Navigating Textual Space in Print and Digital Interfaces:
A Study of the Material and Cognitive Dimensions of Reading Systems

by

Voytek Bialkowski

A thesis submitted in conformity with the requirements for the degree of Master of Information
Faculty of Information
University of Toronto

© Copyright by Voytek Bialkowski 2011
Navigating Textual Space in Print and Digital Interfaces:
A Study of the Material and Cognitive Dimensions of Reading Systems

Voytek Bialkowski
Master of Information
Faculty of Information
University of Toronto
2011

Abstract
This research examines situated behaviours and perceptions around textual navigation as it is practiced in situ by professionals working in various domains. In its investigation of interactions between human cognition and mediating artifacts, this research relies heavily on the resources of cognitive ethnography, including both observation and in-depth interviews with participants. Relevant contributions from the fields of information studies, book history, digital humanities, and human-computer interaction are presented to further elucidate the findings of this study. The findings reveal several emergent, interrelated navigational strategies, such as the use of annotations as navigational aids, reliance on automated interface actions, and the navigational value of interface metaphors. In further addressing the practice of textual navigation, this research also describes the creation of a prototype interface reflecting the study’s findings. This research proposes new ways of conceptualizing textual navigation and designing interfaces that support emergent textual interaction.
Acknowledgments

It is with great pleasure that I am able to thank those who have made this thesis possible.

I would like to sincerely thank my supervisor, Alan Galey, for his enthusiasm, guidance, and encouragement throughout the course of this project. He has shared with me his exceptional teaching and mentorship, numerous insightful discussions, and his excellent company. I thank him for introducing me not only to the Book History and Print Culture program, but also to a number of original and fruitful sites of knowledge that are pronounced within this thesis.

I would also like to express my gratitude to Matt Ratto, whose involvement and feedback during this process have been valuable. Our conversations always inspired me to engage with difficult and exciting issues. I thank Matt for his abundant willingness to share his knowledge and experience, as well as for his lightning-fast provision of help when it was most needed.

Other members of the Faculty of Information are also deserving of acknowledgement here. I thank the Associate Dean of Research, Lynne Howarth, for her discerning eye and her encouragement during the early stages of this endeavor. I am also grateful for the hard work and kindness of the Faculty’s administrative, library, and support staff, as well as the librarians and staff at the neighbouring Thomas Fisher Rare Book Library.

I am also thankful for the friendship and encouragement of my colleagues at the Faculty and in the Book History and Print Culture program. I am very fortunate to have studied alongside such bright and industrious individuals.

Lastly, and most deeply, I wish to thank my family and friends for their unfaltering support.
# Table of Contents

Abstract ............................................................................................................................................... ii

Acknowledgments .............................................................................................................................. iii

Table of Contents ............................................................................................................................... iv

List of Figures ..................................................................................................................................... vii

List of Appendices ............................................................................................................................ viii

1 Introduction .................................................................................................................................... 1

1.1 Defining the Research Problem .......................................................................................... 1

1.2 Context of the Research ...................................................................................................... 2

1.3 Statement of Significance ................................................................................................... 5

1.4 Research Objectives and Questions .................................................................................... 5

1.5 Scope and Limitations of the Research ............................................................................... 6

1.6 Chapter Outline ................................................................................................................... 7

2 Literature Review ......................................................................................................................... 10

2.1 Previous Literature on Reading and Media ...................................................................... 11

2.1.1 Methodological Problems of Reading Task .......................................................... 13

2.1.2 Methodological Problems of Media Condition ..................................................... 15

2.2 Navigation and Manipulation of Texts ............................................................................. 16

2.2.1 Navigation of Databases and Hypertext ............................................................... 17

2.2.2 Comparative Studies of Navigation and Textual Media ....................................... 18

2.3 Distributed Cognition ........................................................................................................ 24

2.3.1 Theoretical Framework ......................................................................................... 24

2.3.2 Methodological Framework .................................................................................. 26

2.4 Activity Theory ................................................................................................................... 28

2.5 Reading Goals ................................................................................................................... 30
List of Figures

<table>
<thead>
<tr>
<th>Number</th>
<th>Figure Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Traces of ordinatio as seen in a copy of Peter Lombard’s <em>Sententiarum libri IV</em></td>
<td>34</td>
</tr>
<tr>
<td>2</td>
<td><em>Watching the Script</em> visualization of Shakespeare’s <em>King Lear</em></td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td><em>The Mandala Browser</em>’s user interface</td>
<td>41</td>
</tr>
<tr>
<td>4</td>
<td>Built-in navigational elements within Apple’s Preview interface</td>
<td>63</td>
</tr>
<tr>
<td>5</td>
<td>A conceptual blend incorporating a line of people and a trajector</td>
<td>84</td>
</tr>
<tr>
<td>6</td>
<td>Orientation aids in printed books</td>
<td>97</td>
</tr>
</tbody>
</table>
List of Appendices

Appendix A – Table Summarizing Reading Goals................................................................. 127
Appendix B – Ethics Approval ......................................................................................... 128
Appendix C – Recruitment Letter ................................................................................... 129
Appendix D – Individual Letter of Consent ..................................................................... 130
Appendix E – Organizational Letter of Consent................................................................. 132
1 Introduction

Digital texts, like printed texts, subsist relative to some form of material interface or mediating object. Such an interface—whether it is a book, pamphlet, word processor, or e-reader—prescribes, affords, and constrains user interactions with the coexisting text. The most essential of these interactions between reader and text is that of navigation. The processes of orienting oneself within text, following the flow of text, and marking or otherwise manipulating text for recall purposes, are essential to reading—our text-based cultural exchange. As Jerome McGann puts it, “because human beings are not angels, these exchanges always involve material negotiations. Even in their most complex and advanced forms—the intercourse that is being human is materially executed: as spoken texts or scripted forms.”1 The material manifestations of text provide the overarching rationale for this and related studies inquiring into reading and medial forms. The present study aims to identify and analyze the multiple ways in which our cognitive faculties interact with the materialities of media to influence our navigation of textual space.

1.1 Defining the Research Problem

The methods by which we navigate textual space are essential to our interaction with textual forms. A closer look at navigational strategies reveals their importance within complex relationships between readers, texts, and technologies. The space of possible interactions that exists between a reader and a text is rendered in material terms, by way of the technologies that enable those interactions. It is essential, then, to understand the role of media within textual navigation. What types of navigational interactions do

---

certain textual media promote? What interactions do they hinder? How might we better understand the relationship between human cognitive action and machine action as they operate relative to the medial and structural forms of documents?

The present research focuses on real-world instances of textual navigation within professional settings. By grounding the dialogue in situated professional practice revolving around documents, the aim is to uncover relations between navigational practices, situated goals or tasks, and medial affordances. The dependencies of tasks, user perception, and idiosyncrasy complicate our understanding of textual navigation. This is a beneficial complication primarily because it allows us to look more closely at the interplay between various environmental and cognitive structures as exhibited in real-world practice.

These problems of materiality, cognition, and media affordance all intersect in the act of navigating text. The present study aims to investigate the behaviours and strategies of professional users’ navigation of texts and to understand such processes as complex cognitive and material interactions. The present study further engages with these navigational processes in the design and implementation of an ethnographically-informed prototype reading interface.

1.2 Context of the Research
The study of reading media drew significant attention within the human factors research of the 1980’s and 1990’s. The research and development facilities belonging to Xerox, in particular, emerged as the primary sites for much of the comparative research on textual media and formats. While the empirical measurement of reading, including speed, accuracy, and readability, was certainly central to the research agenda at Xerox, that is
not to say that research was totally localized within this one organization. Rather, comparative studies of textual media, including then-nascent hypertext, quickly spread throughout the broader academic and professional research communities.

The adoption of the Cathode Ray Tube (CRT) along with other Video Display Units (VDU) within computing systems promoted inquiry in the area of comparative media studies. Previous to that, as Nick Montfort notes, computer terminals were often equipped with paper tapes, punch cards, and other paper-based technologies to facilitate both input and output.\(^2\) The screen radically changed the nature of human-computer interaction by presenting a dynamic display, which as Lev Manovich notes, constitutes a real-time space.\(^3\) Such screens were graphical or textual display spaces, bridging the worlds of human language and machine language with their ability to display dynamic input and output. It is this apparent (though misguided) contrast between dynamic screen and static print that promoted comparative research of print- and screen-based reading.

The new textual medium represented by the screen was met with suspicion of its viability as a reading interface. As Andrew Dillon writes in his review of the related literature in 1992, “the recent proliferation of VDUs […] has resulted in an increased awareness in the inherent difficulties involved in displaying text on screen.”\(^4\) As advances in screen technology improved brightness, contrast, aspect ratio, resolution, and other display specifications, research on media differences between screen and print similarly increased, with renewed focus being placed on each new iteration of hardware.

---


and software. In this way, research focus quickly shifted from the general study of on-screen texts, to the more sophisticated study of hypertext interfaces.

Why was the hypertext interface so central in the early research on reading media? Hypertext interfaces created a textual space that leveraged the dynamic nature of the screen, and further differentiated the prospects of screen-reading from those of paper-based reading, thereby promoting scholarly interest in these new interfaces. In many ways, hypertext revealed what bibliographers and textual studies scholars have known for some time: reading is inextricable from its material manifestations or methods of delivery, and that text (in its many manifestations) is itself a dynamic construction demonstrating both fixity and fluidity. N. Katherine Hayles has suggested that hypertext, as a mode of reading and textual navigation, is rooted in older forms such as the encyclopedia, which she regards as a print hypertext. I would add that other textual forms such as commentaries, biblical texts, and commonplace books also occupy this same category of print hypertext. Non-linear modes of reading are not new, though the breadth of their application was greatly enhanced by Hypercard systems of information storage and retrieval (packaged with many early versions of the Mac OS), as well as by early hypertext fiction. Hypertext interfaces not only promoted renewed scholarly interest in the differences between print- and screen-based texts, but also, and more importantly, they promoted the study of processual differences in navigation, manipulation, and other readerly processes across various media.

---

1.3 Statement of Significance
The present study aims to identify and bridge specific divergences and gaps in the literature on reading and media. The processual differences in navigation within various media spaces have been identified by O’Hara and Sellen as being one such gap in the literature.\(^7\) However, the present study also aims to bridge epistemic divides that have been operating within this area of research, and those operating outside of it. Many traditional and emergent disciplines have stakes that are rooted in problems of textual representation and navigation. Bibliography and textual studies, digital humanities, human-computer interaction, interface design, and cognitive science all grapple with problems that are close to the core questions of the present study. These fields are rarely incorporated into a whole research program; however, the lines of dialogue—both explicit and latent—that operate between these fields suggest that such disciplinary convergences of methods and theories are essential to approaching the problems of the present study.

1.4 Research Objectives and Questions
The present study aims to observe and analyze the navigational strategies and behaviours exhibited by a cross-section of readers as they carry out reading tasks as part of a professional role. Specifically, it aims to investigate their perceptions and experiences of textual navigation in relation to technology, interfaces, and formats, and to understand these acts of textual engagement as material-cognitive events. The present study builds on previous research on reading by pursuing an understudied aspect of reading media—

navigation—and by mobilizing the methodological and theoretical resources of several
disciplines towards that pursuit.

The primary research objectives of the study are as follows:

RO1: to observe the various readerly practices that constitute textual navigation in print
and digital interfaces

RO2: to uncover and analyze the relationships between tools, interfaces, and cognition
within textual navigation

RO3: to incorporate ethnographic findings into a prototype digital interface that extends
discussion of these interactions and relationships

The study’s primary research questions are as follows:

RQ1: What are the material-cognitive processes exhibited by readers in their navigation
of digital and printed texts?

RQ2: How can we explain differences in readerly process across various media
configurations?

RQ3: What is the role of interface in the navigation and manipulation of texts?

RQ4: Rather than merely mimicking the print interface, how can digital tools translate
previous media interactions, while exploring new opportunities of cognitive-
material interaction?

1.5 Scope and Limitations of the Research

The present research investigates the procedural and relational interactions between
readers and textual objects in both digital and print media. Of primary interest are those
textual interactions that directly impact the experience of textual navigation. By
incorporating a cognitive ethnographic approach in observing participants and recording
data, the present study aims to understand these processes from the perspective of a
variety of professional participants. The non-homogeneity of the participants helps to elicit a range of results that span several reading activities. However, in the interests of appropriately limiting the study’s scope, this study will not necessarily span all reading goals as outlined in a typology proposed by O’Hara (see Appendix A for a summary of O’Hara’s typology). Further research might address questions regarding a specific reading goal or interface, whereas the present research attempts to capture and analyze processes of textual navigation more broadly.

1.6 Chapter Outline
The thesis follows this introductory chapter in five parts. Chapter 2 offers a review of the relevant literature across a number of disciplines. It begins with a contextualization of previous studies on reading and media, specifically focusing on comparative studies and inquiring into some of the methodological and theoretical issues arising from the early literature. Following the contextualization of this broad area of study, the literature review outlines the notable research that explicitly addresses the navigation and manipulation of texts, with a particular focus on studies inquiring into database and hypertext navigation. In turn, I will give considerable attention to distributed cognition as it is the overarching methodological and theoretical model upon which the present research is premised. An assessment of reading goals is presented as a supplement to the

---


ethnographic work of the study, and as a method for further grounding the present study in goal-centric systems, as prescribed by distributed cognition methods. The chapter concludes with an examination of textual navigation and interface design within the field of digital humanities, where the theories and models of the present research find significant correlates.

Chapter 3 outlines the methodology and study design of the present research. It includes detailed descriptions of the ethnographic procedures and data recording methods used in the present study. This chapter also describes the manner in which a prototype digital reading interface has been incorporated into the study, and its benefit as a means of extending the analysis and discussion of the study results.

Chapter 4 provides the reader with detailed descriptions of the study’s core findings. It begins with an overview of the study’s participants, and continues, in narrative fashion, to describe our observation sessions and subsequent discussions. This chapter also outlines three major patterns of use emerging from the ethnographic study, namely annotation and highlighting as navigational strategies, the use of automated interface elements (such as automatic scrolling) and how such elements are incorporated into users’ broader navigational patterns, as well as the value of navigational metaphors within reading interfaces.

In-depth discussion of the study results follows in Chapter 5, where I reference historical accounts of textual navigation that reveal strong parallels to the practices observed in the present study. The discussion then follows the three patterns of use outlined above. With regard to annotation and highlighting, a significant portion of the discussion describes how these textual practices function not only to improve
comprehension, but the ways in which they may be applied as orientation cues or navigational strategies. Following that, I consider the automated aspects of digital reading interfaces, particularly in light of how they enable users to off-load part of the cognitive work associated with textual navigation. The discussion of these two major threads, annotation and highlighting on the one hand, and automated navigational actions on the other, is largely guided by distributed cognition theory.\textsuperscript{10} Other important work in the area of digital humanities and interface design, particularly Stan Ruecker’s notion of cognitive reassurance, also figures prominently in the discussion of automation and navigation. This chapter also incorporates a description and analysis of the prototype reading interface designed concurrently with data collection and analysis. A methodological evaluation and chapter summary, incorporating close scrutiny of various epistemic models and their relationships to research methods, conclude this chapter.

I begin Chapter 6 by briefly recontextualizing the present research by way of Jay David Bolter’s and Richard Grusin’s notion of remediation. I then proceed to summarize and extend the core findings, arguments, and discussions of the present research. This chapter also includes consideration of study limitations, which are largely based on issues of scoping, and the emergent nature of the study’s findings. Finally, I conclude the thesis by outlining some of the prospects for future research in this area of study.

2 Literature Review

Alberto Manguel has suggested that “reading, almost as much as breathing, is our essential function.” To read and comprehend systems of signs of varying complexity, whether they are alphabets, number systems, or ideograms, constitutes a ubiquitous textual act. As opposed to the codified notion of literacy, textuality fulfills a more universal human function; one that Jerome McGann terms “the textual condition.”

Reading as a form of textual interaction, however, is not a singular activity; it is fluid, contextual, highly embedded in specific domains or areas of practice, shaped by goals and tasks, and contingent on documentary structures, tools, and associated practices. It is necessary then, to interrogate the embeddedness of textual interaction and the forces that context, environment, and materiality exert on reading processes. As these are the main themes of the present study they will be emphasized throughout the literature review, and their various connections to textual navigation will be mapped across several disciplines.

In this literature review I will begin by evaluating and discussing some of the previous human factors research that has inquired into the relationship between reading and media. As this relationship has advanced a vast body of research and scholarly writing, only the most relevant studies will be included so as to provide a context for the reader. I will then focus more closely on the processes of textual navigation and manipulation as they have been elucidated in a number of key studies on hypertext and database environments. Following that, I will negotiate some of the methodological and theoretical frameworks that will be brought to bear on the present research, namely, those

---

from the fields of cognitive science and the digital humanities. Within the field of
cognitive science, I will draw upon the work of Edwin Hutchins, James Hollan, and
various other authors working within the theoretical and methodological framework of
distributed cognition. Later, I will consider the domain of the digital humanities, where I
will examine the central role that textual navigation plays within this area of study. The
digital humanities projects (the Watching the Script project and the Mandala Browser)
that I will consider later in this chapter demonstrate a domain-level approach to reading
as ‘prospecting’ and present exemplary and innovative models for supporting reader
navigation.

2.1 Previous Literature on Reading and Media
Reading and the textual interactions that constitute it have been the focus of a significant
body of literature. As I mentioned previously, the 1980’s and 1990’s saw a widespread
interest in reading media. It was during this time that electronic environments for reading
became increasingly available. The coexistence of screen- and paper-based reading
environments invited comparative studies of reading media. Researchers attempted to
discover which reading medium best facilitated performance by measuring indicators
such as reading speed, comprehension, retention, and accuracy, among others. The
volume of early comparative literature on reading media is so extensive that only some
relevant, crystallizing examples may be given close consideration here.

Andrew Dillon, in an article titled “Reading From Paper versus Screens: A
Critical Review of the Empirical Literature,” finds that, based on his own and previous
research, reading from a screen is approximately 20–30% slower than reading from print.
Dillon notes that this approximation is based on a number of studies employing
inconsistent performance indicators and methodologies; however, slower reading speeds of digital text are supported by much of the early literature. Similarly, Gould et al. (1987) find that proofreading is performed roughly 20% faster, and with greater accuracy, on paper than on a screen. These findings are corroborated by Wright and Lickorish (1983), Creed et al. (1987), and Mayes et al. (2001).

Quantification of reading performance, however, was not confined to indicators of reading speed or accuracy. Several past studies have also attempted to quantify reading comprehension. Muter et al. (1982) conducted a study of reading comprehension by administering a post-reading comprehension assessment in the form of twenty-five multiple-choice questions. This study finds that there is no significant correlation between reading media (digital or print) and reading comprehension. Similarly, studies undertaken by Cushman (1986) and Oborne and Holton (1988) find no significant difference in reading comprehension when reading from either medium. A study undertaken by Belmore (1985) tasked participants with reading short passages in digital and print media for the purposes of measuring speed and comprehension. Following the results of a comprehension test, it appeared at first glance that participants reading within

the screen condition displayed poorer comprehension results. However, Belmore finds that these results were later explained by the order in which media conditions were presented to subjects, as the results were only true for those subjects who were presented the digital media condition first.

The results of these early studies were largely inconsistent, and as O’Hara and Sellen note, often “unremarkable.” The methodological approach of many of these early studies may be described as primarily psychometric in that they attempt to quantify learning and other cognitive events through the use of performance indicators or other experimental instruments. This psychometric approach to reading media has been hampered by several broad methodological problems. I will consider these problems as they relate to two main methodological choices of reading task and media condition.

2.1.1 Methodological Problems of Reading Task

In order to study an indicator of performance, reading speed for instance, it was necessary for researchers to design studies that would operationalize and measure reading in a controlled environment. The assignment of a reading task was the predominant method by which researchers might create such an environment. Many of the early studies assigned participants the task of proofreading a given sample of text. While this was an efficacious method for controlling variables, proofreading, as it has been argued by Dillon et al., is not representative of other forms of textual interaction. Another study by Helander et al. (1984) argues that those studies using proof-reading as a reading task

15 O’Hara and Sellen, “Comparison of Reading,” 335.
“made it difficult to generalize the results beyond the conditions of the particular study.”

