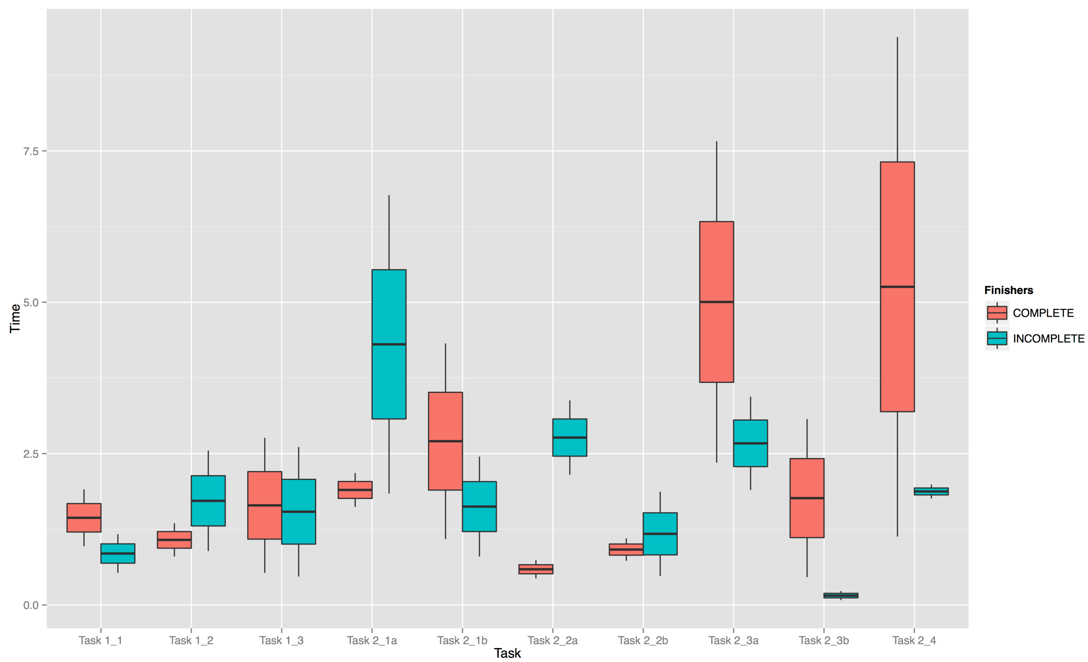

Figure 9. TOT comparison for Finisher and Non-Finisher sub-groups

Self-Reports

While audio-video data captured from the webcam does coordinate on-screen actions with affective reaction as gauged by facial expression, it is beyond the scope of this current study to adequately or appropriately surmise how using BigDIVA resulted in participants' affective reactions. After all, since BigDIVA was new to the participants while Google was used daily, some manner of novelty effect would be expected. Further, since BigDIVA did require some manner of learning curve (and at least two participants experienced delays due to server interruptions), such analysis would likely have been biased towards affects such as frustration or confusion [D'Mello and Graesser 2012]. Nevertheless, at first glance of BigDIVA's network visualization all users did display unique momentary reactions. For example, B04 noticeably smiled, B01 appeared surprised, B02 exclaimed quietly to himself "What," and B08's brow furrowed. In other words, the novelty of networked browsing appeared to induce affectations — perhaps even "joyous" in some cases — that in and of itself may offer participants hope of a new manner of searching. 38

Indeed, based on the self-report questionnaire following the search tasks, participants were largely in agreement about the potentialities of networked browsing. While many elaborated on early frustrations with the new functionalities of the search tools, or the initial learning curve, all participants remarked about BigDIVA's ability to establish an understanding of the relationship between the collections and their individual archive sources. In particular, three common themes were apparent from the participants' self-reports: that the novelty of BigDIVA's networked browsing was either "fun" or "interesting," that BigDIVA could be most useful for specialized archives or use in scholarly settings, and that the networked visualizations may be pedagogically valuable for demonstrating relationships between scholarly sources (see Table 3 below). 39

Another unique theme expressed by participants related to the nature of web-based search queries altogether. In particular, while participants noted that after a brief adjustment period they were able to successfully search and find specific information using BigDIVA, that they would still use a more typical visualization such as Google — even if networked browsing were an option with Google. Participants justified this preference with the fact that a text-based list of results still might be simpler and quicker if the user already knows what they are looking for; whereas networked browsing would be preferable if the user was not certain what they were looking for. In other words, networked browsing would be more suitable for exploring the contents of an archive without a predisposition for specific results. 40

