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An Adventurous E-Reader for Non-Linear E-Books

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AN ADVENTUROUS E-READER FOR NON-LINEAR E-BOOKS

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Non-linear books are published in print format as sequential text or digitally as collections of documents linked together via hyperlinks. These publication methods are problematic for readers and authors alike. Readers are often presented with unintuitive interfaces that do not indicate critical contextual information; authors struggle to order non-linear content into linear formats or to create and distribute their work in resource intensive digital mediums. While standard e-books might be a convenient format for non-linear books, current e-readers used to view them are severely limited; they mimic the format of physical books and fail to solve problems inherent in displaying non-linear content in a sequential order.

In this research, a novel e-reader prototype, called Adventurous Reader, was developed and tested. This e-reader displays e-books as a collection of linked documents as specified by the author while providing readers with crucial information about their position and progress. When e-books can be viewed in such an interface, they can serve as a solution to many of the problems authors and readers currently experience in the creation, distribution, and consumption of non-linear texts.

Table of Contents

1 Introduction

Non-linear books are any books that are not meant to be read sequentially from the beginning to the end. These include Choose Your Own Adventure (CYOA) books, textbooks, and certain experimental fiction and non-fiction. Most non-linear books have some level of interactivity, a feature that shows promise in teaching, promoting healthy behaviors and choices, and encouraging adults and children to read (Green & Jenkins, 2014). Readers explore information rather than passively absorbing it or experience grand adventures where their choices directly affect the narrative.

Because of this, writing non-linear books is important for educators, authors, and scholars (Green & Jenkins, 2014) (Jensen, 2001) (Pope, 2007), but current publishing methods are limited. When published as printed books, non-linear sections must be ordered in some way. While conventions dictate where to place indexes and appendixes, for example, ordering the sections in other types of non-linear prose is not as obvious or intuitive to readers. Non-linear digital books have been published as applications, websites, and web applications, but these products are difficult to create, advertise, distribute, and sell. Applications, for example, must be developed and tested for each release platform, usually selected from a limited subset of devices. Websites can be accessed from many different devices but must be maintained and secured against unauthorized users if their content is to be sold.

E-books and e-book reading applications (e-readers) are similar to websites but have properties that make them a more convenient medium for distributing books. Readers purchase e-book files and view them using an e-reader of their choice. Like web browsers, e-readers exist for nearly every device, making it easy to distribute e-books to a wide audience. E-book files can be thought of as portable websites; most standard file types, including epub, mobi, and azw, are HTML-based, containing one or more compressed HTML files.

Despite their advantages, e-books are not seen as an interesting or viable way to publish non-linear books for the same reason that non-linear books are unpopular in other digital mediums. Often, books published as applications or websites are displayed in interfaces that are unintuitive to readers and do not provide positional information necessary for readers to orient themselves in a non-linear prose. For e-books, although it would seem as though an e-book file would be displayed as a website composed of webpages, current e-readers are designed to mimic the format of physical books, ordering an e-book's content into a single document before displaying it. This interface not only omits necessary positional information and is unintuitive to readers but also prevents authors from exploring one of the features that is most intriguing about digital mediums: the ability to link separated sections of text together.

This research highlights the strengths of the e-book format by demonstrating that non-linear e-books can be displayed as a collection of linked documents that users can navigate without becoming disoriented. A novel e-reader prototype, called Adventurous Reader, that can display standard e-book files in this way was developed and tested. **This**

e-reader provides users with their position in the context of the narrative and the overall text to reduce feelings of disorientation while reading non-linear e-books. To test if this interface fulfilled these goals, the following research questions were explored in two user studies:

Research Questions
1. Do users understand their position in the narrative?
2. Do users understand the relationship between the e-book's text and the network?
3. Can users estimate their progress through the e-book from the network?
4. Do users understand how to advance through the text?
5. Do users experience less disorientation in Adventurous Reader than in Calibre?

User testing also established the basic usability of Adventurous Reader's interface by examining the following usability questions:

Usability Questions
1. Can users find buttons and functions when needed?
2. Can users find specific nodes when prompted?

These studies revealed that Adventurous Reader does successfully communicate the user's position in non-linear texts. The interface, however, requires more work to make it user-friendly to average computer users and provide readers with more information. Still, Adventurous Reader shows promise as a solution to the problems authors and readers currently experience in the creation, distribution, and consumption of non-linear texts.

2   Background & Related Work

Non-linear books in this research refer to fiction and non-fiction that are primarily text-based with axial, arborescent, or network (Ciccoricco, 2007) structures. Axial fictions have a central storyline with supplementary material branching off of it. Textbooks also have an axial structure as they are usually meant to be read linearly but have optional sections. Arborescent fictions also have a central story but with many branching paths and endings. These include CYOA books, generically called pick-a-path books, and game books, pick-a-path books where available choices and their results depend on previous choices readers made, ability points they earned, or items they picked up. Network fictions do not have a central storyline and can be read in different orders. Encyclopedias contain articles that can be read in many orders and that often reference each other.

Despite their long history, finding and reading these books or exploring their artistic and educational possibilities can be difficult or unrewarding. The following sub-sections explain the importance of studying and creating non-linear books, the current methods of publishing these books, and the strengths and weaknesses of each.

2.1 The Importance of Non-Linear Books

Non-linear digital books have been studied for several decades for their uses in education and entertainment, but there is still more exploration to be done especially in the area of

user interface design. Non-linear digital non-fictions were successful as learning tools for college students and eventually evolved into the Internet. Arborescent fictions are a popular area of study for educators for their potential benefits for children and adults. Despite these successes, more complex and creative works of non-linear fiction and non-fiction have been less successful in entertaining or teaching the public because of lack of awareness that they exist and inattention to potential readers.