In a cognate study on the effect of document genre on reading, Alberts and Bertrand-Gastaldy (2006) have stated that studies on reading “are often realized in an artificial research setting where fictitious textual practices are referred to users.” The primary problem with much of the early literature is not simply a shortcoming in the form of nongeneralizable results, but rather, a contrived research design that fails to capture actual reading practices in situ. More recent studies have acknowledged this shortcoming and have attempted to approach reading as a situated activity. O’Hara and Sellen, in a study investigating differences between paper and online documents, assigned the reading task of text summarization, arguing that it is “naturalistic and representative of reading in real work settings.” While summarizing text appears later in O’Hara’s work as one of many differentiated reading goals, O’Hara and Sellen argue in this study that text summarization holds greater relevance to general reading practice than does proof-reading. Thus, the general thrust of the early literature moves in the direction of more situated and ecological study design.

19 O’Hara and Sellen, “Comparison of Reading,” 335.
2.1.2 Methodological Problems of Media Condition

The other broad methodological problems in the early literature on reading media are the choice of media condition (or format) and its presentation to study participants. Previous studies have used a variety of paper printouts, photocopies (as in Wright and Lickorish, 1983), or typescript for the paper condition, and compared those paper conditions with screen conditions variously including CRTs (Cathode Ray Tubes) and other VDUs (Video Display Units). As described by Dillon et al. (1988), the inconsistency of digital display formats, particularly in terms of aspect ratio, resolution, screen flicker, and viewing angle, may have presented uncontrolled variables.

The practice of assigning one screen technology or software environment over another presents problems beyond those posed by complex variables such as screen quality or specification. The assignment of a particular piece of software and hardware as the screen condition (sometimes called the ‘online condition’) requires users to interact with texts in environments that may be foreign to them. The assigned screen condition may be unrepresentative of the realities of real-world textual interactions in the same way that assigned reading tasks have been. By acknowledging reading as a largely idiosyncratic, ecological, and contextual set of processes, qualitative approaches to reading practice avoid many of the shortcomings of psychometric and quantitative research. Rather than presenting a reading environment as part of the study design, a situated ethnographic approach acknowledges the reading environment itself as a valid object of study.

---

2.2 Navigation and Manipulation of Texts

As O’Hara and Sellen have noted, the literature on reading and its relationship to media has favoured inquiry into performance differences rather than process differences.\(^{21}\)

*Performance differences* as used here are taken to mean any quantifiable differences in performance measurement such as speed, accuracy, or comprehension. By contrast, *process differences* constitute a group of differences that are less quantifiable and more experiential and procedural in nature such as any differences in how reading ease, engagement, manipulation, or navigation are perceived by readers. However, many of the early studies focusing on navigation and manipulation—the two processes most relevant to the study at hand—have also been hindered by an inclination towards quantification-and performance-based research. As O’Hara and Sellen note, the in-depth study of textual navigation and manipulation has not been given significant attention.\(^{22}\)

However, several studies touch on themes that are essential to the present research. Hagelbarger and Thompson (1983), Canter et al. (1985), Conklin (1987), Richardson et al. (1988), Foss (1989), McKnight et al. (1989), Dillon et al. (1990), Mcknight et al. (1990), and Smith and Wilson (1993) consider manipulation and navigation within various early hypertext and database environments. These studies provide a working context for the study at hand. Moreover, they identify several themes useful for the present study, such as the notion of feeling “lost in hypspace,”\(^{23}\) and the role of hierarchy or other structural

\(^{21}\) O’Hara and Sellen, “Comparison of Reading,” 335.

\(^{22}\) Ibid.

considerations within documents, as well as defining important terms such as disorientation problem and informational metaphor.

2.2.1 Navigation of Databases and Hypertext

Research on the navigation of texts did not enter broad scholarly discourse until the advent of hypertext. It was at this time that scholars began seriously considering the ways in which media conditions define reading processes. Many of these early studies on navigation in hypertextual documents refer to an article by Edwards and Hardman titled “Lost in Hyperspace”: Cognitive Mapping and Navigation in a Hypertext Environment.” Prevailing perceptions of the difficulty of navigating hypertext provide the rationale for much of this early literature. The navigational difficulties of hypertext have been supported by earlier studies on databases and menu-based interfaces for non-hypertext documents. A study by Canter et al. in 1985 shows that users often feel lost in such environments, or that they regularly return to the top level of a hierarchical menu structure when becoming disoriented within a database. A later study by McKnight et al. finds that similar usage patterns occur in hypertext environments. McKnight et al. find that users spend significant time on the index or contents page of large hypertext documents and jump from the index to relevant nodes within the text. The authors regard

---


this back-and-forth movement between a top-level menu (or home page) and the relevant sections of the hypertext document as a suboptimal navigational strategy.26

2.2.2 Comparative Studies of Navigation and Textual Media

McKnight et al. carried out the most comprehensive comparative study inquiring into the relationship between navigation and textual media in 1990. In this study, participants were asked to read from a textual sample in one of four formats; two hypertext formats (TIES and Hypercard) and two linear formats (word processor and paper). Participants were then asked to answer questions regarding the contents of the document they had read. The speed at which participants read through each document was recorded as well as the length of time they spent on the contents/index page. Any differences in speed could not ultimately be attributed to the format, but rather, were attributed to variables such as familiarity with the topic area, individual reading speeds, or familiarity with the respective media condition. However, the researchers note that the length of time spent on the contents/index page was significantly higher for participants reading from the hypertext formats. By contrast, participants reading from the linear formats (word processor or paper) spent significantly less time using these navigational aids and more time visually scanning the document itself.27

While the study into linear reading versus hypertext reading by McKnight et al. (1990) presents various insights into the relationship between document format and

information retrieval, it does not provide sufficient consideration of user-centric modes of manipulation and navigation. McKnight et al. focus on only those manipulation strategies directly related to information retrieval. However, textual manipulation and navigation consist also of recall wherein readers rely on user-generated marking or other annotations as well as actions associated with physical memory, such as turning a page, in order to find information. While McKnight et al. usefully explain some of the inherent affordances of these environments, they only superficially describe how readers are able to negotiate these affordances outside of the context of an assigned information retrieval task. Readers after all, are not passive agents; they are able to circumvent, appropriate, or otherwise utilize navigational structures and processes for their benefit.

Despite the important lacunae present in the existing literature, such as the general lack of consideration of user agency and of the materiality of the interface, several vital concepts, theories, and design principles have emerged in regards to textual navigation and the way in which readers interact with navigational aids or interfaces. Among these, the concepts of informational metaphor, disorientation problem, and history trees provide an entry point in assessing the role of the reader in relation to the material matters that make up interface interaction.

**Informational metaphor**

In the field of information studies, metaphors offer users a means of conceptualizing information structures and practices in terms of real-world counterparts. For instance, trees, maps, or other metaphorical constructs on the interface level can aid users in
navigating information systems by drawing parallels to other objects or practices that may be familiar to them. Informational metaphors have proven useful within a range of study domains. Recently, in the literary history domain, Franco Moretti, in his book *Graphs, Maps, Trees*, uses metaphorical structures such as maps and trees to help shape a quantitative approach to literature. Moretti’s metaphors of trees and maps, drawn from the fields of natural science and geography respectively, constitute navigational metaphors for his readers. They provide rich tools for intuitively understanding Moretti’s quantitative framework and for following Moretti as he navigates broad literary corpora such as British novels published between 1800 and 1829. Likewise, in the field of digital text editing, informational metaphors have been prized for the usability they add to interfaces. Ray Siemens, writing from the perspective of digital humanities, has noted that operational metaphors (interface-level metaphors) contribute to user interfaces by making their functionalities more intuitive or straightforward for users to understand. The interface metaphor emerges as a key navigational aid within many different domains and styles of interface design.

Such interface metaphors are of particular value for novice users who may be unfamiliar with the complex logic and operations inherent in the information structures of databases, networks, or hypertext. One particularly interesting use of the information metaphor in interface design is described in a study by Allinson and Hammond wherein

users were presented with multiple text navigation alternatives that were characterized by different travel holiday metaphors. Users were instructed to select either a ‘guided tour’ of the software environment (a guided software tutorial) or a ‘go-it-alone holiday’ (a less structured browsing alternative). The researchers find that both alternatives were used strategically by participants to complement their individual styles of learning. The study by Allinson and Hammond suggests that informational metaphors are useful for those navigating unfamiliar software environments. More importantly, the authors argue that informational metaphors are most useful when they reflect individualized or idiosyncratic learning styles and modes of navigation.

Disorientation problem

The disorientation problem arose from the previously mentioned phenomenon of feeling ‘lost in hyperspace.’ As a technology largely divorced from contemporary, linear modes of reading (as in novels), hypertext was regarded as being difficult to navigate effectively. Users often felt disoriented within large or complex hypertext documents. This may be attributed to a lack of linearity, disassociation from physicality, or to a lack of navigational aids or markers. Edward Tufte has suggested that disorientation on the level of interface can also be explained by the low resolution of screen technology in the 1980’s and early 1990’s. Such “low-information displays” as he calls them, “lead to breaking up of work into user-irritating micro-steps, with a consequent loss of coherence to sequences of operations.” More than likely all of the above aspects of early hypertext

software, and the hardware used to access them, contributed to the disorientation experienced by users.

Carolyn Foss describes three specific ways in which disorientation manifests itself in the navigation of hypertext documents including: not pursuing planned digressions, not returning from a digression, and forgetting which nodes (or pages) have been visited. A user’s sense of orientation within documents appears to hinge on a number of combined structurally-prescribed and individual processes. The structures prescribed to users via software or hardware are important, but equally important are the ways in which those structures are negotiated by users and how users make meaning of them. The interplay between structural and individual processes has largely been overlooked in the design of past psychometric and quantitative research on readerly navigation and manipulation. It will, however, figure prominently within the present research.

Disorientation within large or complex documents is not necessarily unique to hypertext or even to screen technology. We may become disoriented within printed works when categories or contents are not sufficiently organized, when we are unfamiliar with the text’s domain or discipline, which may have its own unique organizational schemas for its documents, or when documents lack basic navigational aids such as pagination. The manifestation of the disorientation problem in paper-based documents is also of interest to the present study.

**History trees**

History trees are graphical representations of a user’s movements through hypertext documents. Such an interface element shows the reader their chosen reading path as they navigate from one structural unit of text to another. Foss proposes that history trees may be a useful interface component in complex hypertext documents. While their use outside of hypertext documents has not been fully developed, history trees do illustrate an important characteristic of textual navigation, namely, that textual navigation and disorientation can be described along two main axes; spatiality on one hand and temporality on the other. Disorientation within texts can manifest itself when the user is unsure of where to go to next (a spatial issue), or when the user is unsure of the path they took in arriving at their present location within a text (a temporal issue).

While Foss’s history tree presents an apt approach to navigating documentary structure, it largely relegates the agency of the user to the simple actions of following structural organization. The user’s reading path, as captured by a history tree, documents which nodes the user has visited but does not sufficiently describe what the user has done there. Although user annotations are possible within this tree structure, the user’s interaction with the document’s nodes or pages largely rests outside of the purview of the history tree. In this sense, such a history tree does not depict the navigation of a series of linked nodes as much as it depicts movement in between nodes. The approach that Terry Harpold proposes in his book, *Ex-foliations: Reading Machines and the Upgrade Path*, manages to incorporate the structural affordances of a given medium with the user

---

34 Ibid., 413-414.
agency that is inherent in reading and navigating text. Harpold refers to this process of temporal navigation as historiation. He writes, “each moment of the reading encounter is the inconsistent aggregate of other moments, stimulated—consciously and unconsciously—by marks and patterns of marks (and relations of marks too inchoate and variable to be qualified as ‘patterns’) that evoke others and thus generate meanings that are specific to the encounter.”

What emerges from Harpold’s account is an approach to annotation as a temporal negotiation of documentary structure. In other words, annotation figures as a tool that allows users to create patterns of meaning within documents. These sorts of interactions can be seen as parallel to the documentary structure of the work in that they allow the user to plot their own history within a document, which may vary significantly from the prescribed structure. Such a conceptualization allows for the consideration of navigation as a structural negotiation, but also as a generative activity whereby readers create meaning through their interaction with and alteration of texts. It is this active, user-centric approach to navigation that is of interest to the present study.

2.3 Distributed Cognition

2.3.1 Theoretical Framework

The human factors research outlined above engages with media and the effects of media on human cognition. These studies attempt to decipher how screen technology impacts the process of reading, which is undoubtedly a complex cognitive process. There are strong parallels to the study of human cognition, and the interdisciplinary field of cognitive science. Cognitive science has traditionally excluded the study of media and

---

other factors that have been considered extraneous to human cognition. However, the theory of distributed cognition, most famously discussed in the work of Edwin Hutchins and James Hollan, attempts to incorporate objects, media, and social interactions into a coherent understanding of human cognition. As Hollan et al. describe it; distributed cognition extends beyond the individual in an attempt to “encompass interactions between people and with resources and materials in the environment.” In Hutchins’s monograph *Cognition in the Wild*, he brings this framework to bear on the cognitive task of navigating a navy vessel through waters. Rather than finding a neat interaction between the navigator and a given medium (a navigational map, for instance), Hutchins discovers that the cognitive task of naval navigation involves a myriad of people, social interactions, navigational technologies, visual cues, and other environmental elements. In other words, he suggests that human cognition transcends any one individual, and that cognition is spread across individuals living and working in communities, extending even to the objects with which those individuals interact.  

*Cognition in the Wild* was followed by Hutchins’s exploration of how human memory operates in the context of an airplane’s cockpit. In this study Hutchins continues exploring human cognition by radically changing the unit of analysis. Rather than studying the individual, Hutchins studies the entire socio-technical environment of an airplane’s cockpit. He finds that the pilot’s cognitive faculties, particularly those related to memory, are supplemented by a number of environmental factors that support and recreate that cognitive function. Various tools at the pilot’s disposal, such as altimeters

---

37 Hollan, Hutchins, and Kirsh, “Distributed Cognition,” 175.  
and related instruments, are used to off-load the cognitive work associated with memory
during the landing of an aircraft. A significant portion of cognition appears to occur
externally, as material-cognitive interactions with tools and environmental forces. It is
therefore essential, as Hutchins argues, to study the work environment as a whole
cognitive unit.39

2.3.2 Methodological Framework

As described by Edwin Hutchins, ‘cognitive ethnography’ fulfils a descriptive function in
detailing the setting and tasks associated with human cognition. This approach to human
cognition, Hutchins states, arose in response to cognitivist thinking: the notion that
cognition constituted a set of strictly internalized processes without any significant
relation to the material world wherein they were carried out.40 According to traditional
cognitivist thinking, the setting, tasks, and social relations that accompanied cognition
were deemed largely insignificant in relation to the cognitive processes operating inside
of the human brain.41

Distributed cognition functions simultaneously as a methodological and
theoretical framework. In both of these capacities distributed cognition is intended to
support ethnographic fieldwork in addition to the subsequent design and evaluation of
tools and interfaces. As Hollan et al. argue; “the theory of distributed cognition provides
[…] a fertile framework for designing and evaluating digital artifacts.”42

---

41 Ibid.
42 Hollan, Hutchins, and Kirsh, “Distributed Cognition,” 175.
cognition functions as a design methodology in three distinct ways: through the incorporation of ethnographic data into new designs, the speculation of new uses for old strategies, and the translation of strategies effective in one domain into a new domain.\textsuperscript{43} The design process described by Hollan et al. is highly self-reflexive in that ethnography informs designs which may then be evaluated theoretically by those same ethnographic standards. This process is similar to what Daniel Fallman calls research-oriented design, wherein “design and research seem to fuel each other ad infinitum.”\textsuperscript{44}

Among the benefits of a distributed cognition approach to design is its propensity for uncovering embedded and situated activity. This benefit is particularly salient for the present study in that the realm of textual navigation has traditionally resisted quantitative experimental design. By contrast, a qualitative approach allows for the examination of a variety of emergent properties that may impact reader navigation in various media with a particular focus on situated environmental factors. As a result, these emergent properties may be studied and weighed by the researcher, incorporated into design prototypes and evaluated based on cognitive theory, or other theoretical models. The possibility of capturing and modelling idiosyncratic behaviour is of particular benefit to the present study as readers’ navigational strategies appear to be highly situated and oftentimes idiosyncratic in nature.

\textsuperscript{43} Ibid., 182.  
2.4 Activity Theory

Another related theoretical model, activity theory, likewise emphasizes the contexts wherein human cognition takes place. As Bonnie Nardi notes, activity theory is the oldest and the most matured among the approaches to human activity and its many contexts.45

Both distributed cognition and activity theory stem from the well-documented relationship between human tasks and their various contexts (social, material, and cultural). These theoretical models for understanding human cognition and practice demonstrate many similarities, such as the embeddedness of the human agent within larger systems or structures. In both models, human activity is dependent on persistent structures such as tools (or objects) and other material artifacts. The depiction of tools and mediation (the ways in which objects mediate and control human behaviour) as important structures is central to both models.46 These structures are durable in the sense that they are transferable between situations and activities. Within distributed cognition, Hutchins provides the example of naval cartography as being a relatively durable structure that is incorporated into various actions and activities.47 Similarly, in activity theory, discrete actions can belong to numerous activities, wherein they are differentiated by the goals of the particular activity.48 The commonalities between these approaches are mutually beneficial in that they allow us to gain a closer understanding of the central aspects of both theories.

46 Ibid., 38.
There exist, also, some notable divergences between distributed cognition and activity theory. Distributed cognition, as stated above, enlarges the unit of analysis in an attempt to reveal functional systems, a term that is itself intended to extend analysis beyond individual cognition and action.⁴⁹ An emphasis on system goals, rather than on individual goals, reveals that distributed cognition is more closely attuned to systemic, rather than to individual behaviours. By comparison, activity theory considers the role of objects and corresponding actions in direct relation to the activities of individual actors. Though material artifacts are valuable within both frameworks, their value is more pronounced within the framework of distributed cognition. As Nardi notes, “distributed cognition tends to provide finely detailed analyses of particular artifacts.”⁵⁰ In activity theory, artifacts are acknowledged as functional organs, and are positioned as being prosthetic to the natural resources belonging to human agents.⁵¹ However, of greater interest to activity theory is how such functional organs are marshaled within culturally constructed activities.

While the scope of the present research precludes an extended evaluation of alternate theoretical models, such as that proposed by activity theory, it is valuable to draw these preliminary contrasts and similarities here. While activity theory presents an alternative model that may be useful for conducting similar studies of situated textual practice, the distributed cognition model is favored and used extensively within the present research. My adoption of distributed cognition within the present research is a

---

⁵¹ Ibid., 38.
result of several factors. Among them, distributed cognition’s focus on material events, close scrutiny of artifacts, and well developed ethnographic and design frameworks, have been particularly decisive in that regard. Conversations resulting from the intersections and divergences between these approaches to human activity have created fertile conditions for investigating questions of epistemics and method. Given the extensive history of study design in the area of textual media, it is worthwhile to give such questions further attention. I will consider and evaluate certain methodological strengths and weaknesses of distributed cognition later in the thesis, where I will again refer to activity theory and the work of Bonnie Nardi (see §5.6, particularly §5.6.2 on Tacit versus Explicit Knowledge).

2.5 Reading Goals

Texts, as I have noted earlier, are read in various ways in order to fulfill various goals. Reading is not a singular phenomenon that can be studied as such, but rather is an aggregate of processes and behaviours specific to various types of interaction with texts. As part of ‘The Affordances of Paper’ project at Xerox, Kenton O’Hara developed a typology of reading goals to assist in the evaluation of reading media. This reading typology includes twelve common reading goals that have been described in previous research on reading (see Appendix A). Different modes of reading emphasize certain textual interactions or behaviours while understating others. For this reason it is important to acknowledge the role played by reading goals in any study of textual interaction, and particularly within a distributed cognition framework where goals are essential to understanding human activity. O’Hara notes that the typology of reading goals is not meant to be used as a rigid classification system, but rather as a “high level
framework.”\textsuperscript{52} In the present study, this typology is used along the lines prescribed by O’Hara, as “an initial orientation when attempting research such as observational and laboratory studies of people reading for different purposes.”\textsuperscript{53} As an initial orientation, the typology of reading goals was useful in the recruitment of study participants and in establishing professional contexts for their reading activities. Both of these applications will be discussed in further detail in the subsequent chapter on Methodology.