Networked Visualization Features	• “Different colors for visualizing resource, genre, and so on is neat — this would be helpful if someone is looking for a specific source” • “Fun to play with!” • “Very interesting to get to see the number of results as well as the networks and communities” • “Good for kids who are used to visual interfaces” • “The instant landscaping of sources that could be explored was unique”
Scholarly Usage	• “Provides a quicker way to filter scholarly data like in a library database. It really helps to see the source of information” • “Help for interdisciplinary searches if you're not entirely certain of what you’re looking for, and if you're interested in intersections in disciplines” • “It helps you realize the results might pertain to the critic or scholar, not the author” • “Great tool to explore topics I'm already familiar with” • “Very good for research in the humanities that involves multimedia formats” • “Could be good for academic searches but also government records and medical research in order to organize specific types of data”
Pedagogical Usage	• “Interesting as a pedagogical tool for getting students to see connections between sources” • “Good for younger kids who are used to visual interfaces — it would be great at capturing the attention of those audiences” • “it would be good to show to students who really don’t understand too much about searching”
Everyday Use	• “If I was trying to get a better conceptual understanding of relationships between sources” • “Probably to explore topics I’m already familiar with” • “mainly to see connections with locations of sources, as well as prioritization. It would be great for really digging” • “I wish that Google’s Image Search would have this sort of node quality”

Table 3. Transcriptions of participant self-reports

Discussion

This study set out to explore how networked browsing allows subjects to explore and interpret relations between archived resources. Our guiding research questions were: *how do participants use BigDIVA in comparison to a more traditional browser interface such as Google*, and *how does BigDIVA’s interface afford and evidence generous interfacing or archival liveness*? While our small and preliminary usability study certainly does not exhaustively answer either of these questions, we are left with valuable evidence that point towards the potential range of experiences and materialities that networked browsing has to offer. 41

In response to our first research question, the BigDIVA usability study provided evidence of how the process of searching with BigDIVA compares to a more traditional search tool like Google. According to our analysis of users’ input- 42 related actions, we observed that despite the fact that BigDIVA employs traditional faceted search functionality (albeit with networked visualization) participants experienced browsing differently for Google and BigDIVA. Participants took significantly longer to complete BigDIVA tasks, in some cases were unable to complete certain tasks, and in some cases attempted to transfer functionalities from Google. Additionally, participants generally used the search bar less, the mouse and cursor less, and the faceting features more when completing BigDIVA tasks compared to Google tasks. It was therefore apparent that, perhaps because of the comparative study design, when participants shifted from using Google to BigDIVA that they experienced a performative disruption. The spike in mouse clicks for the first BigDIVA task, which subsequently leveled out for participants, exemplified the learning curve or adaptation to the distinctive performances engendered by networked browsing.

Analysis of input actions or completion of search tasks on their own, while key components in understanding the cybernetic assemblage, do not tell the whole story of how — in Barad's and Drucker's terms — a human intra-acting with the distributed machinic components is made discursively meaningful. Self-reports of users' experiences and perceptions regarding BigDIVA therefore revealed the most surprising observations and indications of what it is like to perform networked browsing. Participants described their initial impressions of networked browsing as "fun," "interesting," or "different" — regardless of their success or failure in the search tasks. They additionally reflected on the potential scholarly and pedagogical applications, and yet, most surprising, participants remained skeptical of networked browsing's usefulness for everyday web browsing (i.e., in place of typical search interfaces like Google); however, numerous participants suggested it would be more fitting functionality for finite archives (i.e., such as the ARC catalog). 43

That participants generally reported such positive experiences and perceptions of BigDIVA, in spite of its more specialized use, is a promising indication that networked browsing may indeed engender Shneiderman's (1996) "joyous experience" for interfacing with the web. Indeed, such experiences are difficult to observe by examining input-related actions alone and without facial recognition software to analyze affect. In future study, we therefore intend to place greater emphasis on *how* users experience networked browsing with an eye toward longitudinal designs and repeated self-report measures in addition to analyses more common in usability research. These observations follow Warrick's (2012) suggestions for the combined use of log-file data to track input and output actions in addition to more traditional ethnographic methods, such as interviews and longitudinal participant observation, in order to examine usability and use of new tools in the digital humanities. If our study observed even an inkling of how new users performatively intra-acted and engaged in meaning-making with BigDIVA, then more prolonged and iterative observations would be able to richly observe use in context. 44

Limitations and Future Research

Of course, as implied already, our study was not without its limitations. In addition to a small sample size, we wish to emphasize that the comparative design of our study is one such limitation, because, as participants self-reported, BigDIVA prioritized a different kind of browsing than Google. Finding information in BigDIVA did not require a scavenger hunt amongst a hierarchical text-based list that required prior knowledge encoded in the form of a query. Instead, BigDIVA made information available without a search query, thus begging participants to visually untangle and play with the networked catalog. Our study design admittedly prioritized specific search tasks in order to target use of specific features as well as to allow easy comparison to search tasks in Google. Open-ended tasks or longitudinal observation, per [Warwick 2012], would therefore be well-suited alternatives. 45