Non-linear digital books delivered through hypertext systems have been extremely successful as learning tools. The Internet, arguably a descendant of these systems, is still important to students today. Studies conducted by George Landow (1989) and Johnathan Smith (1996) in the use of digital collections of hyperlinked documents in their college English courses revealed that the systems were beneficial and even enjoyable. Students who used the systems tended to read more contextual material; had a better understanding of the materials; introduced more types of data and factual evidence into discussions, papers, and exams; and made better use of glossaries, footnotes, appendices, and indices in physical books. Landow also reported that class participation increased by 300%.

Because non-linear fiction can be entertaining while also making use of hypertext and interactive learning, these stories have been studied for their educational uses. Green and Jenkins argue that arborescent fictions can be used to teach healthy behaviors and encourage reading (2014). Some educators use text adventures, a type of non-linear fiction, in classrooms to teach children critical thinking skills and reading comprehension (Sadofsky, 2010). Other educators teach students about tools for writing non-linear books such as Inklewriter (Inkle, 2014) and Inform 7 (Inform, 2014) to inspire them to write.

The abilities non-linear content has in digital mediums have inspired some authors to explore the creative possibilities of network fictions and non-fictions (Jensen, 2001) (Pope, 2007). Today, most people spend hours reading and researching online (Sadofsky, 2010). Because of this, biographies, autobiographies, textbooks, essays, stories, and poetry that have the same form and behavior as websites could be more engaging and attractive than linear books to modern readers.

These more creative books, however, have remained mostly unknown outside academia because of lack of awareness that they exist (Pope, 2007), inattention to potential readers (Jensen, 2001), and unintuitive interfaces (Gee, 2001). Nikolaj Jensen argues that these books are often intentionally written to defy most writing and narrative conventions and are consequently unapproachable to average readers. User studies to test this theory and determine how average readers interact with and react to these books are rare though with James Pope's and Kim Gee's studies being the only ones known. Both studies found that the interfaces for these books are often unintuitive and impede the reader's ability to enjoy and comprehend the texts. Pope, Gee, and Jensen among others plead for more attention to users and more research in the area of interface design. Jensen continues that if these books are to ever become mainstream entertainment, authors need to theorize less, listen to potential readers, and write more. Improving the efficiency of publication, accessibility, and visibility of these books could help achieve this goal as well.

2.2 Current Solutions

There are no shortage of ways that non-linear books can be published in digital and physical formats. Books, applications, websites, text adventures, and e-books have all been used. The following sub-sections give an overview of each of these mediums, provide a sampling of tools and techniques used to create non-linear books in each, and discuss their strengths.

2.2.1 Books

In physical books, the sections of non-linear texts typically must be ordered so that the book can be bound. Authors and publishers have created a variety of solutions to the problem of ordering unordered content. For axial fictions and textbooks, optional sections are usually placed at the end of the book or in side notes, footnotes, or marked sections. In *House of Leaves* (Danielewski, 2000), an axial fiction, optional paths are found in footnotes that often span pages. In arborescent fictions such as the *Choose Your Own Adventure* book series (Chooseco, 2015), sections are ordered in a variety of ways including randomly (Swinehart, 2009). In encyclopedias, sections are ordered alphabetically. Network fiction authors such as Marc Saporta, author of *Composition No. 1* (Visual Editions, 2011), avoided ordering sections by publishing a book-in-a-box, a box of pages or pamphlets that can be read in any order.

2.2.2 Text Adventures

Text adventures, one of the earliest forms of digital, axial and arborescent fictions, appeared sometime in the 70s (Sadofsky, 2010). Unlike in other mediums where readers select from a discrete set of choices to advance in the story, readers of text adventures interact by typing free-form text after reading each section. Today, these non-linear books can be created with natural programming languages such as Inform 7 (Inform, 2014), distributed in one of several file types, and read using an application called an interpreter. Interpreters are available on all major platforms and even run in web browsers, making text adventures accessible to everyone.

2.2.3 Applications

Before the widespread use of the Internet, non-linear books were also published digitally as applications for Windows and Macintosh. Today's book applications target hand held devices and Linux, Macintosh, and Windows computers. Tools for creating these applications for non-programmers have existed since the late 80s (Bolter & Joyce, 1987) and have evolved into more advanced tools used today. With the variety of tools available and limitless possibilities, authors can create an application that gives their readers a unique experience while reading their book.

After their release in 1987 (Bolter & Joyce, 1987) (Phin, 2014), Storyspace (Eastgate Systems Inc., 2009) and Hypercard allowed authors to create digital, non-linear book applications. With Storyspace, a specialized application for creating non-linear books, authors could create separate pages for each section of text, connect them with hyperlinks, and then export the book as an application to their readers. Hypercard, a popular tool for creating applications for Macintosh computers, was also used to create interactive books.

Storyspace (Eastgate Systems Inc., 2009) and Hypercard (Phin, 2014) are no longer supported by modern operating systems but have been succeeded by tools like LiveCode (LiveCode Ltd., 2015). LiveCode claims to make programming applications for all major platforms easy and inexpensive for programmers and non-programmers. According to LiveCode, users can build software for multiple devices from one code base easily. This tool has been used to create non-linear book applications such as the interactive graphic novel *Midnight Rises*.

Most modern book applications are built by professional developers, typically for handheld devices. An application for *Composition No. 1* (Visual Editions, 2011) randomly selects pages for the user to read next. Coliloquy's (Coliloquy, 2014) work included applications for books like *Fluid* (Sentell, 2012), that displayed the sections of non-linear books separately. Chooseco (Chooseco, 2015) creates digital adaptations of the original CYOA series. Its applications provide users with a map of all the paths through the story for navigation.

A subset of applications known as visual novels are digital non-linear novels accompanied by images, animations, music, sounds, video, and sometimes even game-like elements. Arborescent fictions are the most common type of non-linear work in this medium, but axial fictions like *The 39 Steps* (The Story Mechanics, 2013) and network fictions like *Analogue: A Hate Story* (Love Conquers All Games, 2012) also exist. Many modern visual novels are made using tools like Ren'Py (Ren'Py, n.d.), a popular visual novel engine that makes programming, writing, and designing easy.