2.6 The History of the Book

The history of the book, \textit{l’histoire du livre}, or simply book history, is an interdisciplinary field encompassing a number of research areas and objects of study. As Alexandra Gillespie notes, the field supports academic activities varying between cultural studies, sociology, the history of science and technology, and literary studies, to name only a few.\textsuperscript{54} For the purposes of the present research, I will focus on a small subsection of this field, namely, that subsection most interested in historical accounts of reading practices and in the evolution of the book as a piece of technology.

The accounts of historical reading practices, specifically those from the Medieval and Renaissance periods, are of greatest value for the present study. It is during these periods that the book—or codex—underwent intense material transformations. In the late Medieval period the evolution of scribal practices brought numerous changes, both to the structuring of the book’s interior and to its exterior bindings. New modes of writing and

\textsuperscript{52} O’Hara, \textit{Typology of Reading Goals}, 16.
\textsuperscript{53} Ibid.
presenting text evolved, as in scribal shorthand, as well as in the increasing use of marginal commentary or rubrication (the use of red ink to signify important structural or thematic divisions within texts). These changing material forms of the book mirrored cultural and intellectual changes in the approach to texts. Similarly, in the Renaissance period, increasing proliferation of, and accessibility to, printed works promulgated changing patterns of reading and textual interaction.

As Leslie Howsam so pointedly puts it, “the book can be a force for change and the history of the book documents that change.”55 The history of the book provides a number of intriguing historical parallels to our contemporary interaction with texts, be they in codex form, on a portable device, or in a word processor. As a documentation of cultural and intellectual practices surrounding material objects, book history is particularly well suited to help us explore texts in their various material manifestations. In this regard, I will rely most on the work of Ann Blair, M.B. Parkes, and William Sherman, who offer significant insights into the textual practices of Medieval and Renaissance readers.

Ann Blair’s analysis of historical reading practices is valuable in that it outlines specific readerly behaviours from the early modern period. Particularly valuable is her account of the strains on early modern readers, who were, as Blair notes, “under the pressures of too many books and too few resources, notably of time, memory or

55 Leslie Howsam, Old Books and New Histories (Toronto, CA: University of Toronto Press, 2006), 5; italics in the original.
money.”

Seemingly anachronistically, Blair uses the term *information overload*—a term borrowed from contemporary information theory—to describe the pressures placed on Renaissance readers. This parallelism between contemporary theory and historical practice appears in Blair’s work as a rhetorical frame within which she introduces various historical practices. However, contemporary theories, such as those in the fields of information studies or cognitive ethnography, have more to offer to the study of book history than simple rhetorical devices. It is my conviction that there are important and productive disciplinary parallels that are latent between the history of the book and the contemporary ethnographic study of reading. Moreover, such parallelisms are mutually beneficial in that they provide insight into both areas of study.

The work of M.B. Parkes is particularly useful in the context of the present research because it explicitly engages with issues of textual navigation. In an essay titled “The Influence of the Concepts of Ordinatio and Compilatio on the Development of the Book,” Parkes describes changing textual practices as reading filtered from the monastic to the scholastic domain. Of particular concern for Parkes are the concepts of *ordinatio* and *compilatio*, which describe two different traditions or approaches to documentary organization. In the former, *ordinatio*, the ordering of text is clearly defined through the use of rubrication, paragraph markers, or other, similar navigational aids inserted by scribes and readers. The marginal marks (written in Greek) found in the Thomas Fisher Rare Book Library’s copy of Peter Lombard’s *Sententiarum libri IV* clearly illustrate this practice (fig. 1). In the latter concept of *compilatio* the hierarchical ordering of a work

---

gives way to the compilation of thematically related passages. These concepts are useful for understanding the structural dimensions of theological texts, which I will consider later when describing one of the study participant’s interaction with theological texts (see §4.1.2 on Participant #2: Anne). Furthermore, these concepts also provide historical parallels that help illustrate the cognitive theory of conceptual blending, which I will discuss in detail later (see §5.2.3 on Blending Conceptual and Material Structure).

Figure 1 Traces of ordinatio as seen in a copy of Peter Lombard’s *Sententiarum libri IV*.  

---


58 Peter Lombard, *Sententiarum libri IV* [ca. 13th cent.], Thomas Fisher Rare Book Library, University of Toronto, shelf mark MSS 01125, digital ID F4319, leaf 6r. © University of Toronto 2011. Image reproduced with permission from the copyright holder.
Another book historian, William Sherman, describes the systematic nature of textual interaction during the early modern period. He notes the ways in which reading practices evolved, even painstakingly tracing the lineation of particular and peculiar readerly symbols, such as the manicule (☞).\(^5^9\) Sherman’s work demonstrates the continuum between past and present textual practice. For instance, Sherman notes the metaphorical value of the manicule, as an “anthropomorphic rather than an arbitrary sign,” and the way in which this particular metaphor creates conditions for intuitive use.\(^6^0\) This is a point that is also emphasized in the writing on contemporary interface metaphors that I outlined previously. To approach early texts, those of interest to book historians, with an eye towards usability, interface interaction, and information management, sheds light on various contexts and systemic influences operating on readers, both past and present.

In Chapter 5, I will more fully examine the parallelisms between historical practices and the observable results of the present study (see §5.1 on Parallel Practice: Historical Accounts of Textual Navigation). Also, further consideration of the concepts of *ordinatio* and *compilatio* appears throughout the thesis, in relation to participant observation and in relation to conceptual blending theory (see §4.1.2 and §5.2.3, respectively).

\(^6^0\) Ibid., 47.
2.7 Digital Humanities

Digital humanities is a field, or collection of fields, that largely resists easy definition and characterization. Its uneasy relationship to traditional forms of scholarly inquiry only make it that much more difficult to set down precisely. A tool-based approach to humanities research appears as one of the central facets of the digital humanities. As a field, digital humanities originated within the humanities computing scholarly communities of the 1960’s and 1970’s when humanities scholars began applying computational methods and tools to traditional humanities problems, most notably to concordances and corpus studies. The use of electronic tools for the study of literature, history, and other humanities disciplines resulted in a methodological framework for investigating difficult problems in the humanities, however, tools-based research was also responsible for the creation of an entirely new set of disciplinary problems as well. Problems of informational representation, modelling, and communication emerged as scholars began incorporating digital tools into their research. Attempts by researchers to synthesize, make sense of, and ultimately communicate their research findings have expanded the field of digital humanities, transforming it into what it is today. Although digital humanities research is concerned with a multitude of disciplinary problems, the problems of information representation, modelling, and interface design hold the most relevance for the present study.

---

Perhaps one of the most important concepts to emerge from the digital humanities scholarship is the notion of materiality of digital texts. In the same vein as bibliographic and textual criticism—fields that have long been concerned with the material characteristics of texts—new approaches to digital texts are paying closer attention to electronic texts’ material aspects, their modes of delivery, and the subsistent file systems and computer code that make those texts possible. Michael Joyce, most famous for his electronic fiction piece *Afternoon, a Story*, is quoted as saying “print stays itself; electronic text replaces itself.” Such an approach can be seen as representative of prevailing notions about the ephemerality or immateriality of electronic texts. It is precisely this notion of electronic text’s ephemerality that Matthew Kirschenbaum attempts to combat in his book *Mechanisms: New Media & the Forensic Imagination*. Kirschenbaum proposes a theory of text that he calls ‘formal materiality,’ which he describes as an attempt to “capture the multiple behaviors and states of digital objects.” According to Kirschenbaum, electronic texts are always inextricably linked to the materiality of their delivery systems. Processing chips, memory, and other hardware considerations, as well as their relationship to software instructions lie at the heart of digital texts. Therefore, it is possible to consider various aspects of computation as having material effects on electronic texts.

---

N. Katherine Hayles also considers the materiality—or as she refers to it—the ‘embodiment’ of electronic texts. ⁶⁵ Among the many examples that she uses in support of the materiality of electronic texts, Hayles cites the editorial decisions made by the editors of The William Blake Archive. Hayles writes, “The editors of the Blake Archive are meticulous in insisting that even small differences in materiality potentially affect meaning, so they have gone to a great deal of trouble to compile not only different works but extant copies of the same work.” ⁶⁶ The Blake Archive’s editorial team has gone so far as to include a colour calibration application that corrects the colour of the images based on the user’s hardware and software configuration in an effort to represent colours as accurately as possible. Such editorial decisions suggest that materiality is at work in electronic environments as well, and further, that material matters ought to be leveraged in the design of digital reading interfaces.

As I have mentioned earlier, tool-building and prototype development are central to the scholarly work of digital humanities research as scholarly inquiry and discourse increasingly revolve around the conceptualization, design, and implementation of digital projects. Projects such as the Watching the Script Project and the Mandala browser provide unique perspectives on textual space and navigation in digital reading interfaces. Both projects also demonstrate firsthand the value of prototyping in the digital humanities.

⁶⁵ N. Katherine Hayles, My Mother was a Computer: Digital Subjects and Literary Texts (Chicago, IL: The University of Chicago Press, 2005), 120.
Watching the Script is a digital environment providing side-by-side reading and visualization of Shakespearean plays (fig. 2). The project was created at the Humanities Visualization Lab at the University of Alberta under the direction of Stan Ruecker and Stéfan Sinclair. Various active interface elements are presented to the user, including multiple navigational paths. The user may navigate linearly by starting the script sequence and watching the entirety of the play. Alternatively, the user may opt to use the ‘Overview’ panel to navigate major hyperlinked milestones within the text, such as Acts or Scenes. The colour coding of character names is persistent across all of the interface panels (‘Overview,’ ‘Cast,’ ‘Reading View,’ and ‘Stage View’). The most prominent interface feature, however, is the ‘Stage View.’ It is here that the linear reading model is transformed into a spatial visualization of how the actor’s speeches and actions might look in a multidimensional space. Subsequent iterations of the Watching the Script Project have incorporated three-dimensional modelling of the stage and its actors.

The Mandala browser is another project encapsulating similar design and navigational principles. Like the Watching the Script Project, it is also authored by Stan Ruecker and Stéfan Sinclair. The application’s authors describe it as a “rich prospect browser” capable of aiding in data-mining exercises. The underlying logic of the Mandala Browser moves beyond simple Boolean searching and allows the user to create

---

various search parameters and then weigh those parameters in order to add emphasis to certain search terms.

**Figure 2** *Watching the Script* visualization of Shakespeare’s *King Lear* (Screenshot by the author)

Apart from the complex computational logic inherent in the application, the dimensionality of the textual field that is visually presented to the user is one of the application’s most note-worthy functions. Users are able to browse the textual space by controlling the level of zoom or magnification, by rotating the textual field, adding axis, or removing axis (fig. 3). What emerges from this design is an approach to textual space that acknowledges the agency of the user in their pursuit of specific information or informational relationships within text. The user’s ability to rotate, reorient, and otherwise, find themselves within the textual field is a result
of carefully planned and well-articulated interface design principles. The graphical (visual and mathematical in this case) metaphors such as ‘zoom’ and ‘rotate’ create the conditions for the kind of intuitive and seamless interface navigation that Ray Siemens encourages in his writing.  

Reading and associated activities in the digital humanities can be aptly compared to prospecting, as they are by Willard McCarty in his book *Humanities Computing*. McCarty writes, “there are times and contexts, such as now with computing, when meaning needs to be *excavated* and brought to bear on a situation we do not understand.” Emergent here is a distinct disciplinary approach to reading and how that approach manifests itself in the built tools and environments that support it. In the Mandala Browser, as in the Watching the Script application, reading takes on the

---

70 Siemens, “Text Analysis,” 96.  
71 McCarty, *Humanities Computing*, 2; italics added.
characteristics of ‘prospecting;’ of searching, reorienting, re-searching, and eventually striking at some sought-after, or perhaps even unexpected information. The interface design work that is being carried out in the digital humanities demonstrates that consideration of users’ navigation of textual space is a key element in designing interfaces that support specific textual interactions. Moreover, it is a valuable reference domain for the purposes of the current study in that it realizes, in exceptionally clear terms, how interface design can be used to support specific individualized goals, styles, and processes of reading.

2.8 Summary

In this review of the literature, I have undertaken three primary objectives: (i) to introduce, contextualize, and evaluate past studies in human factors research in regards to reading media broadly, and more specifically in regards to textual navigation and manipulation, (ii) to introduce the methodological and theoretical models that will be brought to bear on the present research, and (iii) to provide a preliminary map of the disciplinary junctures that the present study will scrutinize and ultimately incorporate into its main argumentation. Particularly, in regards to the third objective, the literature review has served to open lines of dialogue between disciplines that are often viewed as divergent, rarely being included within a single discussion. These multi-disciplinary lines of dialogue will be given additional attention throughout the present study and will provide greater insight when placed relative to specific observations and when incorporated together within specific arguments.

As I have demonstrated here, the study of reading and media poses a wicked problem within numerous disciplines. Particularly in the human factors research that I
have outlined above, reading media has presented this discipline with a constantly shifting, elusive object of study. This is evidenced by the sheer volume of related research, and the iterative nature of research design within this area. By extending our disciplinary scope and incorporating new insights from other disciplines, it is possible to approach textual interaction, specifically textual navigation, from new directions. The past research outlined in this chapter will serve as a guide for articulating those new directions, and will ultimately culminate in the design of a prototype navigational element.

In the following chapter, which will outline the methodological design of the present research, I will refer back to the foundational research and literature introduced in this chapter. As the present research incorporates a mixed-methods approach to the central problems of the study, these references will be distributed across a number of disciplines and theoretical models. In particular, the procedures and data-collection methods of the present study are heavily influenced by previous work in cognitive ethnography. The rationale for improved study design, latent within my arguments in the present chapter, will be made more explicit in the subsequent description and discussion of methodology.
3 Methodology

The methodology of the present study is informed by the literature covered in the preceding chapter. The aim has been to integrate a number of methodological and theoretical frameworks from fields such as cognitive science and digital humanities in facilitating an interdisciplinary approach to the centralizing problem of the study: how can we capture and conceptualize the material and cognitive processes of navigating textual space? In light of earlier studies on reading media, the present study uses a qualitative process-based approach (rather than a psychometric or performance-based approach). A qualitative approach was chosen for the present study because it is more likely to reveal, organically, the variety and range of behaviours and processes that make up professional readers’ navigation of textual space. Rather than measuring specific aspects of performance or efficacy, the study aims to understand textual space as a whole environment, one in which media affordance and materiality, user behaviour, and social conditions contribute to the user’s experience of textual navigation.

Although the perceived efficiency of navigating texts in print and digital media is central to the questions of the present study, it is important to acknowledge that attempts to quantify efficiency, such as ease of reading or navigating texts, have traditionally been fraught with methodological problems.72 A more effective and insightful approach to the present research questions is to understand performance as it is perceived by readers within a mixed-methods qualitative framework of observation and in-depth interview.

Further, in following the disciplinary methods of cognitive science and the digital humanities and applying these findings to the design of a prototype object, the present study aims to coalesce various aspects of textual navigation and interface design within a single thought experiment.

3.1 Study Design

The ethnographic portion of the study, comprising the observation and in-depth interview of participants, forms the first stage of the research. While the term ‘ethnography’ originated within the fields of cultural anthropology and sociology, its significance for the present study is largely informed by its use within the field of cognitive science, and particularly within the methods of cognitive ethnography described earlier. As Edwin Hutchins states, cognitive ethnography fulfils a primarily descriptive function. Among its major goals is to “describe the cognitive task world.” \(^{73}\) Hutchins’s use of the word ‘world’ here signals the inclusivity of his descriptive approach. According to this method, any cognitive task is inextricable from the setting where it is performed and from the material resources used towards its completion. The present study is based on this fundamental descriptive function of ethnographic fieldwork, where observation and interview of participants provides a detailed description of the cognitive task of navigating texts. This approach provides descriptions of the cognitive task world of participants and complex narratives that reveal certain aspects of textual navigation that are impossible to deduce from within controlled laboratory experiments.

---

\(^{73}\) Hutchins, *Cognition in the Wild*, 371.
The ethnographic stage of the study provides data and other support material for the second stage, the design and creation of a prototype digital reading environment. These two aspects of the study form a continuous process of data collection and design. The descriptive or narrative nature of the ethnographic data provides sample use-case scenarios which are useful in the design process. Furthermore, the interweaving of the ethnographic work with the design process ensures that the design is situated within the practice of real-world professionals. The integration of ethnography and design will be described in greater detail later in this chapter (see §3.2.4 on Prototyping).

3.1.1 The Reading Task

As we know from our daily interactions with textual objects, the act of reading is a highly situated and varied act. Whether we are reading an advertisement or a scholarly journal, the objectives of our reading have obvious effects on how we approach textual material. As O’Hara and Sellen note, reading consists of multiple goals and objectives and as such, it is impossible to consider reading as a singular activity.\(^{74}\) Even in the specialized domains of professional work, reading can be used to fulfill any number of organizational objectives (reading for discussion, proof-reading, reading to apply).\(^ {75}\) As I have noted in the review of past studies, the selection of the reading task constitutes one of the most important and contentious methodological decisions undertaken by researchers. The reading task referred to participants in the present study is informed both by the past quantitative inquiries into reading and by a cognitive ethnography framework.

---

\(^{74}\) O’Hara and Sellen, “Comparison of Reading,” 336.  
\(^{75}\) O’Hara, *Typology of Reading Goals*, 7.
The present study asks participants from various professional fields to read and interact with their own professional documents in situ. Participants were asked to schedule a meeting when they expected to be working with documents as part of their professional role. During this time, participants would carry out whatever document-related activity they had planned to undertake during that time. The situated nature of the reading task ensures that various reading goals are included in the study. Moreover, it allows for the study of the whole environment where the participant carries out their regular reading tasks. This environment includes interactions between users, documents, other supporting materials, interfaces and other technologies, as well as social interactions. This aspect of the present methodology has been heavily informed by the theory of distributed cognition. Hollan et al. state that the focus of distributed cognition “has always been on whole environments: what we really do in them and how we coordinate our activity in them.” Such a holistic approach to cognitive processes will become further evident in the procedures and data recording activities.

3.2 Procedures and Data Recording

3.2.1 Observation

Participants were asked to schedule a meeting with the researcher of approximately one hour in length at a time when they expected to be reading and interacting with documents as part of their professional work. This one-hour meeting was divided into two approximately equal portions; the first portion consisting of videotaped observation, and the second consisting of an audio-recorded interview. During the observation session, I

---

took notes regarding specific textual interactions or events that the participant had engaged in. For instance, the participant’s use of supplementary documents or glosses, specific interface features, annotation, and bookmarking, as well as other textual interactions were all noted as distinct events. Such a focus on events is an important aspect of a distributed cognition framework.\textsuperscript{77} Interface actions such as opening new windows, performing string searches, and making use of navigational aids such as glosses and tables of contents are distinct materially anchored events. The field notes reflecting such events coupled with reference to the video footage were then used to guide the proceeding interview session.

3.2.2 In-depth Interviews

While the interview portion was largely guided by notes and video footage from the observation portion, several preliminary questions were asked of each participant in order to establish a context for their work with documents. The following questions were asked of each participant:

Question set #1 – Professional context:

a. What are the primary aspects of your work?

b. What is the primary reading goal associated with your work?

c. In what medium do you interact with documents on a regular basis?

d. What are the primary types of textual documents that you regularly interact with?

\textsuperscript{77} Ibid., 179.
The phrasing of questions a. and d. was largely open-ended for two reasons: so that participants felt free to reveal only information they were comfortable with revealing, and that they felt free to describe what they deemed important about their professional work with documents. In the two remaining questions, terms such as ‘reading goal’ and ‘medium’ were referred to participants to help guide discussion and to situate participant responses within previous research on readings goals and reading media. The term ‘medium’ may be seen in this phrasing as somewhat ambiguous, although that ambiguity proved beneficial to the study as it invited a number of varied responses from participants. These responses could be coded as either print-based or digital; the two major categories emergent from this question.

Such questions regarding the participant’s professional work provided a valuable context for the participant’s work with documents. Given the narrative nature of the cognitive ethnographic approach, it was important to capture this contextual information. Through the use of these initial questions, it would be possible to ascertain whether the reading task the participant had carried out was part of their routine work or part of a special project, or whether the medium with which they had worked was their regular medium for textual interaction, or specific to that particular task.