At the same time, comparative methods are still valuable for design and experiential considerations of these interfaces. After all, if networked browsing indeed affords unique performative understandings and meaning-making experiences compared to other operationalizations of faceted search functions, then more detailed comparative studies could reveal the distinctions in those processes, particularly comparing similar scholarly faceted search tools such as a university library database. As suggested above, such a comparative study would do well to not solely rely on input-based behavioral measures that privilege the machine components of the interface, and instead privilege the human components in the interface by observing affect, metacognitive processes, as well as self-report measures to emphasize users' perceptions of their experiences. In particular, such methods could potentially parse out the distinction between users' understanding of search functionality from archive architecture, as well as how, in their own terms, they 46 may find joy in their browsing experiences.

Conclusion

Based on the observations from our study, networked browsing may indeed be suggestive of Whitelaw's (2015) "generous interfacing" that emphasizes browsing as a tool for exploring relationships between nodes in archives. The possibilities for exploration and play are evidenced not only in how archives may be accessed and searched for specific scholarly aims, but also for configuring new relational understandings of the distributed materiality of an archive itself. In other words, networked browsing may help users conceptualize archives as agential or living material bodies. In doing so, searching through an archive is no longer a linear act of retrieval, but perhaps an exploratory and contingent act of meaning-making. 47

Of course, our study's observations and what they suggest only yield more questions about networked browsing, faceted search functions, and generous interfacing. As mentioned above, further research design would do well to observe how individuals might use BigDIVA over a longer span of time, involve more open-ended tasks, and involve multidimensional analysis. In particular, future research should question what could users learn or discover with BigDIVA when simply given time and freedom to experiment with networked browsing and explore the archive? Would they come to a more detailed understanding of its components (i.e., collections, individual resources, faceting structures)? Would they become more fluent with the interface's functionality? Such questions, which we see as central to the study of knowledge-production in the digital humanities, would require attention to *usability* of digital tools as well as a well-rounded and holistic model of who a digital *user* is and how they engage in *use*. 48

Appendix

BigDIVA Usability Study Procedures

I: Preliminary Questionnaire:

1. What is your current degree level?
2. What is your current academic or professional position?
3. What would you consider your “field”?
4. How frequently do you use Google or another search engine to look up casual information?
5. How would you rate your skill level at using search engines?
6. Can you explain the difference between these search queries: macaroni and cheese, macaroni AND cheese?
7. For academic or scholarly research, how do you begin to search for resources and materials?

II: Google Search Tasks:

1. What is one of William Blake's famous works? [GENERAL QUERY]
2. Find an example of a relief etching by William Blake. Provide the URL of the image [FACETING, RESOURCE META-INFORMATION]
3. Search for an etching from William Blake's “Milton a Poem”. [FACETING, QUERY MODIFICATION, SORTING RESULTS]

III: BigDIVA Search Tasks:

1. A) Using BigDIVA, search for WILLIAM BLAKE. What are the names of a collection that appear to have the most results? B) What about when you visualize by Genre instead of Resource? [GENERAL QUERY, FACETING]
2. A) What is an individual result from one of these collections? B) What about a still image or a manuscript? [FACETING, SORTING RESULTS]
3. A) Search for WILLIAM BLAKE again visualizing for Resource, and find the Blake Archive node. What is the publication year of Night Thoughts, copy 1 (object 28)? B) What is the first line from object 28? [FACETING, RESOURCE META-INFORMATION]
4. Search for “chastity” and find one individual result that contains that search term in the primary source text [QUERY MODIFICATION, RESOURCE ASSESSMENT, SORTING RESULTS]

IV: Follow-Up Interview:

1. What were your general impressions of BigDIVA?
2. What were your experiences finding an individual result in BigDIVA compared to Google?
3. What was new or unique about BigDIVA?
4. What was easy to adjust to?
5. What was difficult to adjust to?
6. What do you think the BigDIVA search visualization is particularly good for? What is it bad for?
7. If Google or another popular search engine offered the option to do search visualization like BigDIVA, would you use it? Why or why not?

Table 4.

Notes

[1] www.bigdiva.org

[2] The ARC catalog is an index of information collected from a number of federated websites and placed into a Solr index

[3] We cite Shneiderman's (1996) description of data types in order to provide context to his argument about information exploration, and would like to acknowledge that this taxonomy is not without its criticisms. In particular, we caution against an unquestioned reading of Shneiderman's suggestion that texts are 1-dimensional (see discussions about texts as social bodies from Bruno Latour, Yrjo Engestrom, and Jerome McGann).

[4] https://www.techsmith.com/morae.html

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