2.2.4   Websites
Since the early days of the Internet, publishing online has been a popular way to distribute non-linear books. Like applications, authors have the freedom to create a custom website for their book and the experience they want readers to have. Today, there are a variety of tools that authors can use. These include HTML for creating custom-built websites, Flash (Adobe Systems Incorporated, 2015) for creating custom-built applications, and a number of web-browser-based story engines.

Authors have used basic HTML and tools like Unity (Unity, 2015) and Flash (Adobe Systems Incorporated, 2015) to create customized interfaces for their non-linear books. Examples created primarily with HTML include network fictions like *253* (Ryman, 1996) and *These Waves of Girls* (Fisher, 2001) and *The Victorian Web* (Landow, 2014), a large, interconnected collection of documents on British Victorian economics, literature, philosophy, history, science, technology, and visual arts. Andy Campbell's work includes custom-built web applications such as the axial fiction *The Virtual Disappearance of Miriam* (Bedford & Campbell, 2000) created in Flash and the arborescent fiction *Inkubus* (Campbell & Wilks, 2014) created with the Unity game engine. Authors can still create a custom website for their book today and host it for free or very cheaply with a service like Neocities (Neocities, n.d.).

For authors who do not need a custom interface for their book, there are a variety of easy-to-use, online authoring tools. Inklewriter (Inkle, 2014), Choice of Games (Choice of Games LLC, 2015), and Infinite Story (Infinite-Story.com., 2015) are some examples of tools specifically for arborescent fictions, the most popular type of non-linear fiction. Twine (Klimas, n.d.) is a framework flexible enough for all types of non-linear writing.

Inklewriter (Inkle, 2014) is a web browser-based application for reading and writing arborescent fiction. With this tool, authors can easily write their story, create choices for readers to make, and program more complex logic such as checking ability points. Readers also view the book using Inklewriter, which doubles as an in-browser reader.

Choice of Games (Choice of Games LLC, 2015) has created a similar tool for arborescent fiction writers, but stories can be published to web applications or standalone applications for distribution on hand held devices. Authors write their book using Choice of Games' natural scripting language ChoiceScript. They can host their finished book on a website or submit it to Choice of Games for distribution as a standalone application.

Infinite Story (Infinite-Story.com., 2015) allows authors and readers to write and read arborescent fictions online. Story sections are written and displayed using simple HTML. Authors can create a complete story or allow their readers to add new paths to make an infinitely long and complex tale.

Finally, Twine (Klimas, n.d.) is an online editor for non-linear stories. Authors have a network interface where they can organize sections and see how they are connected together. Links are created by using special syntax within a passage's text. Multimedia elements are also supported. When finished, authors can export their story to an HTML file and host it on a site like Neocities (Neocities, n.d.).

2.2.5 E-Books

Less commonly, non-linear books have been published as e-books. The arborescent fiction *The Most Boring Book Ever Written* (Pitts & Kerkhoven, 2012) and the axial fiction *Fluid* (Sentell, 2012) are two examples. Similar to text adventures, e-books are distributed in one of several file types and read using an application called an e-reader. Like interpreters, e-readers are available on all major platforms, making e-books accessible to a wide audience. E-books are also similar to simple websites; most e-book file types are created with HTML. Mimicking the format of their physical counterparts, however, sections making up an e-book are ordered and viewed in a single document even if the e-book file contains several HTML files. Tools such as Sigil (Schember, 2015) and Calibre's e-book editor (Goyal, 2015) are available to assist authors in creating an e-book file that conforms to the standards required by all e-book distributors.

2.3 Current Problems

These mediums all have their strengths and weaknesses, and there is not a perfect solution. Table 1 summarizes the strengths and weaknesses of each. Depending on what medium is used, a non-linear book could be easy to create but difficult to advertise to potentially interested readers or easy to sell but inflexible in format. A common problem

that runs through all these mediums, however, is poor user interface design. This section goes into more detail about the challenges of each medium.

*Table 1: A summary of the strengths of mediums non-linear books are often published in. Entries marked with an * are debatable.*

	Books	Websites	Web Applications	Applications	Text Adventures	E-Books
Easy to Create	X	X		*	X	X
Easy to Distribute	X	X	X	*	X	X
Easy to Advertise	X					X
Easy to Sell	X			X	X	X
Flexible Format		X	X	X		
Supports Multimedia		X	X	X	*	*
Resistant Against Obsolescence	X	X	X		X	X

2.3.1   Books

When published in a physical medium, non-linear books require readers to do extra work to move forward in the book and keep track of where they have been, tasks that could be done by the computer in a digital medium. In linear books, readers only need to turn the page to advance and their progress is the same as the page number. In non-linear books, however, readers must manually find sections when prompted or as desired to advance and will likely not read sections in the order they appear in the book. It is up to readers to keep track of what they have read.

Arborescent fictions in particular also rely on the reader to follow the rules laid out in the book to advance through the narrative in a coherent way (Swinehart, 2009). Readers must turn to the pages specified after making decisions and be trusted to not cheat by ignoring decision points. In game books, readers must also keep track of items they have collected, ability points they have incurred, and sections they have visited and answer questions honestly based on what they have and where they have been.

2.3.2   Text Adventures

While text adventures share many of the strengths of e-books in terms of their accessibility, their writing style is much less flexible. Text adventures excel at describing objects and locations (Reed A. A., 2010). Successfully describing actions, thoughts, and dialog is more difficult. Experienced text adventure players also do not expect to see images or multimedia, and support for these features in interpreters is minimal or non-existent. There is also a high learning curve for new players (Reed A. A., 2010), and while it is possible to sell the files containing text adventures, they are difficult to classify and advertise to audiences outside the small text adventure community (Sadofsky, 2010).