These initial questions also provided insight, from the participant’s perspective, into how their professional activities aligned with previous research on reading goals. Participants were presented with a chart adapted from a previous study (Appendix 1) and were asked to choose the reading goals they felt best described their work with
The remainder of the interview session was devoted to investigating the experiences and perceptions of participants in relation to textual navigation.

O’Hara et al. have shown that reference to video recordings of situated cognitive tasks during participant interviews is beneficial in developing dialogue about specific events or actions undertaken by participants. Based on video footage and notes taken during observation, I developed lines of dialogue specifically focusing on the participant’s strategies for textual navigation. Such strategies included those aiding the participant’s sense of orientation or location within the text, as well as those aiding their ability to recall locations within text. The information collected during the observation session, when combined with the following question set, focused the conversation during the interview:

Question set #2 – Textual activities:

a. What are the pre-existing elements in your documents (headings, pagination, etc.) that aid you in navigating or manipulating the text?

b. What are some examples of elements that you may add to a document, or would like to add to your documents, for the purposes of more easily navigating or manipulating them?

c. To what degree would you say you are able to navigate your documents effectively?

d. To what degree would you say you are able to alter/manipulate, or otherwise engage with your documents?

The second set of questions asks participants to reflect on the documents and processes that make up their professional reading practice. In this portion of the interview,

---

78 O’Hara, Typology of Reading Goals, 7.
participants were encouraged to think about their textual interactions in relation to documentary structure; how documentary structures such as headings, pagination, or tables of contents affected their navigation of texts, and how those documentary structures could further improve their navigation. During the course of answering these questions, participants often referred to practices they had engaged in during the observation session. Other times I would refer to specific events I had observed and would relate those events to the question at hand. This method of mutually referring to concrete examples grounded this set of interview questions in specific events or interactions. A more detailed account of the results and effectiveness of this method will be described in the proceeding chapter on study results.

3.2.3 Document Collection

Following the interview session, I asked participants for access to the documents that they had been working with during the observation session. Where permissible, I obtained photocopy, photograph, or electronic copy of the documents that had been used by participants during that session. These documents allowed closer analysis of the markings or other alterations made by participants. Representative as they are of the material interactions of the participant, participants’ documents are particularly helpful in understanding how participants used specific interface features to navigate and manipulate text. During data analysis, the documentary evidence was later used alongside the transcribed interviews.

3.2.4 Prototyping

As I have stated earlier, prototyping and tool building constitute a specific style of productive scholarly discourse in the field of digital humanities. As articulated in various
digital projects, theories and arguments are built into these prototypes. Alan Galey and Stan Ruecker have stated that one of the main benefits of these built tools or prototypes is that they may present contestable, defensible scholarly interpretations. They write, “one of the functions of the [digital] artifact then becomes to communicate that interpretation, and to make it productively contestable.” Another function of the digital prototype is its generative role in refining and shaping scholarly perspectives. Returning to the Watching the Script project, the generative role of the prototype becomes clearer as the project’s authors discuss various iterations of the prototype and the ways in which previous iterations transformed the authors’ thinking about theatrical texts. The present research incorporates prototyping in a similar vein, as a generative and theoretically valuable process that allows for the extension and further elucidation of the present study’s arguments.

While the specific shape and functionalities of the prototype will be described in subsequent chapters, it is necessary to outline the primary methodological aspects of the prototype design process here. Relying on the cognitive ethnography method, the prototype is drawn primarily from the ethnographic data collected during the course of participant observation and interviews. In grounding the prototype in real-world practice and experience, this method provides a complementary perspective on the ethnographic data. The prototype addresses specific observable navigational events, such as automated

---

81 Ibid., 406.
navigational actions, annotation as navigation, and the role of informational metaphors. It provides a synthesis of the study’s findings, and an environment that supports the emergent behaviours observed throughout the study. The prototype does not intend to solve emergent navigational problems, but rather, intends to present an alternative approach to the study’s core findings. As the framework of distributed cognition suggests, a continuous process of data gathering and design allows for renewed consideration of cognitive events. 83

3.3 Participants

Four participants were selected from various fields, rather than from a single professional domain, in order to provide a range of navigational strategies and document types for the present study. An inclusive approach to study domain and the use of heterogeneous study subjects have not traditionally been part of the distributed cognition framework. In outlining the methodology of distributed cognition, Hollan et al. suggest that it “requires researchers to make a real commitment to a domain.” 84 Several studies emerging from this framework demonstrate the researcher’s specialized knowledge of a particular study domain. For instance, in Cognition in the Wild, Edwin Hutchins relates his past experience as a racing yacht navigator and how it benefitted his ethnographic work aboard the U.S.S. Palau. 85 Hutchins states that his past naval experience made it possible to accurately transcribe specialized language used by his subjects and to understand the technical systems used within the naval domain (navigational equipment, maps, and other

84 Ibid., 179.
85 Hutchins, Cognition in the Wild, xii.
As an adaptation of the cognitive ethnographic model, the present study requires significantly less specialized domain knowledge, largely as a result of two independent factors. Firstly, the present study aims to compare and contrast navigational activity across several different reading goals and participant domains. The variety and richness of these reading goals necessitate a heterogeneous approach to participant and study domain inclusion. Secondly, in contrast to the traditional research undertaken within this framework, the present study’s focus is not on group dynamics and social structures but rather on documentary structure, practice, and the experience of users. Social interactions, although relevant, are tacit in that ethnographic work is carried out on an individual, rather than on a group level. Social aspects emerge organically via textual communications and interactions rather than by way of group problem-solving as on the bridge of a naval vessel.

Participants were all actively employed in professional positions that required considerable contact with documents (either electronic or print). Participant selection was carried out within a number of organizations including human resources firms, not-for-profits, community services, publishing, and others. As the ethnographic component of this study is intended to support and inform the development of a prototype digital reading environment, the number of participants has been limited. A smaller participant group was advantageous in these circumstances because the navigational behaviours and strategies used by participants might be more closely analyzed, and even those behaviours that might appear idiosyncratic would be given consideration in the prototype.

86 Ibid., 24.
development process. As suggested earlier, the present study’s aim is to describe and reveal narratives around specific navigational behaviours—an aim which would become overwhelming given a larger participant group.

3.4 Variables

The independent variable of this study is the reading medium used by participants in their work. Other variables emerged in the course of the study as specific aspects or affordances of the medium in question. Software platforms, websites, and hardware all contributed to the individual user’s strategies, experiences, and perceptions of navigating texts. The interaction between these variables will be more closely examined in the following chapters, which outline and analyze the study results.
4 Results

The data gathered throughout the ethnographic process offers an information-laden and insightful account of users’ navigation of texts. Following the methodology of cognitive ethnography as outlined previously, the results form descriptive narratives about the study participants in their situated work with documents. The participants’ respective professional domains, tasks, and reading goals are summarized in a table below (Table 1) so as to provide an overview of the ethnographic work. Following this overview, I will provide a descriptive account of each participant and the focal points of their work with documents that I obtained during the observation session and subsequent discussion. Later in the chapter, I will outline three key themes that emerged from the ethnographic work, namely, the roles that annotation and highlighting play in navigational practice, the value of automated navigational actions, and user perceptions of interface metaphors in relation to usability and navigability.

4.1 Participant Overview

The following table (Table 1) provides an overview of the participants’ organizational domains, organizational roles, reading tasks, reading goals, and the document formats they used. This data was synthesized from an approximate total of four hours of video-recorded and audio-recorded observations and interviews.
### Table 1 Overview of Study Participants

<table>
<thead>
<tr>
<th></th>
<th>Organizational domain</th>
<th>Organizational role</th>
<th>Reading task(s)</th>
<th>Reading goal(s)</th>
<th>Document format(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Martin</td>
<td>Teacher Professional Development</td>
<td>Director</td>
<td>-Handling emails</td>
<td>-Reading to learn</td>
<td>-Emails</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Using database documents</td>
<td>-Reading for research</td>
<td>-PDFs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Reading a PDF report</td>
<td></td>
<td>-Google documents</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Online databases</td>
</tr>
<tr>
<td>Anne</td>
<td>Religious Community Services</td>
<td>Lecturer</td>
<td>-Reading in preparation for a lecture</td>
<td>-Reading to learn</td>
<td>-Print books</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Reading to apply</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Reading for discussion</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Reading to search/answer questions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Reading to self inform</td>
<td></td>
</tr>
<tr>
<td>Jordan</td>
<td>Human Resources</td>
<td>Corporate Trainer</td>
<td>-Searching for and evaluating research</td>
<td>-Reading for research</td>
<td>-Websites</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Synthesizing research</td>
<td></td>
<td>-Databases</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Online scholarly journals</td>
</tr>
<tr>
<td>Paul</td>
<td>Financial Services</td>
<td>Analyst</td>
<td>-Transferring content to a wiki</td>
<td>-Proof-reading</td>
<td>-wiki web application</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Editing content</td>
<td>-Reading to search/answer questions</td>
<td>-Microsoft Word documents</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-PDFs</td>
</tr>
</tbody>
</table>

1*Note:* Participants were asked to identify reading goal(s) most closely associated with their work with documents. A list of reading goals was adapted from source: O’Hara, *Towards a Typology of Reading Goals*, 7.
As described earlier in the chapter on methodology, participants were selected from various domains so as to represent a variety of differentiated tasks, reading goals, and media configurations. There is some overlap between participants’ reading goals, which was to be expected given that participants were free to self-identify with more than one reading goal. However, tasks undertaken by participants were highly differentiated and provided numerous opportunities for comparison and contrast of their navigational strategies.

4.1.1 Participant #1: Martin

The first observation and interview that I conducted was with Martin, who is currently working in the role of Director at an organization that focuses on teacher professional development. Martin explained that his work involves overseeing online and offline programs catering to teachers; providing educational resources, community support, and other tools for their success. Martin had scheduled a meeting with me in the morning, and had explained that he would be carrying out his regular morning routine, which involved handling emails from his colleagues, interacting with documents within an online organizational database, and transferring documents to multiple online platforms (Scribd, Diigo, and others). Martin suggested that these tasks formed the basis of his regular interaction with documents. Another emergent task that Martin demonstrated during my time with him was his interaction with a PDF report that he was reading in preparation for an upcoming conference that he would be attending.

Martin began by demonstrating his interaction with emails and associated documents. He said that he receives many emails which simply require him to read and become acquainted with their contents, or that require a simple answer in response to a query. However, he identified a number of emails that require him to look more closely at and interact with relevant documents. One of these consisted of a draft Microsoft Word document outlining the terms of a potential
organizational partnership. Martin explained that for the purposes of accessing this document within his organization he would upload the electronic document to an organizational database. He prepared this document by changing the filename so that it would be consistent with his organization’s file naming standards. He then proceeded to upload the document to the database used by his organization.

As Martin was uploading the draft document to the database, I noticed that the database interface he was using did not provide a confirmation dialogue confirming the upload had been successful. Instead, the database software automatically scrolled down to the list of uploaded documents appearing at the bottom of the database entry. During our subsequent discussion I asked Martin about this feature of the interface and its implications for his navigation within the database. He replied, “like a visual confirmation, it doesn’t say your document has now been saved. It shows me that the document is now there and I don’t have to scroll down to make sure. So it goes back to the original page where I started from and I can move on. So that’s very helpful.” Martin’s comments suggested that even if he were presented with a confirmation dialogue box he would still instinctively scroll down to the bottom of the database document to visually confirm the presence of the document he had uploaded. The database interface used by Martin appeared to intuitively support his navigation of this content-rich database entry. In Martin’s subsequent tasks, I also observed a number of interface interactions that similarly supported and enhanced his navigation of his textual documents.

Martin suggested that he also interacts with a number of other, larger documents on a regular basis. He identified documents such as official reports, organizational documents, and scholarly journal articles as being the primary documents he works with in his capacity as Director. Having finished uploaded and interacting with documents in the database environment,
he moved on to a 66-page report that he was reading in preparation for an upcoming conference. He used his Macbook’s Preview software to view and interact with this particular document. While working with this report, I observed Martin using the software’s highlighting functionality to highlight various passages. He suggested, however, that his primary focus is on annotating the document. Martin relayed that he found the process of annotating the document helpful in preparing for his upcoming conference. He also suggested that the ability to paste URL information into annotations was helpful in connecting the report to other organizational documents or websites.

While Martin was reading and interacting with the report document in his PDF Preview application, I noticed that he did not appear to be making use of the application’s page preview sidebar. This sidebar (fig. 4) displays consecutive thumbnails of the document’s pages on the right-hand side of the screen, adjacent to the active page. During our subsequent discussion, Martin stated that the sidebar was not particularly useful to him as a navigational aid. He expanded on this point by saying: “the other side of the interface is much more important because that’s the interface that’s going to display any notes that I made and that’s of interest if I’m reviewing a document. So no, that list of thumbnails isn’t really helpful at all.” Martin’s comments reveal a distinct approach to annotation as it relates to textual navigation. Rather than the presence of the sidebar that displays inherent documentary structure, it is the presence of user-generated marks that guides Martin’s navigation of the text. He associates the left-hand side of the interface (where his annotations appear) with the processes of document navigation and recall.
Furthermore, Martin’s occasional inclusion of URLs in his annotations suggests another strategy by which he is able to appropriate and expand upon the interface’s formal structure. While the PDF Preview application he is using does not recognize the URLs as hyperlinks, he is able to include the plain-text content of the URL as a work-around for connecting and relating multiple documents.

Upon Martin’s closing and reopening of the PDF Viewer application, I noticed another automated interface action similar to the automation operating within his organizational database. When he reopened the document after interacting with it and annotating it, he found that the document had opened to display the page where he had stopped reading. Later, in our discussion, Martin noted that this automated feature was helpful in that it allowed him to resume exactly where he had left off. What emerged throughout my observation and discussion with Martin was his reliance on a hybridized navigational approach incorporating both user-generated...
navigational aids and automated interface actions. I will return to this hybridized approach later in this chapter when I consider the role that interface automation plays within textual navigation (see §4.2.2 on Automation of Interface Actions).

4.1.2 Participant #2: Anne

I conducted the second study with Anne, a Lecturer working in the context of a community church. Anne regularly lectures and teaches classes in association with her local church. In support of her lectureship, Anne revealed that she spends a significant portion of her preparation time by reading and interacting with textual documents. Some of the documents that she works with on a regular basis include the text of the Christian Bible (in various versions), biblical commentaries, concordances, dictionaries, and other supporting texts. Anne’s work practice and our subsequent discussion revealed that the primary medium she works with is print. She did point out that she may occasionally access certain resources online; however, print books figured most prominently in her work practice. Throughout the session, Anne demonstrated the strategies she employs when preparing for a lecture, including consulting biblical commentaries and other supporting texts, highlighting the text of the Bible, as well as her reliance on annotation and other user-generated marginalia.

Anne began by introducing me to the various texts she uses in her work. As mentioned above, these included concordances, commentaries, a biblical dictionary, as well as the Bible itself. Following this brief introduction to her texts, Anne proceeded to read from these various texts in preparation for her lecture. The text of the Bible was situated directly in front of her on the desk, and appeared to be the primary text with which she was working. Adjacently, she had placed and opened two books of biblical commentary written by biblical scholars. Throughout
the observation session, Anne highlighted, underlined, and annotated both her primary text as well as her supporting texts.

Later, during our discussion, Anne described the way in which the structural consistency between the various texts had facilitated her ability to effectively read from multiple sources. She revealed that the organization of the commentaries was “based on the book, the chapter, and the verses,” which mirrored the structural organization of her main text, the Bible. According to Anne, this structural consistency easily allowed her to find specific passages and to annotate them to emphasize parallelisms across her supporting texts. This behaviour, of using the Bible’s structural consistency for navigation, reinforces a claim made by M.B. Parkes. Writing on biblical study within the twelfth century, Parkes states, “the Bible text was sufficiently familiar to the reader so that no further ostensible guide to the arrangement of the material was required, and in such circumstances no further developments were stimulated.”87 Parkes describes this structural consistency as the ordo or the ordinatio of the work.88 While, at the time, no further structural guide or built-in navigational aid was deemed necessary beyond the inherent ordering or succession of the text on the page, new modes of biblical study would later create the conditions necessary for the re-ordering, or compilation of biblical texts—the notion of compilatio. I introduce these terms and notions here to illustrate the importance of documentary structure, particularly consistent structures, in current reading practice as well as in historical accounts of reading. However, I will refrain from giving these terms further consideration until the fifth chapter (see §5.2.3 on Blending Conceptual and Material Structure).

88 Ibid.
It is worthwhile to describe some of Anne’s textual practices in greater detail. When comparing passages across multiple books, Anne made extensive use of underlining and highlighting. She would also circle certain key words while underlining the rest of the words in the sentence. For longer paragraphs, Anne noted that she might “draw a line, a vertical line, through the whole paragraph.” These practices figured prominently in her interaction with documents. Anne also revealed that she had applied a consistent strategy in further indicating the significance of particular passages. In our discussion she stated: “I have methods of how I grade the importance of the text, that part to me, so I would go up to five stars. Anything that has five stars is something that’s worth reading again.” She would subsequently indicate less important passages by using a fewer number of asterisks.

These annotative and marginal practices formed a coherent method that guided Anne’s interaction with her texts. I was very interested in how this method contributed to Anne’s interactions with texts, specifically as she navigated the various documents she was comparing and consulting. In our discussion, Anne revealed that the processes of annotating and underlining proved essential to her cognitive process of making sense of textual structure. She said “when I highlight, it sort of resonates in my mind; I feel as though it’s sinking deeper in my mind.” It was clear that these textual practices improved, or seemed to her to improve, her understanding of the text.

Previous research on annotative practices confirms that annotation can aid in the reader’s comprehension of texts.89 In the study conducted by O’Hara and Sellen, the researchers find that “the very act of making such marks is a process which aids understanding and facilitates the

89 O’Hara and Sellen, “Comparison of Reading,” 337.
building of an internal representation of the text.”90 The need to internally represent the text in the course of navigating becomes even clearer when working from multiple texts. Anne suggested that her textual practices such as underlining and highlighting were pivotal during her subsequent return to, and recall of the text. She said, “if I want to remember the book, I look at the highlight […] I would hardly go to the parts that are not underlined.” As I had gathered from my observation, these user-generated marks played a vital role in how she navigated multiple documents. The use of marginalia allowed Anne to more easily locate and associate relevant passages across a number of supporting texts. Moreover, such material interactions acted as persistent reference points for any future consultations that Anne might undertake with those texts.

4.1.3 Participant #3: Jordan

I conducted the third study with Jordan, a corporate trainer working at a company specializing in human resources and related training programs. Jordan revealed that the primary aspects of his work involve reading documents relating to employee rights, such as the Ontario Human Rights Code, and subsequently synthesizing and organizing that information into Microsoft PowerPoint presentations and other documents. On the day that I met with Jordan to carry out the study, he was working on a project requiring him to search for and evaluate articles relating to cultural differences in adult learning habits. He identified websites, online databases, and scholarly journal articles as the primary types of documents that he would be consulting. He explained that he would later synthesize these findings and use them within his training seminars.

90 Ibid.
During my observation of Jordan’s work with documents, I observed him searching for and navigating article abstracts. Jordan relied extensively on string searches (or keyword searches) in his research work. He searched the database he was using and then used his Safari browser’s built-in search box to further navigate the results from his initial search. He would then evaluate each article abstract based on the presence of his keywords and the context within which they appeared.

Upon finding an article containing his search terms, Jordan opened it within the database interface, and quickly scrolled through the document. He would pause at headings and subtitles to gain more information about that particular document. However, he would quickly return to string searching as his primary method for navigating the document. Again, using his web browser’s built-in query tool, he would search for his desired terms and jump to any instances returned within the document. As Jordan was reading through the article, he opened his word processing application in order to copy and paste text from the article and to add his own notes to those relevant sections. In our subsequent discussion, Jordan revealed that a barrier he encountered during this process was the proliferation of read-only documents within the database—documents which could not be exported from the database. This hindrance necessitated his creation of a supporting document. When I asked Jordan about manipulating the documents he was working with, he replied: “the only way I can manipulate that document is if I copy and paste it and add to it into my own reflection or my own research. I’m not going to be able to manipulate on that website or in that journal. The reason I create an external document is so that I can create my own version of that document.”