2.3.3   Applications

An application can give readers a unique experience for a particular non-linear book, but these applications can be expensive to develop and difficult to create, advertise, and distribute. With the help of a developer or studio, custom-built book applications can cost as much as $25,000 (eBook Architects, 2015), which authors may not be able to pay for easily. An application created for one book usually must support multiple devices to reach a sufficiently large audience, but because of the cost of development, it is usually only feasible to support a subset of devices and platforms, which limits the author's audience and reader choice.

Creating the application is further complicated if it targets handheld or e-reader devices. These devices vary so much in hardware, capabilities, and software standards that an e-book application may need to be modified or even rebuilt to fulfill the requirements of each device. These applications for one book can be very different between devices (Costanzo, 2014) (T. Sentell, personal communication, February 26, 2015). Custom-designed features may not even be possible on some devices, which can leave readers disappointed. In addition, handheld devices are evolving so quickly that they can disappear in as little as two years (LondonBookFairVideo, 2011). Experimental and non-linear book applications themselves have also been known to disappear within the same time frame as they become outdated, are discarded as failed experiments, or their creators go out of business. Simon & Schuster's vook (Simon & Schuster, n.d.) experiments and Coliloquy's (Coliloquy, 2014) entire catalog of enhanced e-books and e-book applications are some examples.

Choice of Games (Choice of Games LLC, 2015) and LiveCode (LiveCode Ltd., 2015) offer potential solutions to these problems, but they do not solve all of them. While LiveCode claims to make development easy, it does not appear to support any e-reader devices by default, which potentially interested readers of electronic books are likely to have. Choice of Games can publish an arborescent fiction to several devices, but their system is not flexible enough for other types of non-linear fiction where links appear in more places than at the end of sections.

These solutions also do not solve the problem of how e-book applications are advertised. Once a book becomes an application, it is sold through App Stores instead of through e-book distributors. In an App Store, book applications compete with games, general applications, and e-reader software instead of with other books (eBook Architects, 2015). Some stores can narrow searches to "Book" applications, but this classification is also used for e-readers, e-book library organizers, and other book-related applications. Further narrowing browsing results to genres is extremely limited or unavailable.

Unlike other book applications, visual novels are often classified as and sold alongside video games (Love Conquers All Games, 2012) (The Story Mechanics, 2013) (Ren'Py, n.d.), but their anticipated format is not suitable for all types of non-linear writing. Multimedia is required and expected to be presented in a particular way.

2.3.4   Websites

Non-linear books published as websites can reach a large audience, anyone with a web browser and any required plugins, but advertising those websites and selling their content is difficult. If authors would like to sell their non-linear book, they will need to secure its website against unauthorized individuals and maintain it themselves. Platforms for selling books published as websites do not appear to exist. Whether the author sells their website or not, the book will likely only be known to the small group of readers. Websites promoting non-linear and experimental digital books such as the Electronic Literature Organization (Electronic Literature Organization, 2015) are only known to the small group of electronic literature enthusiasts. Twine (Klimas, n.d.), Inklewriter (Inkle, 2014), Choice of Games (Choice of Games LLC, 2015), and Infinite Story (Infinite-Story.com., 2015) each have a collection of stories written in each system, but there do not appear to be any websites aggregating stories between systems. Overall, most people do not know that non-linear books published as websites exist, and even if these websites are found, they may not be recognized as a book (Pope, 2007).

2.3.5   E-Books

The simplest way to get non-linear, electronic books in front of potentially interested, avid readers would be to publish them in a well-known format for books, namely e-books, but this option has serious limitations as well. Standard e-readers do not improve upon the interface of physical books when used for displaying non-linear content. The reader is still responsible for keeping track of their position and progress but in a digital medium that could take care of these tasks for them.

While e-readers communicate the reader's overall position in the text, they do not indicate the reader's position in the narrative. In an arborescent fiction, for example, readers can simultaneously be in the middle of the e-book's text and at the end of a path through the story. The interface only communicates that readers are in the middle of the text, which does not reflect their position at an ending in the narrative nor does it show what choices the reader made to arrive at that location. Readers also do not know from the interface how much of the work has been consumed because their current position is not the same as the number of pages they have read as with linear texts.

E-readers also do not take advantage of the unique way digital mediums can display and connect non-linear content, which can be unintuitive for the reader and can negate the author's intent. When the sections composing the e-book are displayed in a single linear document, this wrongfully suggests that they can be read in a linear order. A long document of non-sequential or unrelated sections of text and images can also be confusing or intimidating to frequent Internet users, who are used to reading content in shorter, hypertext documents.

Finally, while some types of e-book files support embedded media such as video, audio, animations, and applications, e-readers that can display these files and distributors who will distribute them is very limited (eBook Architects, 2015). Apple's iBook's platform has the best support in both distributing enhanced e-book files and providing e-reader devices that support them, but support in other e-reader software and devices is spotty.

Embedding video and audio in an e-book can also make the file cumbersomely large for readers to download. For authors interested in merging media elements with text, e-books are less attractive for these reasons.

2.3.6 Unintuitive Interfaces

In digital mediums, the interfaces for non-linear books are often as important as the book's content for readers to enjoy the book and comprehend it. In a study conducted by James Pope (Pope), avid readers of traditional fiction were observed reading hyperfictions, a term typically associated with digital network and axial fictions. Pope reported that readers were frustrated by unintuitive, uninformative, and cluttered interfaces. Hyperfiction interfaces were non-standard compared to the interfaces of similar forms of entertainment such as games or websites. Readers also had difficulty determining their position in the overall text and in the narrative. When readers did not understand where they were in one or both of these dimensions, Pope found that they usually felt confused, lost, and unable to summarize the book. The interfaces also lacked tools that helped readers determine their progress through the text, navigate to any section at any time, and avoid sections they had already read.

With Pope's theories in mind, text adventures, applications, websites, and e-readers all frequently present readers with unintuitive, unappealing, or uninformative interfaces that can hinder the reader's ability to enjoy and comprehend the book. While the stories they tell usually have simple arborescent or axial structures, the interfaces for text adventures are known to be alien and difficult for new users to learn (Reed A. A., 2010). With applications and websites, authors have complete control over how their book looks, and there are few conventions or user studies to guide how the interface for a non-linear book should look or behave (Pope, 2007). This opens the possibility that authors will create an interface that makes their book unusable or unattractive, a possibility that Pope believes happens frequently and is likely a factor in the unpopularity of electronic literature. Finally, e-readers are familiar to most people, but when used to display non-linear books, they do not convey the user's position in the narrative or progress.

As an example, Figure 1 shows a screenshot from a section of *These Waves of Girls* (Fisher, 2001), a hyperfiction published as a website that was used in Pope's study. This section alone has fourteen outgoing hyperlinks. The interface shows no information about how the user arrived at this section, how long the book is, or how much of it the user has read. The only tools users have to track their progress and navigate are those provided by their web browser. These include the Back and Forward buttons and the browsing history. With such little information, limited tools, and the high number of links, users easily lose track of their position and progress in the text and the narrative.
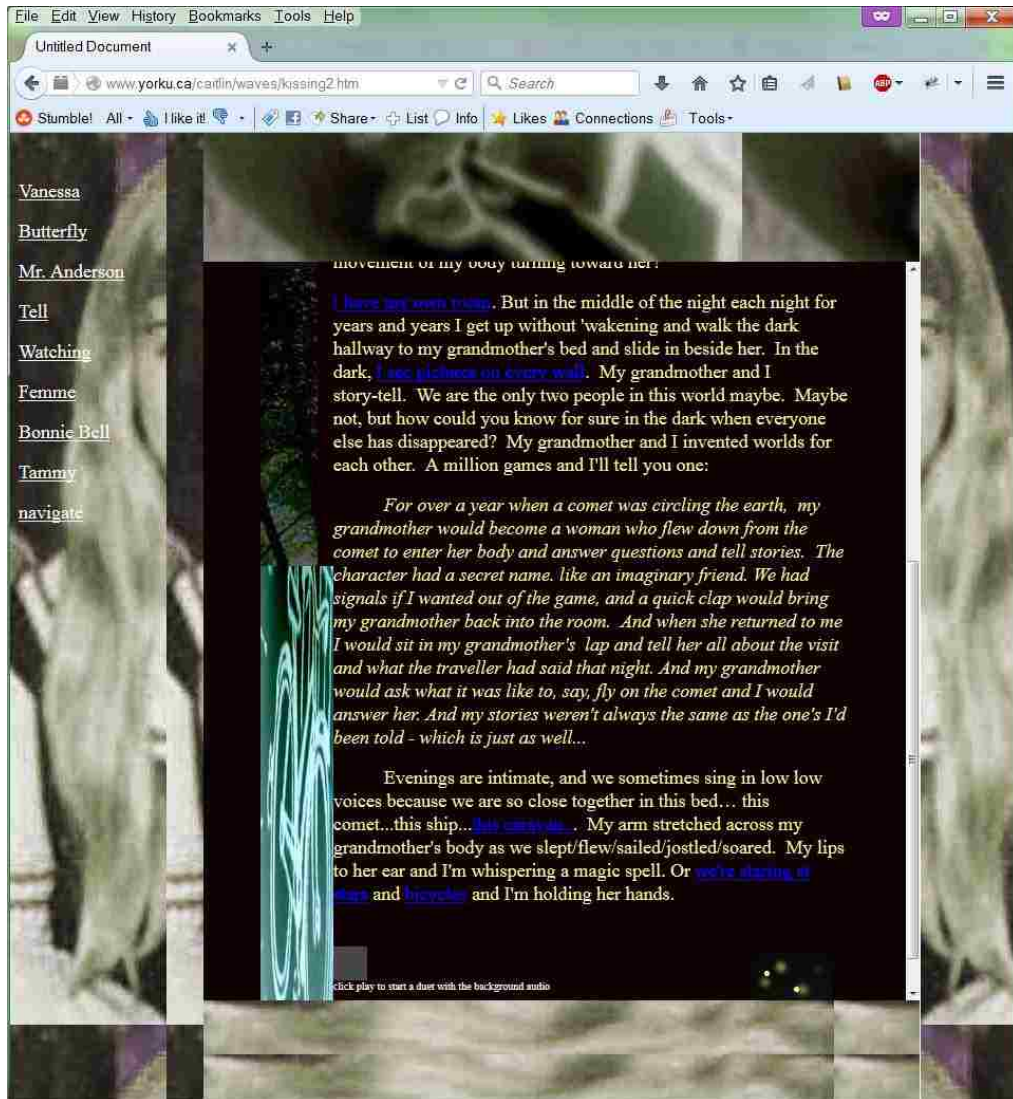
Figure 1: A screenshot from a section of These Waves of Girls (Fisher, 2001).

3 Adventurous Reader

The Adventurous Reader prototype was developed to solve many of the problems associated with digitally publishing non-linear texts by leveraging the strengths of the e-book format and displaying non-linear books in a novel interface. Adventurous Reader separates the e-book into sections as specified by the author and ensures that users have adequate navigational tools and positional information. In doing this, it shows the viability and strengths of using e-books for non-linear texts.