The creation of an external document emerged as a logical step in Jordan’s process of synthesizing research. However, he suggested that this external document also provided a more
immediate benefit in that it guided his reading and navigation of his primary text. He referred to the external document as containing a number of “reference points,” consisting of copied and pasted text, keywords, and his own summary text, that helped him while he was reading. These reference points appeared to function similarly to the way that annotations and other marginal notes function. However, being housed within an external document, such reference points were removed from the original text and its subsistent documentary structure. Jordan’s textual practices demonstrated that users mobilize external interfaces and tools for textual interaction, often out of necessity as when their primary reading interface precludes certain functionalities. Jordan’s creation of an external document, though not an ideal form of textual interaction, demonstrates the value of navigational aids within reading interfaces.

4.1.4 Participant #4: Paul

I carried out the final observation and interview with Paul, a Risk Analyst working in the financial sector. Paul explained that his regular work with documents includes handling contracts, schedules, statements, and other documentary evidence useful in assessing financial risk. Paul is also involved in the recent deployment of a new software suite to be used within his organization. Paul explained that during our time together he would be working with documents related to the software deployment. In this capacity, Paul’s task involved creating a wiki environment that would incorporate training information and software documentation relating to the new software suite. Paul was working from a 130-page Microsoft Word document that he explained would form the core content available on the wiki platform. Beyond transferring this information from one format to another, Paul was also responsible for ensuring the accuracy of the information on the wiki platform and the functionality of the platform’s various features.
Paul’s work with documents appeared to hinge on his ability to quickly navigate between the various software platforms he was using (Word document, wiki editor, and the published wiki itself). These platforms provided divergent and unique representations of what was essentially the same content. Paul would copy and paste a segment of text from the word document to the wiki editor, and then add markup code that the wiki editor understood as discrete instructions for displaying that text. Following that, Paul would load the wiki preview that displayed the wiki page, as it would appear in its published state. Navigational features specific to each piece of software aided Paul’s navigation of his texts. While working in the Word document, Paul was able to follow it linearly, scrolling as necessary to the next item to be transferred over to the wiki. Returning to the wiki and refreshing the page, Paul was returned to the top of the wiki page. In order to preview the newly added or altered sections of text, Paul used the wiki’s built in table of contents. This table of contents appeared as a sidebar on the right-hand side of the screen. By selecting a heading, Paul was immediately taken to the desired section of the document. Furthermore, the wiki platform was intuitive enough to add headings to the table of contents as Paul added new headings in the wiki editor. This was achieved by adding three consecutive equal signs around new headings.

In our subsequent discussion, Paul revealed that these semi-automated features of the wiki’s infrastructure were very useful in decreasing the amount of work associated with adding and proof-reading new content. Moreover, the table of contents was particularly valuable as Paul frequently refreshed the page and subsequently navigated towards newly added content. As Paul was adding and editing content on the wiki platform, I noticed that he also engaged in more traditional textual practices. Upon discovering what he supposed might be typographic problems with the original document, Paul used highlighting and annotations to flag these sections for later review with the document’s authors. Such actions were relatively easily performed in the Word
document. In the wiki platform, however, Paul used a variety of *ad hoc* annotative tools in order to mark the section of text for later review. Within the mark-up code of the text editor, Paul included commentary syntax that the software would save but not display in the wiki preview. These comments were strictly for Paul’s reference while he was working within the text editor. Further, Paul also used the web application ‘Diigo’ to highlight and annotate sections of text as they appeared in the wiki preview. These redundant annotative practices revealed the inherent problems of working with multiple digital formats. Annotations were saved and displayed in their specific contexts of Word document, wiki source-code editor, and wiki preview window, but there was no way of relating them or quickly viewing them together.

4.2 Emergent Patterns of Use

4.2.1 Annotation and Highlighting

Both Martin and Anne made extensive use of annotation and highlighting as they performed their work with documents. Though they were working in different media conditions (Martin was working with digital documents in the form of PDFs, whereas Anne was working with printed books), both participants relayed the value of this type of textual interaction. Based on my discussions with Martin and Anne, it appears that user-generated annotations and highlighting play a significant role in how users navigate textual documents. Martin had claimed that the annotations he added were more useful as a navigational aid than the built-in page-view sidebar. Furthermore, both Martin and Anne valued annotations as a way of linking to external documents. Martin occasionally incorporated URLs as plain-text within his annotations, thereby creating a makeshift link to an external document, despite the fact that hyperlinking is not supported within annotations. Similarly, in her consultation with various print books, Anne used annotation and highlighting to create visual links between the primary text of the Bible and
numerous supporting texts. In both cases, annotations functioned as links to physically external or absent referents. In the case of Paul, whose annotations spanned across multiple digital formats and procedural steps, there was no clear way of organizing or creating links between various annotations. However, they did provide a reference for Paul and pointed towards actions he still needed to carry out in relation to each specific document.

As evidenced by the participants’ behaviours and their subsequent elucidation of those behaviours, annotation and highlighting provide an effective method for negotiating a document’s structure. Not only are these practices important for the reader’s immediate comprehension and meaning-making during reading, but also for the reader’s quick orientation and re-orientation within documents and for any subsequent recall of the document’s contents. These results are consistent with observations made by Muhammad Asim Qayyum. In a study of graduate students reading course-related materials online, Qayyum suggests that annotations were used to “place bookmarks to separate the article into various topics or ideas.”91 In the present study annotations also appeared to function as bookmarks that aid the reader in the creation of an internal representation of the text.

The present results, as they pertain to highlighting and annotation, are also corroborated by previous studies inquiring into the role that highlighting plays in the reader’s recall of documents. A study by Ed H. Chi et al. uses head-mounted eye-tracking hardware and software to demonstrate that readers are more likely to pay attention to highlighted portions of text rather

than to un-highlighted portions. The value of annotation and highlighting for textual navigation is significant and will be scrutinized more closely later in this study.

4.2.2 Automation of Interface Actions

Throughout the course of my time observing participants, I noticed that some of the users’ navigational actions were automated, or at least partially automated by the interfaces with which they were interacting. Martin demonstrated the automatic scrolling that quickly enabled him to check for the presence of a document he had uploaded to his organizational database. Likewise, the PDF preview application that Martin used had automatically saved and reopened the page he was last reading. While I observed Jordan, I noted how he used both automated scrolling and manual scrolling to orient within textual space.

A study by Teevan et al. interrogates the cognitive differences between searching and browsing for information in online environments. Based on their study of MIT Computer Science graduate students, Teevan et al. find that participants used keyword searches only 39% of the time when looking for specific information online. The researchers describe two navigational models that they witnessed throughout the study; that of teleporting directly to the information desired, and that of orienteering in smaller increments in the direction of desired information. Jordan’s processes, however, appeared to blend these two strategies in that his keyword search (or teleport) was itself an incremental or iterative step in finding the desired information as it appeared in its context. Jordan appeared to be engaging in both of these

---


navigational processes, and as described above, seamlessly incorporating them together in his search for information about ‘cultural differences’ and ‘adult learning.”

Jordan’s use of keyword searches functioned, in much the same way as Martin’s use of the automated features of the database or the PDF viewer, as a negotiation between the documents’ prescribed navigational tools and individual navigational practices. In essence, Jordan and Martin allowed their respective interfaces to make certain intuitive navigational moves on their behalf. James Hollan and Edwin Hutchins term this sort of interaction with one’s material environment as a cognitive off-loading.94 Cognitive off-loading is described by Hollan and Hutchins as the propensity for users to off-load certain cognitive functions, allowing them to be taken over by the tools and other resources in their immediate work environment.95 The automation of interface actions is one of the primary patterns of use emerging from the study results. I will consider such automated navigational moves more closely in the subsequent chapter where I will further discuss these findings in light of the theoretical models of distributed cognition research and other related work (see §5.3 on Automation of Navigation).

4.2.3 Navigational Metaphors

As I discussed in the Literature Review, navigational or informational metaphors contribute to digital interfaces by making their operation more intuitive for users, and especially so for novice users. Terms borrowed from bibliography, such as bookmark and tab have become staple metaphors within web browser interfaces. In my ethnographic work, I recognized a number of similar metaphors at work. While observing Martin as he used various web tools to organize and categorize documents, I noticed that many of them incorporated paper-based metaphors such as

---

95 Ibid.
the use of the word *notebook* to describe a collection of related documents. During our
discussion, I asked Martin how he approached these types of metaphors and what effect, if any,
they had on his work with documents. Martin said that the presence of metaphors in user
interfaces “makes it easier to use those tools and it makes it easier to intuitively—right away—
understand what this tool allows me to do, how it’s organized, and how I can use it in my daily
work.” The present findings are consistent with previous literature on the topic in suggesting that
metaphors are valuable tools for users as they interact with texts and interfaces.96 While Martin
suggested his experience with interface metaphors was generally positive, he did relay a past
experience where the interface metaphor was used improperly. He said “we have, in the past,
used an online platform, a collaboration tool that used the word *notebook* to describe what was
essentially a wiki […] but that’s not what a wiki is, it’s not a personal space; it’s more of a
collaborative space, so that caused some confusion among our members and online participants
in a course.” The adoption of metaphors within user interfaces should be guided by the logical
connection between distinct yet conceptually similar sets of practices. Various aspects of
informational metaphors, particularly their contribution to intuitive user interfaces, will be given
fuller consideration in the following chapter (see §5.4 on the Prototype Navigational Element:
Breadcrumbs).

### 4.3 Summary of Results

The present study has demonstrated that navigational aids and strategies are pivotal in
supporting various work processes involving documents. Moreover, the present results indicate
that certain patterns are manifested across various media conditions, reading goals, and domain
areas. Annotation and related textual practices, in particular, appear to be common across various

configurations of media format and across various tasks. However, the emergent usage patterns of the present study do not constitute a definitive or an exhaustive depiction of textual navigation. Rather, the observable results have revealed an initial sketch, which is exceptionally useful in discussing navigation in material and cognitive terms. As I will elaborate later, this initial sketch may be useful as a point of departure for future research (see §6.2 on Prospects for Future Research).
5 Discussion

Textual navigation is a compelling area of study, particularly in how it reveals the relationship between reader and text. The navigational elements and strategies implicit in paper-based and screen-based reading environments invariably shift the grounds of our relationship to texts, and the nature of text itself. As N. Katherine Hayles puts it, “a moment’s thought suffices to show that changing the navigational apparatus of a work changes the work.”

Seemingly straightforward decisions about textual forms can have intense effects on the reading experience, and on associated human activities more broadly. However, as the present study’s results show, reading is an active exchange where the conditions of the textual space regularly mesh with the condition of the reader. The participatory and active nature of reading is not new to digital documents; rather, it is described in a rich tradition of textual scholarship, most emblematically related in the historical accounts of renaissance readers.

In the following section I will outline some key parallels between historical practices and those observed in the present study in an effort to further contextualize navigational practice. I will then focus more closely on the exchange between user and reading interface, particularly within the two emergent patterns of use presented by user annotation and interface automation. I will rely heavily on theoretical aspects from distributed cognition, most notably by drawing connections between navigational behaviours and cognitive off-loading, as well as the reader’s creation of a blended conceptual space within documents. These specific discussions will also figure into the description and discussion of the ‘breadcrumbs’ interface element that I have created to further explore the research findings. Following that I will evaluate some of the methodological frameworks that have been brought to bear on the present research. In the

methodological evaluation I will give particular attention to epistemic perspectives on digital technologies as they have wide-ranging implications for methodological design and for the future of inquiry in this research area.

5.1 Parallel Practice: Historical Accounts of Textual Navigation

When we consider the activity of navigating documents, the reader’s relationship to several inherent structural elements comes to mind, including page numbers, headings, tables of contents, glossaries, and indexes. We know, however, from the historical accounts presented by fields such as textual studies, that the relationship between readers and documents is rarely so stable and unidirectional. In an article titled “Reading Strategies for Coping with Information Overload ca. 1550-1700,” Ann Blair inquires into the changes in readerly practice that occurred in response to the Renaissance and its accompanying increase in the variety and availability of texts. Renaissance readers increasingly corrected, added to, or created their own indexes within their books.98 It became fashionable to excerpt texts by keeping common-place books, reading journals, or to use other aggregative textual practices.99 Renaissance readers used different colours of ink to differentiate and categorize specific types of passages, facilitating subsequent recall of the text.100 As Blair points out, these practices were often “idiosyncratic” and “inventive,” while also being to some degree systematic and learned.101 Certain Renaissance fashions or popular modes of teaching may have popularized them, however, the way in which textual interaction was enacted by individual readers appeared largely guided by idiosyncrasy, and the requirements of a particular situation or goal.

98 Blair, “Information Overload ca. 1550-1700,” 17.
99 Ibid., 19.
100 Ibid., 23.
101 Ibid., 28.
William Sherman, in his book *Used Books: Marking Readers in Renaissance England*, considers numerous reading strategies, prolific readers, and documentary evidence from the Renaissance period. He notes that Renaissance readers developed complex systems of textual practice, often reified in annotation keys or legends, wherein readers attributed meaning to discrete symbols (astrological, typographic, and other). Many of these annotative systems were inspired by scribal or monastic practices, while retaining their individualized quality. Such systematic and idiosyncratic textual practice continues to this day. Study participant Anne’s grading system of ascending or descending asterisks is indicative of just such a systematic approach to reading. The intervention of the reader into the text, by application of such systems and strategies of textual navigation, suggests that the reader’s relationship to text is one of manipulation, of tailoring texts to specific goals or outcomes.

The results of the present study confirm that the process of textual navigation is, at all points, a compromise between rigid document or interface structures on the one hand, and individualized, situated strategies on the other. At certain times, users rely on the prescribed structural elements that have been built into their document or those that have been designed and presented to them in the software interface. Other times, users ignore these elements and rely instead on user-generated aids or improvisational techniques. At still other points, users recognize some benefits inherent in the interface within which they are working, and opt to reappropriate those elements, combining them seamlessly with more individualized modes of navigation. What emerges is a complex depiction of individuals as they navigate and alter their own textual space. Such behaviours serve to illustrate the intersections between media affordance, user agency, and other affective responses on the part of the user. In the next

---

sections, I turn to two of the three primary patterns of use emerging from the study results, annotation/highlighting as navigational practices and automated textual navigation, to interrogate these patterns in relation to distributed cognition and other models.

5.2 Annotation and Highlighting

5.2.1 Annotation and Highlighting as Navigational Practices

The present study reveals that annotation and highlighting are valuable user-generated tools for textual navigation. In this section, I will consider the ways in which these textual practices work to establish navigational checkpoints or points of reference, and the way in which annotations function in establishing intertextuality—alliterative or other referential connections—across multiple source documents, thereby creating new reading paths. I will also consider the ways in which the process of annotation creates a blended space that incorporates both conceptual and material structures, and how texts treated in this way provide a new approach to media affordance.

Ed H. Chi et al. consider highlighting within the context of previous research conducted in educational psychology. Some researchers working within this context have described the existence of a phenomenon known as the von Restorff isolation effect. This effect demonstrates that readers’ attention is drawn to highlighted portions of text, and that their subsequent comprehension and retention is guided by previously highlighted information.\(^{103}\) The existence of such an effect is partially corroborated by the present findings, particularly in Anne’s description of her subsequent return to highlighted passages and the way in which the presence of highlighting isolated her attention to that specific portion of text. Chi et al. provide eye-

tracking data in support of The Von Restorff isolation Effect.\textsuperscript{104} However, the existence of such an effect fails to explain how the process of highlighting, and related textual practice, allows users to internalize documentary structure for the purposes of enhanced navigation. Clearer theoretical connections between these pervasive textual practices and textual navigation are required. The way in which readers make use of annotations or highlighting as navigational checkpoints or reference points is better elucidated by a look at the way in which annotations are anchored or physically connected to the documentary structure, and how such interactions represent a blending of cognitive and material structure.

5.2.2 Anchoring Practice

Catherine Marshall has described the long-running annotative element of the anchor as a method for designating the relationship between a reader’s annotation and the text’s structural, syntactic, or typographical content.\textsuperscript{105} The annotative anchor may manifest itself as an asterisk, line, or other signifying mark. In digital reading interfaces, the anchor may act as the entry point through which the user must pass in order to access the content of the annotation. This method of annotation anchoring is used in interfaces such as Adobe’s Acrobat, as well as the web application Diigo. It is the anchor, as Marshall suggests, that connects annotations to the linear structure of the document.\textsuperscript{106} However, the connection between anchor and document is not always so clear. As Marshall indicates, the relationship between annotation anchor and documentary structure may be “quixotic” in that where they “start and end is not a carefully-

\textsuperscript{104} Chi, Gumbrecht, and Hong, “Visual Foraging,” 596.
\textsuperscript{106} Ibid.
contemplated decision.”107 The spatial relationship between anchor and document may be fluid, but the very notion of an anchor underscores a physical and spatial connection, despite any fluctuations in proximity between the anchor and the document’s structure.

Returning to study participant Martin and his use of annotations as a method for navigating documentary structure, the physical connection between annotation anchor and document appears as the fundamental element that adds navigational value. In Martin’s work practice, I noticed annotation anchoring functioning on various levels of structural granularity. For instance, some of Martin’s annotations were anchored to highlighted keywords or sentences. Other annotation anchors were operating on a lower level of granularity, being tied to whole paragraphs or larger sections of text. The anchoring style used by Martin was largely adaptive. He appeared to change this style in relation to the types of annotations he was making. Specific reactions to keywords or sentences were reflected by the anchoring of annotations to highlighted text. Other, more general observations or comments were only loosely anchored to paragraphs, placed relative to the text that had inspired that particular thought. The result was a series of close and distant anchors operating alongside each other. Martin’s behaviours suggest that these various anchoring styles formed a whole system of navigation where both close and distant anchoring worked together to provide visual cues relevant both during the initial reading, and for subsequent review.

5.2.3 Blending Conceptual and Material Structure

The visual cues that Martin generated to ease his navigation and subsequent recall of his text operate on various levels, extending beyond the visual or structural level of the document. As

107 Ibid.
Edwin Hutchins points out, “the ability to combine conceptual structure with material structure is a key cognitive strategy.” Hutchins describes this strategy as a conceptual blending wherein conceptual structures are mapped onto material spaces, artifacts, or situations in order to create a third, blended space that facilitates cognitive operations. He positions this activity as being both “general” and “ancient” in the course of human cognition. The central notion behind conceptual blending is one that is common throughout distributed cognition theory; that material structures extend human cognition, effectively distributing cognitive work between human actors and their material environments.

In an attempt to more fully explicate what Hutchins means by conceptual blending, and to more concretely outline its relevance for the present research, I will refer to the more illustrative of his many examples. In this example, Hutchins considers a line of people queuing at a movie theatre to purchase tickets (fig. 5). He writes, “the participants use their own bodies and the locations of their bodies in space to encode order relations.” However, the ability to encode and decode these order relations stems from both cognitive and material inputs. As Hutchins points out, not all lines are queues, and the ability to recognize and operationalize a line as a queue requires a conceptual blending of the line of people (a material input) with some notion of trajectory (a conceptual input).

---

109 Ibid.
110 Ibid., 1555.
111 Ibid., 1559.
In conceptual blending, the material structure provides a relatively stable conduit for cognition; it is the material anchor that secures cognitive activity in real time and space. As Hutchins describes it, representational stability is vital to cognition. He writes, “conceptual structure must be represented in a way that allows some parts of the representation to be manipulated, while other parts remain stable.” Such representational stability is critical in facilitating human computational tasks. Take as an example the computational task of counting a group of people whose numbers and physical locations are constantly changing. In this example the instability of the material representation makes related cognitive tasks very difficult to carry out successfully.

The notion of representational stability is particularly relevant for textual navigation. In the case of Martin’s reading, the conceptual structure included his existing knowledge of the topic he was reading about (open educational resources) and his expectations of what the current document might offer. The material structure of the PDF document, including headings,
subheadings, and other typographic or layout elements, provided the stable, physical space where Martin carried out his cognitive work. The blending of these two structures resulted in an annotated document that displayed points where conceptual structure merged with the material structure of the document. In this way Martin was able to use the material space of the page as a locus and his annotations as individual points, in order to map conceptual structure onto the document.

More generally, annotations and other user-generated navigational aids provide a material place where the reader’s trajectory can be marked. In placing an annotation bubble or an asterisk or in highlighting a portion of text, the reader is engaging in conceptual blending. Because the representation of the document structure (the material input) is relatively stable, it allows the reader to carry out computations about the document. Computations in this context may provide answers to questions such as: How far away am I from the next heading? How many pages have I read? How many arguments has the author made in this section? How does this part relate to the whole? The ability to carry out such computations is integral to the process of textual navigation and it works to decrease the potential for reader disorientation within textual space.