Rather than developing a brand new e-reader, the prototype was built as an extension of Calibre (Goyal, 2015). While Calibre is a popular, open-source e-book reader, converter, editor, and library organizer, it has many of the same problems in displaying non-linear text as other e-readers. In particular, it displays e-book files linearly, lists the table of

contents in an ordered hierarchy, and does not adequately convey the reader's position or progress through the text.
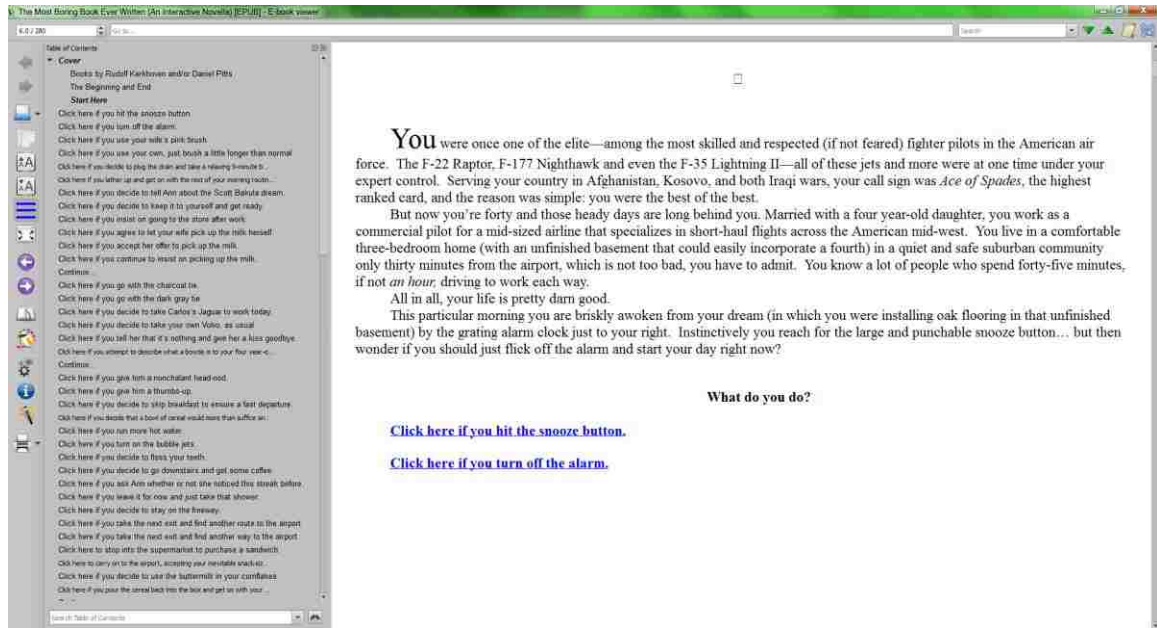
Figure 2: The Most Boring Book Ever Written (Pitts & Kerkhoven, 2012) shown in Calibre (Goyal, 2015).
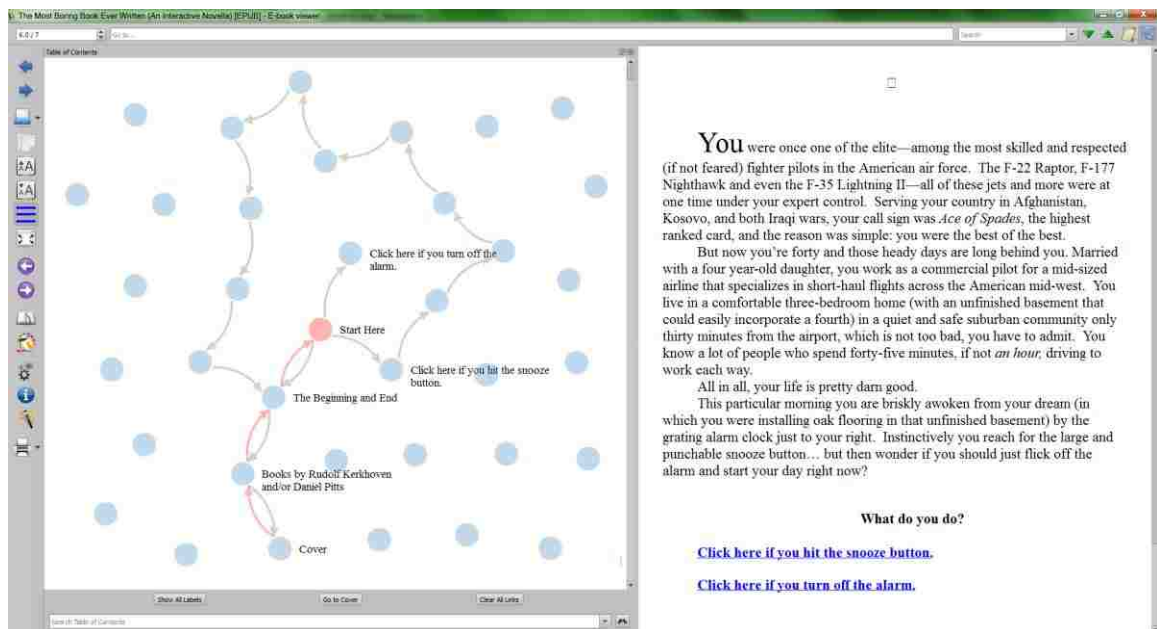
Figure 3: The Most Boring Book Ever Written (Pitts & Kerkhoven, 2012) shown in Adventurous Reader.

To demonstrate, Figure 2 shows part of a pick-a-path book as it would appear in Calibre (Goyal, 2015). The table of contents on the left lists all the sections in the book. Readers can click an entry to jump to the beginning of the corresponding section in the e-book's text, displayed on the right, or they can use the scrollbar on the far right to scroll through the text linearly. If readers start at "Cover" and scroll down until they reach the end of the

book, they would visit every section, many of which are meant to be alternative paths through the text. Displaying the book in this way is misleading because it suggests that readers can "take Carlos's Jaguar to work today" and also "take your own Volvo, as usual" (Pitts & Kerkhoven, 2012) in a single reading. Such a sequential reading is in direct contrast to the purpose of non-linear texts, but the interface unnecessarily suggests that it can be read in that way. In addition, the progress indicator in the upper left shows readers their current position and the total number of pages in the e-book, but this is not a true indicator of progress because the text will likely not be read in order.

Calibre (Goyal, 2015) does, however, provide many of the benefits that make distribution through e-books convenient for authors and readers of linear texts. First, Calibre defines an interface with navigational tools, positional information, and a default text and background appearance for all e-books. This means that authors can focus on writing and creating hyperlinks and less on interface design, which they may not have expertise in. Second, Calibre can display and convert many e-book file types, meaning that authors can distribute their e-books in multiple formats and through multiple distributors with assurance that their readers can view them in Calibre. Finally, Calibre is accessible to most readers as it supports Windows, Macintosh, and Linux computers.

Adventurous Reader's modifications to Calibre (Goyal, 2015) preserve its benefits while providing a custom interface for non-linear texts. First, the sections of the book specified by the author are displayed separately, as if they were webpages composing a website. Referring to Figure 2, Adventurous Reader would treat "Cover" to "Start Here" as a single webpage and all sections after that as separate webpages. Readers scroll through the text composing the current webpage using the scrollbar on the far right. In juxtaposition, Calibre treats the entire book as a single webpage that users scroll through.

Second, the table of contents in Adventurous Reader is displayed as a network of nodes instead of a listed hierarchy. With this interface choice, readers can determine how they got to their current position from the beginning of the book. For ease of comparison, Figure 3 shows Adventurous Reader's display of the same e-book shown in Calibre (Goyal, 2015) in Figure 2. The red links in Adventurous Reader's network show how readers got to their current position "Start Here" from "Cover" while Calibre's table of contents only highlights the readers' current position. How readers arrived at their current location becomes less obvious as they progress.

Presenting readers with the dozens or hundreds of sections making up a non-linear book all at once can be overwhelming. To reduce this clutter, by default, Adventurous Reader only labels a subset of nodes with the titles of their corresponding sections. Labeled nodes are either on the path the reader has most recently taken or linked to the node that the reader is currently viewing. Readers can hold their mouse over a node to view its label and the labels of any nodes connected to it. The Show All Labels toggle button under the network viewer will make all labels visible. At any time, users can click a node to navigate to that section in the text.
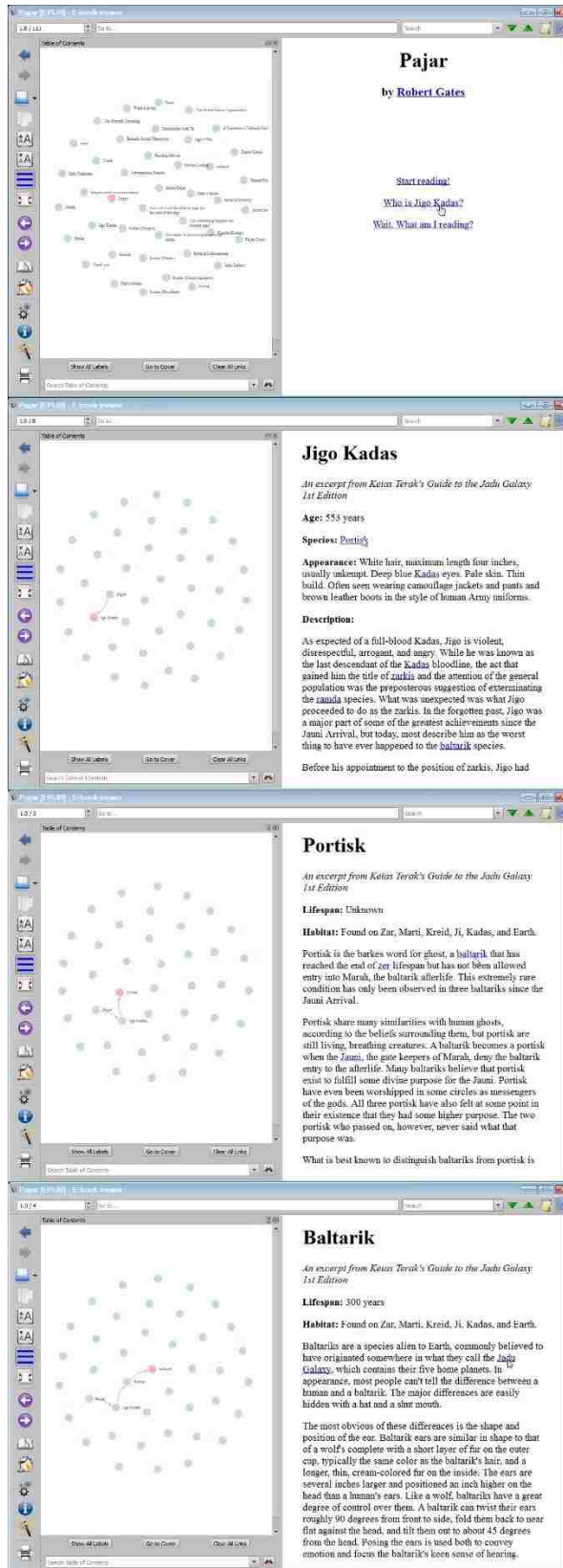
Figure 4: A series of screenshots demonstrating how links are added to the network of Pajar (Gates, 2015) as the user clicks hyperlinks between sections in the text.

The Adventurous Reader network also helps readers find paths they have not tried before and gives them a sense of their progress through the book. When readers open an e-book for the first time, nodes in the network are generated for every section of the book, but no links are created between them. As the user navigates from section to section using hyperlinks in the text, directed links are added between the corresponding nodes in the network. The resulting map is saved between reading sessions. In Figure 3, the red links show the path followed from the beginning of the book to the user's current position while the gray links show previous paths the reader has followed. With this information, users can avoid paths they have already explored, and by noting the absence of links to nodes, estimate how much of the book they have left to read.