I will now return to the concepts of *ordinatio* and *compilatio* that I mentioned briefly in preceding chapters in order to provide a historical example of conceptual blending and to concretely show how it is manifested in documents (see §2.6 on The History of the Book and §4.1.2 on Participant #2: Anne). Writing on these two modes of presenting and reading biblical texts, Parkes describes reading behaviours of twelfth- and thirteenth-century scholars that are very similar to those observed in the present study. Writing on rubrics and reader annotations, such as sub-headings and paragraph markers, Parkes argues that “the *ad hoc* nature of these devices in these early surviving copies demonstrates first that readers felt the need for more
ostensible help in finding their way about in a highly sophisticated and technical argument, and secondly that the producers of books had not yet developed a recognized procedure for coping with this problem.”¹¹⁴ Parkes’ arguments address the twelfth-century text of Peter Lombard’s *Sententiarum*; however, they apply equally to modern digital texts.

Throughout participant observation, I have noted the use of similar *ad hoc* devices as a means of negotiating complex documentary structure. Three participants, Martin, Anne, and Paul, repeatedly used annotations and other forms of textual markup to supplement the navigational aids provided to them by their respective textual interfaces. Also, it is worth noting that Anne’s biblical texts and commentaries, like Parkes’ example of Lombard’s *Sententiarum*, include complex and technical theological arguments. The navigation of such arguments, comprised as they often are of multiple parts, represents a significant computation on the part of the reader. The provisions of *ordinatio* and *compilatio*, then, allowed medieval readers to carry out such computations with conceptual blends. Textual navigation, across media configurations and across centuries, appears to hinge on the abilities of readers to create and carry out conceptual blends.

5.2.4 Annotation and Intertextuality

In their book *The Social Life of Information*, John Seely Brown and Paul Duguid consider various ways in which documents implicate social relations and configurations. In their consideration of documents, the authors state that “documents are not, then, independent. Like biological organisms, every document is always related to some other.”¹¹⁵ Such intertextual relationships between documents are reinforced by the presence of various structural elements

such as citations, acknowledgements, or in the creation of derivative works. In the process of reading, too, latent intertextual connections are actualized by readers.

Throughout my observation of participants, I noticed that annotations figured prominently as a method for flagging intertextual connections between the active document that the reader was reading, and other, related documents. Sometimes, the texts that participants referenced were absent from their immediate workspace, as when Martin included URL information within annotations so as to point to a specific document located in his organization’s database. Other times these related texts were at hand, as when I observed Anne as she underlined and highlighted passages in the main text of the Bible, and then proceeded to carry out the same underlining or highlighting treatment in one of her supporting texts. This action not only flagged intertextual relationships, but also facilitated closer comparison between them. While intertextual connections support various processes (comprehension, summarization), Anne’s intertextual annotations between multiple print documents provide an example of how users of print interfaces create spatial and visual cues for orienting and reorienting their attention between multiple documents.

O’Hara et al. conducted a study of users working and writing from multiple documents. The researchers state that the process of comparing multiple documents represents a highly complex cognitive activity with significant demands on user attention. User behaviour, in the context of comparing multiple documents, is carried out with the aim of reducing cognitive demand. O’Hara et al. find that many of the material properties of paper documents work precisely along these lines of reducing the cognitive demand on readers. They state that “because

---

116 O’Hara et al., “Materiality of Writing from Multiple Sources,” 281.
the text on paper does not move in relation to visual reference points such as page boundaries, readers can reorient to the correct part of the page using the spatial cues of the page.“117 While such spatial cues presented by paper documents undoubtedly prove useful for readers reorienting themselves when comparing multiple documents, it is clear that the material affordances of paper are often supplemented with specific activities that further decrease the cognitive demand on the user. O’Hara et al. cite the behaviour of one study participant as she used her hand to point simultaneously across two documents to compare similarly-structured tabular data. In this case, two major affordances of paper documents identified by O’Hara et al. (their fixed relation to page boundaries and their propensity to be placed side by side, concurrently visible) were further enhanced by the user’s “physical indexical behaviour” of using her hand to guide her comparison.118 In spite of structural consistency, and concurrent visibility, working from multiple printed documents requires significant cognitive effort.

In applying the same highlighting or underlining treatment across multiple texts, Anne created a visual cue in order to better examine and compare the two texts she was actively reading. In light of the observations made by O’Hara et al., the structural consistency between Anne’s biblical commentaries and the text of the Bible were implicitly regarded by the user as being insufficient for effective navigation. In both participant’s cases, the spatial cues of the page were supplemented by user-generated visual cues. In the following section, I will examine the key cognitive strategy of cognitive off-loading, as it is described by Hollan et al., to help explain the tendency of users to augment their navigation with individually generated cues.

117 Ibid.
118 Ibid., 282.
5.2.5 Cognitive Off-loading

Hollan et al. identify four core principles of distributed cognition theory. These four principles are as follows:

—people establish and coordinate different types of structure in their environment
—it takes effort to maintain coordination
—people off-load cognitive effort to the environment whenever practical
—there are improved dynamics of cognitive load-balancing available in social organization.\(^{119}\)

I will focus on the third principle of cognitive off-loading. However, it is important to note that these four principles are closely related. This approach is premised on the first principle that suggests structures useful for cognitive tasks are created and coordinated within human environments and contexts. The effort involved in establishing and maintaining coordination between cognitive, material, and social structures necessitates the off-loading of cognitive effort. As Hutchins points out, the overwhelming benefit of cognitive off-loading is the “change [in] the ratio of cognitive effort to computational accomplishment.”\(^{120}\) In other words, by incorporating material and social structures into cognitive tasks, people are able to maximize the results of their cognitive work while decreasing the associated cognitive load.

In the context of textual navigation, cognitive off-loading functions on various levels. First, I will consider cognitive off-loading as it is manifested in annotative practices, later I will look more closely at its relation to automated interface processes. In regards to annotative practice, I previously noted that annotation was crucial to Anne’s navigation and comparison of

---


\(^{120}\) Hutchins, “Material Anchors,” 1562.
multiple source documents. The contribution of annotative practice to the navigation of multiple
documents may be described along the lines of cognitive off-loading. Indeed, O’Hara et al.
suggest that annotative practices partly function in such a manner. They write, “annotation
allows the contents of working memory to be off-loaded to the external representation.” In
much the same way that airline pilots shift their memory load to certain landing instruments,
annotators off-load their working memory to the annotations and other marks that they create. In
this way navigational processes, such as orienting oneself between two source texts, benefit from
the fact that specific cognitive activities can be transferred to the material object at hand.

The notion of cognitive off-loading is closely related to the previously described
cognitive strategy of creating conceptual blends. Hutchins argues that spaces blending
conceptual and material inputs reduce cognitive load. He writes, “since conceptual models work
by embodying constraints among conceptual elements, both memory and processing loads can be
reduced if the constraints of the task can be built into the physical structure of a material
device.” The ability to manipulate texts in various formats and media constitutes a distinct
affordance. By allowing readers to intervene in the text, particularly by allowing idiosyncratic
practices, reading interfaces may increase the number of available strategies, and the number of
venues available for off-loading cognitive work. Malleability, or the degree to which readers are
able to change or alter medial configurations, emerges as one of the primary affordances of
reading media.

121 O’Hara et al., “Materiality of Writing from Multiple Sources,” 289.
5.3 Automation of Navigation

In contrast to the use of annotations and other user-generated navigational aids, reliance on automated or semi-automated digital interface actions finds few correlates in paper-based documents. Although keyword searching may be understood as an extended indexing behaviour, the ways in which it is automated in contemporary interfaces represents a significantly different process than what is presented by traditional paper-based indexes. Automation is an alien concept within paper-based documents where navigation is carried out manually, with discrete intention and attention required of the user. As a distinct element of digital reading environments, automation of navigational processes deserves greater scrutiny.

5.3.1 Delegation of Human Work

Our propensity to use tools and systems of tools in an effort to off-load cognitive work has been central to the theory of distributed cognition. The relationship between human agents and tools has also received attention within other fields of study. Sociologist Bruno Latour approaches this relationship in a manner that is similar to the approach taken by distributed cognition theorists. Latour coins the terms translation and delegation to describe the processes by which human work is shifted to nonhumans (built objects or tools).\textsuperscript{123} Considering the general relationship between humans and nonhumans, Latour writes “every time you want to know what a nonhuman does, simply imagine what other humans or other nonhumans would have to do were this character not present.”\textsuperscript{124} For Latour, the defining purpose of tools can be described by way of the delegated work that they carry out on behalf of human agents.


\textsuperscript{124} Ibid.
We might describe the relationship between users and automated scrolling elements with Latour’s terms of *translation* and *delegation*, which he defines as the shifting of human work from human actors to their tools and other constructs. However, the application of Latour’s terms here should be further qualified. Latour focuses on discrete, built objects (door-closers) rather than interface elements operating within computer environments. As such, much of his writing on this topic concerns anthropomorphism, or the ways in which humans describe built objects using human characteristics. In fact, Latour’s choice of terms (human and nonhuman) creates a dichotomy wherein he can address certain of these anthropomorphic and sociological issues. Many of the sociological elements that capture Latour’s attention are absent within the context of interface design. Rather, the delegation of human work to interface elements, such as the automation of scrolling within a document, is reified as a predictive delegation in that users’ subsequent actions are predicted and delegated to the interface. In his example of the door-closer Latour suggests a full shift from human to nonhuman labour, as in the total substitution of a human actor (a porter) with a nonhuman mechanism (the door-closer). In reality, the relationship between human and nonhuman labour is more nuanced. The door-closer still requires certain human input (the door being opened) in order for it to carry out its delegated tasks. Rather than a total substitution, the door-closer represents a supplementation or augmentation of human labour.

Similarly in the context of Martin’s and Jordan’s navigational strategies, the delegated work of scrolling is intertwined with the intent and action of the user. This interaction represents a feedback loop in much the same way that Latour’s example of the door-closer does. Human actions trigger nonhuman responses within these systems. Particularly in my observation of Jordan’s navigational strategies, I noted how seamlessly the human and nonhuman scrolling

125 Ibid.
actions were incorporated together. Automated scrolling, then, represents a highly responsive and predictive interface element that delegates cognitive work to the interface, thereby reducing the cognitive strain on the user. However, automation of navigational action may also be unwelcome. If the user’s next movement is not sufficiently predicted, if the navigational automation is so extensive that it undermines the user’s sense of control, or if it otherwise endangers the trust that the user has placed in the interface, then navigational automation might prove detrimental. The positive responses of participants in regards to automated elements suggest that this is not the case in the present study. However, the role of automatic interface elements should be further qualified, and I propose to do so by way of Ruecker et al.’s notion of cognitive reassurance.

5.3.2 Cognitive Reassurance

In a paper titled “Confidence, Visual Research, and the Aesthetic Function,” Ruecker et al. propose that user trust is a central element within interface interaction. The authors interrogate apparent versus actual usability, or the reasons why users might be drawn to the aesthetics of an interface and the resultant effect on actual perceptions of usability. The authors argue that the usability of an interface is interrelated with the perceived aesthetic appeal of the interface, which inspires confidence or trust in the user. The authors use the term cognitive reassurance to describe the interface’s promise of trust and usability. They write, “cognitive reassurance can be provided in a variety of ways, but some of the factors that should be included are the ready availability of help and the provision of an environment that seems appropriate to accomplish the task.”126 These provisions are intended to instill trust and displace any possible fears or

hesitations on the part of the user. Ruecker et al. propose that negative user responses may include fear of wasted effort or time, fear of losing control within the interface, and fear of unwanted outcomes. These fears directly echo the experiences and perceptions of users of early hypertext environments that I have previously described (see §2.2.2 on Comparative Studies of Navigation and Textual Media). The propensity for users to feel lost or to experience a lack of control within hypertext environments correlate to the behaviours described by Ruecker et al. Effective interface design ought to instill a sense of trust within the user. This provision of trust is particularly important in the present context of navigational automation where automated interface elements make major interjections into the navigational processes of readers.

Cognitive reassurance also operates on a more literal level within interfaces. Specifically in the context of Martin’s navigation of his organizational database, automatic scrolling functioned explicitly in reassuring the user that his documents had been uploaded successfully. In this case, automatic scrolling acts as a cognitive reassurant in two distinct senses, by reassuring the user that a particular interface operation had taken place, and more generally as a method for instilling trust in the user. In the first sense, the reassurant is a reflection or evolution of previous best practices of user action confirmation. Ruecker et al. argue that interface elements that represent or otherwise reflect previous best practices may be accepted by users as a form of cognitive reassurance. Though there is no dialogue box in the database interface, the best practice of action confirmation is communicated to the user by an alternative method.

The notion of user trust or confidence in interface design is emblematic of a widening understanding of usability in the context of human-computer interaction. As Andrew Dillon

---

127 Ibid.
points out, traditional metrics for usability, including effectiveness, efficiency, and satisfaction are increasingly being supplemented by the study of affective and emotional responses to interface design.129 Ruecker et al. bridge these affective responses with traditional notions of usability when they consider the ways in which user trust acts to reinforce or undermine the relationship between user task and interface. Central to their notion of cognitive reassurance is the idea that interfaces inspire trust in users by way of their task-appropriateness.130 Extending this notion to automated interface elements, we find that task-appropriateness might help explain the positive or negative reception by the user. In Jordan’s case, we can see how automated scrolling towards keywords supplements, or in some way supplants, the user’s task of visually scanning a document for specific keywords. It is precisely because these automated features supplement highly specific and predictable actions that they may be viewed as beneficial and non-disruptive.

5.4 Prototype Navigational Element: Breadcrumbs

As stated previously, prototyping is a central component of the present study in that it extends the study’s arguments and interpretations in such a way as to make them “productively contestable” (see §3.2.4 on Prototyping).131 Among the present study’s core arguments is that navigational behaviours exhibited by users, while certainly situated within documentary or textual structures, are also very much reactive against them. Small acts of reappropriation on the part of users constitute individual strategies for textual navigation, where individual requirements and the requirements of the task-world are negotiated. The prototype element that is

contextualized and described below extends this core argument, while also reflecting on the major patterns of use that emerge from the study results. In this section I will contextualize the prototype element by looking at its predecessor and namesake, the breadcrumb trail, a navigational aid common in hypertext literature and web design. Following this contextualization, I will briefly describe the functionality of the prototype and use it to extend the present discussion.

In the German folk tale of Hansel and Gretel, Hansel leaves a trail of breadcrumbs for himself and his sister to follow home. This folk tale provides the rationale and metaphor for interface designs incorporating what are called breadcrumb trails. As outlined by Keith Instone, breadcrumb trails may appear in one of three distinct forms representing path, attribute, or location. Path breadcrumb trails display the most recent pages visited by the user, and as such present a dynamic navigational aid. Attribute breadcrumb trails display possible paths that the user might take next. Finally, location breadcrumb trails show the hierarchy of page structure (parent and children nodes or pages).¹³²

Breadcrumb trails represent past navigational moves or offer future paths for reading. In website design, as in early hypertext literature, breadcrumb trails have been regarded as a beneficial aid for readers. In an article titled “The Bookmark and the Compass: Orientation Tools for Hypertext Users,” Mark Bernstein notes that breadcrumbs “help readers avoid undesired repetition [,] guide disoriented readers to familiar territory [, and] mark references to introductory material and overviews.”¹³³

Bernstein outlines several examples of navigational aids within nascent hypertext literature environments. Drawing parallels to the orientation cues found in printed books (fig. 6), he states that various cues such as headings, footers, and page numbers, contribute to create a navigational context for the reader.\textsuperscript{134}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{orientation_aids.png}
\caption{Orientation aids in printed books\textsuperscript{135}}
\end{figure}

Bernstein uses printed orientation cues as a model for designing navigational aids in hypertext environments. He suggests that orientation cues should be prominent, ever-present, and predictable in order to diminish disorientation within electronic interfaces.\textsuperscript{136} Bernstein concludes that the formulation of orientation cues should not be delegated to automatic mapping or indexing operations. Rather, he believes that navigational structures should be incorporated into the work of individual authors. Bernstein argues that an author’s knowledge of the audience and the domain within which they are writing provides value for navigational interface elements. He writes, “we believe that the solution to orienting readers within complex hypertext networks lies not in computer assisted mapping tools, but rather in well-crafted hand tools which will help

\begin{itemize}
\item\textsuperscript{134} Ibid.
\item\textsuperscript{135} Ibid., 35. © Mark Bernstein 1988. Image reproduced with permission of the copyright holder.
\item\textsuperscript{136} Ibid., 43.
\end{itemize}
authors to intelligently and sensitively instruct diverse audiences in the use of complex documents.”

As evidenced by the present study’s results, authorial or documentary structure does not always provide a sufficient navigational context for individual readers. Rather, these structures are appropriated, augmented, and changed based on individual tasks and preferences. Breadcrumb trails may be effective in representing hierarchical structure (in the case of location breadcrumb trails), however, attribute or path breadcrumbs limit the reader to certain predetermined navigational paths.

In continuing to explore the emergent patterns of the present study, I will now turn attention to its component prototype portion. The present prototype imagines what user-centric breadcrumb paths might look like within a digital reading interface. Rather than operating on the level of sites or hierarchies, these breadcrumbs operate on the level of individual documents. The primary functionality exhibited by the prototype is in allowing users to place breadcrumbs as milestones that are relative to the source text. In comparison to other breadcrumb trails, this prototype element is more closely modeled on the story of Hansel and Gretel, where the travelers place breadcrumbs intentionally rather than arbitrarily. The user is free to choose the discrete location of each breadcrumb and to use a keyboard shortcut (the Tab button) to quickly teleport between them.

The simple prototype interface presented here engages all three of the study’s emergent patterns of use within a single interface element. Users are able to use the breadcrumbs to quickly move from one instance to another, thereby facilitating comparison of multiple portions

\[137\] Ibid., 44.
5.4.1 The Process of Prototyping

The process of prototyping, as it has been incorporated into the present study, may be usefully understood as an extension of the present study’s argumentation. Galey, Ruecker, et al. suggest that prototyping may present a productively contestable argument.\(^{138}\) In the literature on distributed cognition, such prototyping and design work extends ethnographic observations, effectively returning argumentation to the site of practice. Matt Ratto describes another analogous perspective, emergent from the tradition of critical design, as critical making. From this perspective, modes of material engagement are used “to supplement and extend critical reflection and, in doing so, reconnect our lived experiences with technologies to social and conceptual critique.”\(^{139}\) In the present study, these lived experiences are represented by the practice-based experiences and perceptions of various study participants.

An emphasis on processual, self-reflexive thinking-through-doing pervades all three of these design perspectives. Galey, Ruecker, et al. begin their discussion of prototyping within the digital humanities by asserting the processual nature of design within that field: “our intention is to extend this logic of process to terms like designing and prototyping, both of which name


activities at the core of the digital humanities.” As the authors suggest, the use of the participle form, as in designing and prototyping, emphasizes process over product. Similarly, in the critical making perspective, processes are valued over particular products or prototypes. Ratto writes, “the final prototypes are not intended to be displayed and to speak for themselves. Instead, they are considered a means to an end, and achieve value through the act of shared construction, joint conversation and reflection.” The procedural, iterative, and self-reflexive nature of design is echoed in the literature on distributed cognition, which is premised on the iterative activities and feedback loops operating between ethnography and design. In all of these perspectives, the use of prototyping is intended to reveal new knowledge, to challenge previous assumptions or results, or otherwise, to provide a variegated perspective on the research or topic in question.

Along these lines, I will now consider the generative value of the prototyping activity that is included in the present research. The goal has been to model emergent patterns of use arising from the research results within a prototype, thereby re-substantiating these patterns within a practical, material environment. In this way, we might more closely engage with the patterns of use exhibited by study participants, and further hypothesize about the design implications of those patterns.

Among the arguments re-substantiated in the prototype, is the argument that textual navigation is inextricable from the requirements of particular goals and desired outcomes. This argument has two logical conclusions. The first conclusion is that the interface designer can

140 Galey, Ruecker, and the INKE Team, “How a Prototype Argues,” 405; italics in the original.
hardly predict the various navigational requirements of users as they engage in specific tasks around specific documents. The second, related conclusion is that designing around highly specific instances of interaction may, in fact, be counterproductive. The requirement, then, and one which I have considered throughout the prototyping process, is of distilling the particularist interactions that are observed within an ethnographic framework in order to find generalizable principles or directions relevant within design. In this sense, the prototyping activity does not seek to address the specific needs of the users whose experiences and practice make up the present study. Rather, the process of prototyping has revealed the importance of locating general principles within ethnographic data that may prove useful within a design context. In this way, the prototyping process has allowed me to focus more closely on the principle of cognitive off-loading, which has figured prominently in both the ethnographic data and the design of the prototype interface.

5.5 Design Perspectives in the Digital Humanities

In considering the prototyping component of the present research, which is simultaneously rooted in the traditions of cognitive ethnography, digital humanities, and critical design, it is worthwhile to return to the design perspectives of the digital humanities. Perspectives on interface design within the digital humanities are still emergent, existing as they do in a relatively nascent state. As a result of these shifting perspectives, the digital humanities offer a valuable case study of interface design as it relates to digital reading environments. As I will argue in this section, shifting design perspectives in the digital humanities are indicative of a field that operates within a liminal space in constant negotiation between new media and their constituent affordances on the one hand, and the rich, historied tradition of print textuality on the other.
Matthew Kirschenbaum has been a vocal critic of prevailing approaches to interface design within the digital humanities, citing the fact that interface work is often put off to the final stages of digital projects, when time and money constraints severely hamper development. Similarly, in a lecture titled “Interactive Visualization for the Humanities,” Stan Ruecker encouraged closer inspection of interfaces within the humanities and called for approaches that privilege the interface as a focal point, rather than as a side effect of research. Viewed in this way, interfaces constitute a shared resource for digital humanities scholars working within various subject contexts, and within various disciplinary affiliations. Of special relevance to the present study is the way in which design contexts might be made more generalizable so as to hold value outside of the conditions of specific studies or projects. This is particularly relevant to the present research in light of the early literature on reading and media, much of which has been hamstrung by non-generalizable methods and results.

Within the field of digital humanities, several authors have raised awareness of the need to extend study and design contexts beyond the conditions of individual studies or projects. Martyn Jessop, in an article titled “Digital Visualization as a Scholarly Activity,” has argued for significant and systematic changes to the way in which visualization work is carried out in the humanities disciplines. Writing on the London Charter on 3D visualization methods, Jessop suggests that its value lies in enabling “potential reuse of the research conducted and its outcomes in new contexts” and in “promot[ing] understanding beyond the original subject

144 Stan Ruecker, “Interactive Visualization for the Humanities,” iSchool Colloquium Series. Faculty of Information, University of Toronto. Toronto, CA, June 3, 2010.
community.” Similar calls for action have been taken up by other authors as well. Galey, Ruecker, et al. consider design transferability as being valuable, yet lacking, within the current design context of the digital humanities. The authors’ criticism is that designs are oftentimes too embedded within specific projects to be of much use to the broader community. A related concept from the work of Galey and Ruecker is the notion of trajectory. Here, trajectory denotes the historical lineation of an interface design. How does the design acknowledge its previous iterations? How does it incorporate affordances from cognate domains?

Such questions are of pronounced interest to the present study. This is particularly true within the design context of cognitive ethnography, which seeks to distill general principles or affordances from oftentimes particularist ethnographic data sets. The intention of cognitive ethnographic design is to document situated goals, behaviours, and interactions using “thick description” and then to move towards generalizable design principles that are useful across a variety of domains. This process works along the lines of mapping commonalities, which are essentially trajectories, that operate between materially distinct yet conceptually similar situations, sets of data, and results.

Notions of domain transferability and design trajectory speak directly to the value of interface metaphors (or as Ray Siemens calls them, operational metaphors). Appropriating design elements and vocabulary from other material and conceptual realms (for example, the appropriation of print-based conventions and vocabulary in the design of electronic books) reveals such elements to be portable and useful across several different contexts. Moreover, as Kirschenbaum suggests, the book and the page are increasingly treated as types of interfaces

146 Ball and Ormerod, “Putting Ethnography to Work,” 151.
themselves. This treatment creates a continuum between various textual forms, one that is evidenced by certain patterns of use observed in the present study, namely the use of annotation as a navigational aid. The notion of a textual continuum on the level of the interface can be highly productive. It allows us to look simultaneously to the history and the future of textuality. As Kirschenbaum writes, the concept of the print interface is “a response to the understanding that the conventions of manuscript and print culture are no less technologically determined than those of the digital world.” To this I would add that manuscript and print culture are not only technologically determined to some degree, but also technically complex and multivariate. This is particularly true of specific periods in the development of the book that I have outlined earlier, namely in the medieval developments of \textit{ordinatio} and \textit{compilatio}, as well as in the intense transformation of reading practices that occurred in the early modern period. This view has been a central argument in the work of several authors, most notably in the work of Paul Duguid and David M. Levy. Duguid has tenaciously defended the need to look simultaneously to the past and the future of textual forms. As he has argued, “if we accept the past as simple and the future as complex, we tend not to question the idea that complex new technologies will sweep away their simple predecessors.” When we speak of design trajectory and domain transferability we are engaging in conversation about the historical dimensions of the interface—and more specifically within the present context—the historical dimensions of textual forms.

However useful it is to study the points of origination of design trajectories, such as the historical contexts within which textual forms developed, we must also study the path that is

\footnotesize

\begin{itemize}
  \item Kirschenbaum, “‘So the Colors Cover the Wires’,” 523.
  \item Ibid.
\end{itemize}
implied by those trajectories as they extend to our contemporary technologies and further into the future. To borrow from Hayles, we must not seek to recreate electronic textuality as a simulacrum of print.¹⁵⁰ To look simultaneously—and meaningfully—to the future and to the past is not an easy task. Moreover, it is one task that has become central to the ongoing work of the digital humanities. Projects such as the William Blake Archive regularly engage with the problems that result from such perspectival frictions. Their work is a constant negotiation between the affordances of electronic environments, and the requirements of bookish representation. Likewise, we ought to acknowledge and directly engage with the interplay between new modes of engagement and those that we have inherited from historical forms. The results of the present study demonstrate that this interplay is indeed at work in situated textual practice, and moreover, that it is not unique to any one mode or domain of reading. Professional practitioners regularly engage in cognitive behaviours that—although they are instantiated in specific material conditions—also transcend those conditions. The prototyping experiment, likewise, engages with this interplay, incorporating both historically continuous and novel modes of textual navigation.

Patrik Svensson, Matthew Kirschenbaum, and several others have suggested that the digital humanities continue to lack solid frameworks for designing and evaluating digital artifacts.¹⁵¹ Kirschenbaum has suggested on numerous occasions that this paucity may be attributed to a lack of time, money, or labour. While such pragmatic concerns are certainly important, of greater importance is the design perspective that has become prevalent in the digital humanities. Such an approach is indicative of what Julia Flanders has called “a culture of

the perpetual prototype.”¹⁵² However, this is not to say that such a culture is unproductive. On the contrary, many members of the digital humanities community have demonstrated the scholarly value of working within such a culture. Ruecker and Sinclair’s article “The Text and the Line of Action: Re-conceiving Watching the Script,” precisely illustrates the value of prototype design trajectories within broader areas of discourse. It is my conviction that emergent concepts such as domain transferability, design trajectory, and cognitive reassurance problematize the assertion that the digital humanities lack sufficient design frameworks for creating and evaluating digital objects. While such notions cannot be held to the requirements of a cohesive framework, they do represent generalizable design principles that bridge gaps between specific projects and between cognate domains.

5.6 Methodological Evaluation

The focus that cognitive ethnographic methods place on individualized, context-dependent practice has been essential to the present study. However, closer consideration of the methodological and theoretical contributions of distributed cognition is required. Historically, methodological and theoretical approaches to reading and the ethnography of reading have been varied and often conflicting. As a result, it is necessary to look more closely at how the study of textual practices, such as navigation, is shaped by methodology and theory. In the following section, I will evaluate the adoption of a distributed cognition framework within this study, and also look more closely at contrasting frameworks, such as activity theory and those operating within digital humanities, and inquire into the epistemics of each.

5.6.1 Cognitive Ethnography

Edwin Hutchins has depicted cognitive ethnography as a primarily descriptive endeavour.\textsuperscript{153} In describing how human actors operate within complex environments, cognitive ethnography includes but also transcends particularistic situations or improvisational techniques. In contrast to situated action theory, which has been described by Bonnie Nardi as tending towards “particularistic accounting of a single episode that highlights an individual’s creative response to a unique situation,” cognitive ethnography pursues structures and interactions that are both durable and generalizable.\textsuperscript{154} This inquiry into durable and generalizable behaviours is partly a result of the grounding of cognitive ethnography in systemic goals. Such a systemic focus largely eludes situated action theory, likewise, it does not figure prominently in activity theory. In the present study, O’Hara et al.’s typology of reading goals, coupled with explicit attention to individuals’ reading tasks, has provided that grounding. This is not to say that improvisation or idiosyncratic actions are not of interest within a cognitive ethnography framework. Rather, such behaviours are recognized as being emergent within real-world practice, as negotiations between systemic constraints and the conditions of individual actors.

The reliance on reading goals reveals the fact that navigational aids and interface features are themselves highly contextual. The usefulness of keyword-searching for Jordan, as he researched and evaluated journal articles, is intrinsically tied to the reading goal and task in which he was engaged. The perceived usefulness of navigational aids appears to be highly dependent on reading goal and task, in that task-appropriateness figures prominently in user’s perceptions of specific interface elements.

\textsuperscript{153} Hutchins, \textit{Cognition in the Wild}, 371.
\textsuperscript{154} Nardi, “Studying Context,” 36.
5.6.2 Tacit versus Explicit Knowledge

Hollan et al. have argued that “well-designed work materials become integrated into the way people think, see, and control activities, part of the distributed system of cognitive control.”\(^1\) Is it possible, then, that this level of integration may obscure, or otherwise problematize data collection methods used in studies of human-computer interaction? Nardi argues that users are often unable to fully articulate their processes or operations within experimental studies, and further, that an acknowledgement of the downfalls of interview data has permeated the field of human-computer interactions.\(^2\) In the present section I will look more closely at the intersection between epistemics and methodology within the present study, and review such intersectionality more broadly within human-computer interaction research.

As Nardi suggests, actual user experience may be divergent from the experience that users are able or willing to communicate. As a major methodological issue, participant communication is rooted in a particular epistemics. Donald Hislop argues that “quite specific conditions are required for information technology-based knowledge sharing to occur successfully.”\(^3\) While Hislop is primarily concerned with information technologies as conduits for communicating knowledge, rather than as forms or sites of knowledge themselves, his arguments provide an introduction to various epistemic perspectives that are valuable in the evaluation of human-computer interaction research.

Hislop argues against objectivist views of knowledge-sharing. He notes that within an objectivist perspective, knowledge may be divided into two archetypes of tacit knowledge and

\(^1\) Hollan, Hutchins, and Kirsh, “Distributed Cognition,” 178.
explicit knowledge. Tacit knowledge, as described by Hislop, “includes both physical skills, such as the ability to ride a bike and cognitive frameworks such as the value systems people possess.” According to the objectivist perspective, explicit knowledge differs significantly from tacit knowledge in that explicit knowledge can be easily communicated and codified in reports, formulas, or designs. Hislop argues that an objectivist approach creates problematic dichotomies between knowing and doing, and between the brain and the body, wherein explicit and tacit knowledge become polarized.

By way of comparison, Hislop refers to the epistemology of practice perspective, wherein both tacit and explicit knowledge are considered to be mutually constituted, being “deeply embedded within and inseparable from the practices and activities that people undertake.” In this sense, tacit and explicit knowledge retain some of their defining characteristics, yet they are not portrayed as being pure types of knowledge or as competing archetypes. Rather, according to such a perspective, practice and activity reveal knowledge that is both articulated and unarticulated. It is an attention to discrete practices or activities that reveals the underlying epistemics of human activity.

Nardi echoes this idea of practice- or activity-based investigation when she considers the value of interview data within user studies. She writes “it is certainly very difficult to say how you type, or how you see the winning pattern on the chessboard, or how you know when you have written a sentence that communicates well.” She describes these three examples as occurring on an operations level. These examples are similar to the operation of a bicycle,

158 Ibid., 167.
159 Ibid., 169.
mentioned by Hislop as an example of tacit knowledge. On this low level of operations, it is generally quite difficult for users to articulate their knowledge of the operation and to describe the way in which they carry it out. However, Nardi suggests that if we look beyond this level of operations, interview data becomes more valuable. She states, “this generalization does not apply to the higher conscious levels of actions and objects; ask a secretary what the current problems are with the boss, or an effective executive what his goals are for the next quarter, and you will get an earful!”161

Nardi’s examples demonstrate the close relationship between epistemics and methodology within user studies. As Nardi herself notes, the apparent difficulty with which participants are able to articulate tacit knowledge or operations-level knowledge has been used as a justification for observational studies. However, observation alone fails to sufficiently contextualize user operations. The present study incorporates both observation and interview in an attempt to bridge the gap between user operations (on a relatively high level of granularity), and user contexts, affects, and broader structures. By incorporating both observation and interview it is possible to develop a holistic understanding of the user’s experience.

Nardi is correct in her observation that human computer interaction research generally tends toward empirical studies focusing on mouse clicks and keystrokes. I make a similar assessment in the Literature Review (see §2.1 on Previous Literature on Reading and Media and §2.2 on Navigation and Manipulation of Texts). Such methodological choices correlate well with objectivist notions of knowledge as outlined by Hislop. Distributed cognition methods, on the other hand, prove much more inclusive of non-quantitative data gathering techniques. As I have

161 Ibid.
described previously, distributed cognition theory values narrative, whether that narrative is documented by way of observation and various recording techniques, or whether it emerges naturally within study contexts or within interview data. Distributed cognition’s approach to narrative as an essential form of data allows even highly embedded or tacit knowledge to be scrutinized. In fact, Hislop suggests that language and stories are among the primary methods by which tacit knowledge is communicated.\textsuperscript{162} This is a position further supported by a study conducted by Julian Orr, and later described by Brown and Duguid. Taking as their example a group of Xerox technicians studied by Julian Orr, Brown and Duguid argue that story-telling is ubiquitous in practical work settings, and that story-telling consists not only of anecdotes, but also of important general principles that are useful across many situations.\textsuperscript{163}

The research methodologies used in human-computer interaction delimit what can be known about human activity. The epistemics underlying participant interview, observation, and other methods of data gathering, are crucial in expressing the locus of the research program, and in assessing a study’s validity. The value of mixed-methods approaches to human-computer interaction research is resultant from the duality of knowledge about human activity. Knowledge, constituted both tacitly and explicitly in human activities, must be approached from multiple directions. Returning to Dillon’s tripartite definition of usability as process, outcome, and affect, the value of mixed-methods approaches becomes even clearer. In order to understand how human actors carry out their work relative to technology, we must, as Dillon notes, avoid “retreat into the easy empiricism of current usability perspectives.”\textsuperscript{164} By delimiting what can be known

\textsuperscript{162} Hislop, “Mission Impossible?,” 167.
\textsuperscript{164} Dillon, “Beyond Usability,” 57-69.
5.6.3 Digital Humanities and Objects of Study

The epistemic issues surrounding digital artifacts as sites of knowledge in and of themselves are closely mirrored by the characterization of the digital within digital humanities scholarship. As Patrik Svensson notes, several “paradigmatic modes of engagement” occur between humanists and digital technologies.\(^{165}\) Svensson offers the following three modes of engagement with technologies: technology as tool, technology as object of study, and technology as expressive media. These various modes of engagement result from methodological choices and disciplinary values, among other considerations. The intersections between digital technologies and humanistic inquiry provide intriguing foils against which I will consider the present object of study.

Cathy Davidson argues that digital humanities scholarship may be divided into two distinct phases, as Humanities 1.0 and Humanities 2.0. The first phase includes the early projects associated with humanities computing where technologies were first put towards the service of text analysis and other humanities problems. In the second phase, Davidson argues that scholarship is extended to include greater participation and openness, which “decenters knowledge and authority.”\(^{166}\) It is the decentralization inherent in this second phase that is essential to the distinction between Humanities 1.0 and Humanities 2.0, in much the same way that decentralization characterizes Web 2.0 in relation to its predecessor. Such decentralization is perhaps most evident in the field’s object of study, which has come to include research typically

\(^{165}\) Svensson, “Landscape of Digital Humanities,” 1, ¶3.

carried out within the design, information, and human-computer interaction disciplines. As evidenced by the work of Stan Ruecker, Stéfan Sinclair, and Matthew Kirschenbaum, among others, digital humanities scholarship continues to expand traditional humanistic study by inquiring into the nature of knowledge, communication, and textuality within digitally inflected contexts.

The digitally inflected context of the digital humanities provides not only a site for continued investigation of humanities problems, but also a self-reflexive space wherein methodological and normative assumptions can be interrogated. Julia Flanders describes humanities computing as “an inquiry into how we know things and how we present them to ourselves for study, realized through a variety of tools which make the consequences of that inquiry palpable.”167 In Flanders’s depiction of the field there is a clear epistemic value associated with digital media as valid objects of study in their own right. In fact, Flanders proposes that such inquiry into the medium “and its role in anchoring our textual perceptions” is one of the notable benefits of what she calls the “productive unease” operating within digital humanities scholarship.168 The productive unease to which Flanders refers is based on a tradition of anxiety towards new media, which, particularly recently, has transformed in such a way as to render that anxious scrutiny of digital media beneficial. Earlier, I have identified a similar suspicion of new media as being a catalyst for early human factors research into screen-reading versus print-reading (see §1.2 on the Context of the Research). While the value of the self-reflexive study of digital media permeates much of the recent scholarship in digital humanities, Svensson notes that the field still lacks a reliable framework for evaluating and designing digital

168 Ibid., 5, ¶15.
tools. The relative absence of such a framework within the digital humanities reinforces the need for continued interest in methods and epistemics, with particular attention paid to those operating within cognate fields.

The discourse occurring in the digital humanities is similar to that occurring within the field of human-computer interaction, where research represents iterative methodological argumentation. In fact, methods such as user observation, interview, and iterative design are common to both disciplines. However, the object of study in these disciplines is often difficult to pin down. As Svensson notes of digital humanities, this is a reflection of a field that is in a state of negotiation. I have argued that a similar characterization can be used to describe the field of human-computer interaction. Literature in both of these fields suggests a desire to investigate not only epistemic issues within digital contexts, but also their influence in directing research within these fields.

5.7 Summary

The present study reveals the embeddedness of textual navigation within specific practice-based contexts. The context of each user’s task, which includes the task itself, user goals, and the material interfaces where work is carried out, is the primary object of study. It is within specific contexts that we can evaluate interface features and interrogate their functions—How are interface features used? When are they used? For what purpose are they used? What affective responses do they produce in users? It is within these specific contexts that patterns of use emerge—patterns which suggest that our current understanding of textual navigation is not sufficiently rich or inclusive.

170 Ibid., 26, ¶173.
The present study demonstrates that navigational aids represent a crucial element in the act of reading, writing, and textual interaction more broadly. Seemingly neutral interface elements delimit a user’s interaction with texts in important ways. These limitations act to reveal the agency of the user in resisting, appropriating, or otherwise augmenting documentary and interface structures for their enhanced navigability. Closer attention to these behaviours and user-centric strategies reinforces the need for continued study and innovation in the areas of publishing, distribution, and interface design.

Textual navigation is, as the present study shows, multivariate and individualized, being a reflection of individual knowledge that is both tacit and explicit. These characteristics describe both what is interesting about the study of textual navigation, and simultaneously, contribute to the difficulties encountered in choosing methodologies and designing studies around textual navigation. While empirical study may have its place within usability testing and interface design, the present research argues for a continued focus on non-empirical inquiry within these areas. The types of user behaviours described in this study, such as the use of annotations or automated elements in textual navigation, transcend the quantitative methods that have become popular in human-computer interaction research. These behaviours represent media interactions and affordances that are more nuanced than those presented in the early research and more indicative of actual use and user perception.
6 Conclusion

In depicting and analyzing textual navigation across various media, the present study has sought to explicate how the material differences between print and digital media influence navigational practice. It is useful, here, to refer to the juncture between print and manuscript culture. Peter Stallybrass offers the following insight: “one might want to see the invention of printing less as a displacement of manuscript culture than as the culmination of the invention of the navigable book—the book that allowed you to get your finger into the place you wanted to find in the least possible time.”\(^{171}\) I will stop short of drawing direct parallels between manuscript and print culture on the one hand, and print and digital culture on the other, believing such comparisons fail to capture the nuances of either historical juncture. However, I will emphasize Stallybrass’s insistence on culmination over displacement. As Jay David Bolter and Richard Grusin put it, “what is new about new media is therefore also old and familiar: that they promise the new by remediating what has gone before.”\(^{172}\) Specifically in terms of textual navigation, the remediation from print to digital has certainly constituted a reimagining of the material aspects of textual space, and as I have argued, also extended the cognitive possibilities of that space.

The present study has revealed that navigation is central to much of the work we carry out with documents. Navigational behaviour is intrinsically tied to our tasks, and the desired outcomes or goals that shape them. More importantly, navigational behaviour observed *in situ* demonstrates a complex blending of conceptual and material space. As a result, users are able to create individualized trajectories through textual space in order to support their specific tasks and


goals. While users’ navigational movements within texts may be influenced by media affordance and specific functionalities, they are not wholly subject to them. Rather, media affordance and interface elements are augmented by specific behaviours that enhance their effectiveness. In some cases, built-in elements designed for enhanced navigability are altogether supplanted by user generated elements.

In this thesis, I have made a number of arguments regarding textual navigation. Key among these are:

(i) the management of cognitive load figures as a primary factor in navigational strategies across numerous media configurations. Annotations and related marks of readerly interaction shift cognitive work from the human to the material object at hand. Such off-loading frees cognitive resources for use towards other more demanding tasks such as comparing multiple documents, following a sophisticated argument, or creating meaning. Where annotations are either not supported or severely restricted by the interface, readers improvise by off-loading navigational work in whatever manner they can. Also, readers value the automation of navigational action so long as it aids their progress through textual space.

(ii) malleability within reading interfaces promotes user trust and other positive responses towards interfaces. Providing a robust interface that promotes the manipulation of text towards various ends is a central feature of successful digital reading environments. Navigational aids are often generated by users in response to those that are presented within interfaces. The major benefit of a malleable interface is in extending the range of possible cognitive-material interactions between reader and text.
(iii) by merging epistemic considerations, mixed-methods approaches create robust environments for the experiential and processual study of human activity. Our cognitive faculties and our material environments are inextricable from one another. Attempts to isolate cognition from the environment where it takes place necessarily reveal only one dimension of multi-dimensional human activity. Mixed-methods approaches consider the constituent parts of human activity as being made up of experience, perception, and action. Applying and further refining such frameworks promises to extend our current knowledge of human activity, particularly as it is carried out in the built world.

6.1 Limitations of the Study
One of the present study’s objectives has been to reveal a range of navigational strategies, and to interrogate those strategies by focusing on their material-cognitive aspects (see §1.4 on Research Objectives and Questions). As a result of using a non-homogenous group of study participants, the results of the present study are not specific to any one reading goal, media configuration, or reading task. Rather than investigating a single mode of reading, the intention has been to present an initial, holistic depiction of navigational practices in professional work with documents, and to problematize the notions of media affordance in relation to textual navigation. However, the study would have benefited from additional participant research, particularly from a greater representation of professionals working primarily in paper-based configurations.

6.2 Prospects for Future Research
The methodological and theoretical implications of past studies have been pivotal in shaping and informing continued research in this area. It is for this reason that I have given considerable attention to these early studies. Throughout the present research I have identified and illustrated the lineage of that methodological and theoretical history. As I have noted in the review of the
relevant literature, the thrust of inquiry within this research area has moved away from quantitative analysis and towards the investigation of situated or embedded behaviours (see §2.1, particularly §2.1.1 on Methodological Problems of Reading Task). This shift has come about through iterative methodological and experimental designs. It is my conviction that such trends within this research area will continue and strengthen in the future.

If, as Andrew Dillon entreats, the field of human-computer interaction continues to include non-operational perspectives, such as considerations of interface aesthetics and user experience, then opportunities for future work in this research area will continue to grow.173 The three emergent patterns of use observed during the course of the present research hold strong prospects for future work. Annotation, for instance, has been given considerable attention as an aid to comprehension and learning, but significantly less has been written about the role it plays as an aid to navigation. Similarly, the off-loading or delegation of human work to nonhuman agents has sparked the attention of select researchers within the cognitive science and human-computer interaction disciplines, yet these important processes have generally evaded the attention of those studying textuality and reading media. Lastly, although metaphors have been shown to be important within interface design, their implications for processes of reading and interacting with texts have been understudied. Beyond continued research that might focus on the emergent patterns of use presented here, future work holds excellent prospects for revealing still other behavioural patterns in regards to textual navigation. Future research in this area will be dependent upon—as the present study has been—questions of methodology and the refinement and reiteration of mixed-methods approaches within user studies.

Hollan et al. offer an insightful perspective on the future of human-computer interaction, one which transcends the constraints of our current technological interactions. They write, “for human-computer interaction to advance in the new millennium we need to better understand the emerging dynamic of interaction in which the focus task is no longer confined to the desktop but reaches into a complex networked world of information and computer-mediated interactions.”

The study of emergent technologies that are already in existence—and continue to be developed—outside of the common desktop environment is promising. E-readers, haptic interfaces, and virtual reality environments are currently undergoing an intense period of development and redevelopment. These and other as yet unknown computer-mediated interactions will undoubtedly be central to the ongoing work of human-computer interaction.

Matthew Kirschenbaum adopts a similar outlook on the future of interface design within the digital humanities, stating, “one of the major challenges for the digital humanities in the coming decade will therefore be designing for interfaces (and designing interfaces themselves) outside of the 13- to 21- inch comfort zone of the desktop box.” An unknown period of time separates human-computer interaction researchers from the situated study of these emergent technologies as they become ubiquitous in practical settings. The continued study of technologies in common usage today, however, will provide the next wave of human-computer interaction research with the essential tools necessary to carry out its work. From this vantage point in particular, the prospects for future work in the area of textual navigation are exceptionally promising.

---

175 Kirschenbaum, “So the Colors Cover the Wires,” 540; italics in the original.
Bibliography


Lombard, Peter. *Sententiarum libri IV.* [ca. 13th cent.]. Thomas Fisher Rare Book Library, University of Toronto. shelf mark MSS 01125, digital ID F4319.


Appendices

Appendix A – Table Summarizing Reading Goals

<table>
<thead>
<tr>
<th>READING GOAL</th>
<th>LITERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading to learn</td>
<td>(Robinson, 1970; Lorch et al., 1993)</td>
</tr>
<tr>
<td>Reading to self inform</td>
<td>(Lorch et al., 1993)</td>
</tr>
<tr>
<td>Reading to search/answer questions</td>
<td>(Mynatt, 1992; Askwall, 1985)</td>
</tr>
<tr>
<td>Reading for research</td>
<td>(Dillon, Richardson, &amp; McKnight, 1989)</td>
</tr>
<tr>
<td>Reading to summarise</td>
<td>(Kintsch &amp; van Dijk, 1978; Brown and Day, 1983; Winograd, 1984)</td>
</tr>
<tr>
<td>Reading for discussion</td>
<td>(Lorch et al., 1993)</td>
</tr>
<tr>
<td>Proof-reading</td>
<td>(Gould &amp; Grischowsky, 1984; Wilkinson &amp; Robinshaw, 1987; Creed, et al., 1987; Wright &amp; Lickorish, 1984a)</td>
</tr>
<tr>
<td>Reading to write and revise documents</td>
<td>(Hayes et al., 1987; McGinley, 1992; Bartlett, 1981; Stallard, 1974; Sommers, 1980)</td>
</tr>
<tr>
<td>Reading for critical review</td>
<td>(Wright &amp; Lickorish, 1984b)</td>
</tr>
<tr>
<td>Reading to apply</td>
<td>(Coulson &amp; Kayser, 1982; Lorch et al., 1993; Sticht, 1985)</td>
</tr>
<tr>
<td>Reading for problem solving and decision making</td>
<td>(Greatbatch et al., 1992)</td>
</tr>
<tr>
<td>Reading for enjoyment</td>
<td>(Lorch et al., 1993)</td>
</tr>
</tbody>
</table>

© Kenton O’Hara 1996. Table reproduced with permission of the copyright holder.
Appendix B – Ethics Approval

PROTOCOL REFERENCE # 25780

November 17, 2010

Dr. Alan Galey
Faculty of Information
University of Toronto
140 St. George St.
Toronto, ON M5S 3G6

Mr. Voytek Bialkowski
Faculty of Information
University of Toronto
140 St. George St.
Toronto, ON M5S 3G6

Dear Dr. Galey and Mr. Bialkowski:

Re: Your research protocol entitled, “Navigating Textual Space in Print and Digital Interfaces: A Study of the Material and Cognitive Dimensions of Reading Systems”

ETHICS APPROVAL

Original Approval Date: November 17, 2010
Expiry Date: November 16, 2011
Continuing Review Level: 1

We are writing to advise you that the Social Sciences, Humanities and Education Research Ethics Board has granted approval to the above-named research study under the REB’s delegated review process. Your study has been approved for a period of one year and ongoing projects must be renewed prior to the expiry date.

All your most recently submitted documents have been approved for use in this study.

Any changes to the approved protocol or consent materials must be reviewed and approved through the amendment process prior to its implementation. Any adverse or unanticipated events should be reported to the Office of Research Ethics as soon as possible.

Please ensure that you submit an Annual Renewal Form or a Study Completion Report 15 to 30 days prior to the expiry date of your study. Note that annual renewals for studies cannot be accepted more than 30 days prior to the date of expiry, as per federal and international policies.

If your research has funding attached, please contact the relevant Research Funding Officer in Research Services to ensure that your funds are released.

Best wishes for the successful completion of your project.

Yours sincerely,

Dean Sharpe, Ph.D.
Research Ethics Board Manager—Social Sciences and Humanities

OFFICE OF RESEARCH ETHICS
McMurtrie Building, 12 Queen’s Park Crescent West, 2nd Floor, Toronto, ON M5S 1S8 Canada
Tel: +1 416 946-5275 • Fax: +1 416 946-5763 • ethics.review@utoronto.ca • http://www.research.utoronto.ca/for-researchers-administrators/ethics/
Appendix C – Recruitment Letter

Dear Sir/Madam,

My name is Voytek Bialkowski and I am a Master’s student at the University of Toronto’s Faculty of Information working under the supervision of Dr. Alan Galey.

I would like to invite you to participate in a study I will be undertaking as part of my thesis work. The goal of my research is to better understand the ways in which professionals navigate textual documents in print and electronic form, and to understand the role interfaces play in professional reading activities. By investigating the effects of interface on readers’ abilities to effectively navigate and engage with their documents I hope to discover the ways in which benefits and shortcomings in print and digital interfaces can be used to inform the design of new reading environments.

As a participant, you will be asked to engage in a brief observation/interview session in the location where you conduct your professional activity. This session is expected to last approximately one hour. The scheduling of this session is entirely at your discretion and ideally will be organized around a specific time when you anticipate you will be engaging in reading and working with documents relevant to your work. The first half of the session will be devoted to observation, including video recording (with your permission), of your navigational strategies on paper or on screen. The video camera will be positioned and focused exclusively on the texts with which you will be working, and will not capture the work environment more generally. In the second half you will be asked to elaborate on the nature of your work with documents, and some of the strategies and tools you use to effectively navigate, use, and engage with your documents. You will also be asked to allow photocopies or photographs of documents which might indicate the physical alterations you have made to the documents you used. These sessions are currently scheduled to take place between the months of December 2010 and January 2011. The results of this study are expected to contribute to current scholarship on reading practices, as well as research and development of reading interfaces.

Because of the often sensitive nature of organizational documents, I would like you to know that your and your organization’s confidentiality are of utmost priority in this study. As scheduling will take place around your schedule, you are encouraged to schedule the session with the researcher when you expect to read non-sensitive documents. All personally identifiable information will be designated by pseudonyms so that neither your identity nor your organization’s will be disseminated in any way. Documents you provide at your discretion may be censored for content, as the primary concern for the study are your alterations, and marks of engagement, rather than the content of the documents themselves.

If you are interested in participating in this research, or you would like more information prior to making a decision, please contact me at v.bialkowski@utoronto.ca or by phone at (416) 804-4329. Alternatively, you may contact my supervisor, Dr. Alan Galey, at alan.galey@utoronto.ca.

Thank you for your consideration,

Voytek Bialkowski
Master of Information Candidate
Faculty of Information, University of Toronto
Appendix D – Individual Letter of Consent

Letter of consent:
Individual participation in observation/interview session

Principal investigator
Vojtek Blajkowski
Master’s student
Faculty of Information
University of Toronto
(416) 804-4329
v.blajkowski@utoronto.ca

Supervisor
Dr. Alan Galey
Assistant Professor
Faculty of Information
University of Toronto
(416) 946-5361
alan.galey@utoronto.ca

Research project summary
Printed texts often present the reader with specific tools, strategies, and aids, which help them in moving through a document, positioning themselves within a document, and remembering where to find specific information within it. Digital texts, on the other hand, present their own sets of tools and strategies that seem to sometimes enhance this user experience and sometimes limit it.

The present study aims to observe and analyze the navigational strategies used by a cross-section of readers carrying out reading tasks as part of a professional role. The main focus of the study is to investigate the behaviours and strategies of users’ navigation of texts and to understand them as complex systems that are directly related to the material medium used by the reader (either print or electronic). This research builds on previous research on reading by addressing an understudied aspect of reading media—navigation—and by applying the findings to the design of a prototype digital reading environment.

Invitation to participate
As a professional undertaking reading and engagement with documents in print or digital formats, you are invited to participate in this study. The present study will use the following processes of data collection: 1) observation and (with your permission) video-recording you in your own work environment, as you carry out your reading activity, 2) the opportunity to conduct an open-ended, audio-recorded (with your permission) interview with you afterwards regarding your professional reading activities and the ways in which you navigate and manipulate your textual documents, and 3) the opportunity to access and copy any documents with which you directly engaged during the course of the observation period, or referred to in the interview. The researcher is more than happy to accommodate your individual needs and the needs of your organization in scheduling the observation/interview session.

Participant rights and ethical principles
It is important to the research team that you are well-informed of your rights as a participant in this study. We would like to emphasize that participation is voluntary, and that your acceptance and approval at each stage in the research process will be sought. Moreover, you have the right to withdraw from the study for any reason and at any time once it begins. Should you decide to withdraw yourself from the study, all information gathered up to that point will be promptly destroyed. Also, during the interview portion of the research, you are free to decline answering any question. Once the study is complete and the data has been published as a Master’s thesis for the Faculty of Information, University of Toronto, you will have the right to access the research results if you indicate your desire to do so below.
Confidentiality in data collection and publication

Data collection methods used throughout the research include: video-recording of approximately half-hour in length during the observation period; as well as audio-recording during the participant interview (also approximately half hour in length). Additionally, field notes may be taken by the researcher during both portions. Following the interview, the researcher will request access to any documents that you have been actively engaging with, and any documents referenced in the interview. These will be used to further study the navigational aids, marks, and other alterations in the documents themselves.

The rights to confidentiality of yourself and your organization are of utmost importance to the research team. To this end, we will ensure that all identities (individual and organizational) are protected and will only be referenced by pseudonyms in all data collection and subsequent publications. Further, all files associated with the research study will be kept in encrypted, password-protected folders on the researcher’s computer. Any hard copy forms (such as the present one) will be stored in a secure filing cabinet at the Faculty of Information, University of Toronto.

Research results will be published as a Master’s thesis at the Faculty of Information, University of Toronto. They may also appear in abridged form in other scholarly venues such as journal articles and conference papers. Independent of the scholarly venue, all of your data will remain confidential and protected from data-collection processes to the final publication of results.

If you require additional information before making a decision you may contact the principal investigator, or faculty supervisor. If you have further questions regarding your individual rights as a participant in this study you are also free to contact the Office of Research Ethics by phone at 416-946-3273 or by email at ethics.review@utoronto.ca.

Participant signature

Having read and understood the above letter, and having had opportunity to ask any questions regarding its contents, I consent to participate in this research.

Participant name: ____________________________

I agree to be video-recorded during the observation portion:
Yes _____  No _____

I agree to be audio-recorded during the interview portion:
Yes _____  No _____

Participant signature: ____________________________  Date: __________

I would like to receive a copy of the published thesis and any other publications using data from this research:

Yes _____  No _____
Appendix E – Organizational Letter of Consent

Letter of consent: Organizational participation in research

Principal investigator: Voytek Bialkowski
Master’s student: Faculty of Information
University of Toronto: (416) 804-4329
v.bialkowski@utoronto.ca

Supervisor: Dr. Alan Galey
Assistant Professor: Faculty of Information
University of Toronto: (416) 945-5361
alan.galey@utoronto.ca

Research project summary
Printed texts often present the reader with specific tools, strategies, and aids, which help them in moving through a document, positioning themselves within a document, and remembering where to find specific information within it. Digital texts, on the other hand, present their own sets of tools and strategies that seem to sometimes enhance this user experience and sometimes limit it.

The present study aims to observe and analyze the navigational strategies used by a cross-section of readers carrying out reading tasks as part of a professional role. The main focus of the study is to investigate the behaviors and strategies of users’ navigation of texts and to understand them as complex systems that are directly related to the material medium used by the reader (either print or electronic). This research builds on previous work on reading by addressing an understudied aspect of reading media—navigation—and by applying the findings to the design of a prototype digital reading environment.

Resources requested
As a participating organization in the current study, the following resources will be requested of your organization and participating employees: 1) individual observation/interview sessions (approximately one hour in length) with one or two of your employees on site 2) access to documents used by those employees during the observation period and/or referenced by them during the interview portion of the session. The timing of these sessions can be arranged by the participant (with managerial coordination if necessary) during the two month period in which data will be collected by the researcher (November 2010 - January 2011). The researcher is more than happy to accommodate your organizational needs and the needs of your employees in scheduling the observation/interview session.

Potential benefit
This study does not provide direct compensation (financial or in-kind) to either participating organization or individuals. However, the results of this study may be potentially beneficial to organizations and/or individuals in terms of the close introspection into reading and textual engagement practices it asks of its participants. In this sense, the study results may be potentially beneficial for your organization in evaluating current practices and in motivating closer attention to interface for reading and documents handling.

Confidentiality in data collection and publication
Data collection methods used throughout the research include: video-recording of approximately half-hour in length during the observation period, as well as audio-recording during the participant interview (also approximately half hour in length). During the observation portion, the video camera will be focused exclusively on the participant’s working texts, and will not capture the working
environment more generally. Additionally, field notes may be taken by the researcher during both portions. Following the interview, the researcher will request access to any documents that the participant has been actively engaging with, and any documents referenced in the interview. These will be used to further study the navigational aids, marks, and other alterations of the texts by the reader.

The rights to confidentiality of your organization and its individual employees are of utmost importance to the research team. To this end, we will ensure that all identities (individual and organizational) are protected and will only be referenced by pseudonyms in all data collection and subsequent publications. For instance, "legal office," "not-for-profit organization," or similar descriptors will be used so that your participation as an organization in the research is anonymous and confidential. Further, all files associated with the research study will be kept in encrypted, password-protected folders on the researcher's computer. Any hard copy forms (such as the present one) will be stored in a secure filing cabinet at the Faculty of Information, University of Toronto.

Research results will be published as a Master's thesis at the Faculty of Information, University of Toronto. They may also appear in abridged form in other scholarly venues such as journal articles and conference papers.

Permission to contact employees and collect relevant data
For the research to be carried out with participants working at your organization the research team would like to request your consent to contact employees and access your facilities as described above. This document does not constitute individual consent which will be carried out on an individual basis with each prospective participant if you are willing to grant us access to contact your employees. If you wish to withdraw your organization from the study once you consent you may do so without any justification. If this should be the case any and all data collected from individuals at your organization will be promptly destroyed.

If you require additional information before making a decision you may contact the principal investigator, or faculty supervisor. If you have further questions regarding your organization's rights as a participant in this study you are also free to contact the Office of Research Ethics by phone at 416-946-3273 or by email at ethics.review@utoronto.ca.

Participant agreement
Having read and understood the above letter, and having had opportunity to ask any questions regarding its contents, I provide organizational consent for the purposes of this research:

Name: ____________________________

Signature: ____________________________ Date: _________