Figure 4 shows an example of how links are added to the network. From the top to the bottom image, the first screenshot shows a view of a network when the e-book *Pajar* (Gates, 2015) is first opened and no links connect nodes together. In the next image, a link is created from "Pajar," the first section of the book, to "Jigo Kadas" when the "Who is Jigo Kadas?" hyperlink is clicked. Similarly, a link is added from "Jigo Kadas" to "Portisk" when the associated hyperlink is clicked in the "Jigo Kadas" section. Finally, a link from "Portisk" to "Baltarik" is added when the corresponding hyperlink is clicked. This process continues as the reader explores the text.

3.1 Detailed Description

The following sub-sections go into more detail about how to use Adventurous Reader's and Calibre's (Goyal, 2015) provided functions.

3.1.1 Interface Buttons and Functions

Figure 5 labels all of the major buttons, functions and interface elements in Adventurous Reader. In addition to these functions, users can also resize the application by clicking and dragging the edges of the window or clicking the Maximize button in the upper right. Many of these functions are inherited from Calibre's interface, but the Show All Labels, Go to Cover, Clear All Links, and Interface Toggle buttons are new features. This section goes into more detail about what each function is and how to use them.
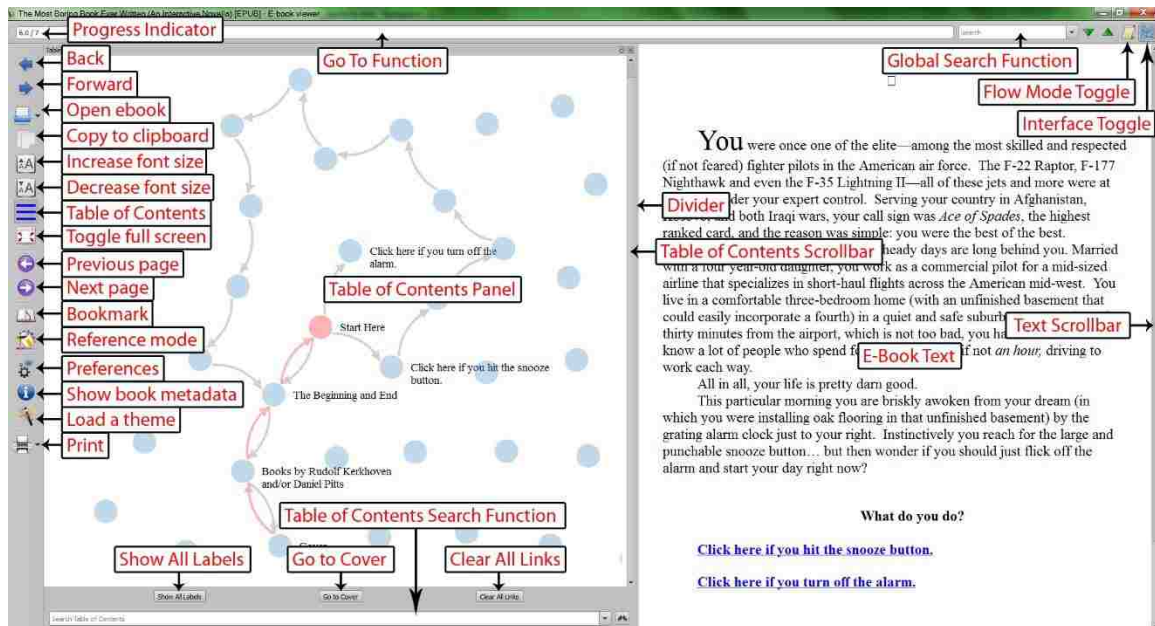
Figure 5: A screenshot of Adventurous Reader labeling its major buttons, functions, and interface elements.

- **Back** – This button returns the user to the previous location in their history. That is, after users click a hyperlink to a new position in the e-book, the Back button returns them to the position of the last hyperlink they clicked. It is very similar to the Back button in a web browser.
- **Forward** – This button sends users to the next location in their history akin to the Forward button in a web browser.
- **Open ebook** – This button opens an open file dialog where users select an e-book from their file system to open in the application. Clicking the black arrow next to the button reveals a drop-down list of recently opened e-books.
- **Copy to clipboard** – After selecting text in the e-book, users can click this button to copy it to their computer's clipboard.
- **Increase font size** – This button increases the size of the e-book's font.
- **Decrease font size** – This button decreases the size of the e-book's font.
- **Table of Contents** – This is a toggle button that opens and closes the table of contents panel. In Calibre, this panel contains a hierarchical list of all the sections in the e-book as shown in Figure 2. In Adventurous Reader, this panel contains a network of nodes as shown in Figure 3. Figure 8 shows what the application looks like when the table of contents is open and closed.
- **Toggle full screen** – Clicking this button displays the text of the e-book and the table of contents in full screen mode. As shown in Figure 6, most of the functions in the interface are hidden and the application takes up the entire screen.
- **Previous page** – Move to the previous page of text if a previous page exists.
- **Next page** – Move to the next page of text if a next page exists.
- **Bookmark** – This menu button allows users to save their current location to a list of bookmarks, go to the position of a bookmark, or open the bookmark manager.

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- **Reference mode** – When this button is toggled, users can hover their mouse over a paragraph to get its reference number.
- **Preferences** – This button opens a menu where users can define how the e-book's text looks and various properties and behaviors of the e-book viewer application.
- **Show book metadata** – When this button is toggled, metadata about the open e-book such as where it was published and its title is overlaid on the e-book's text.
- **Load a theme** – This toggle button allows users to switch between themes, which define how the e-book viewer and the e-book text look and behave.
- **Print** – This button opens a menu that provides users with the ability to print or export the e-book.
- **Progress Indicator** – In Calibre's interface, this shows the user's current position over the total number of pages in the book. In Adventurous Reader's interface, the user's current position in relation to the beginning of the section over the total number of pages in the section is displayed.
- **Go To Function** – To use this function, users type the reference number for a paragraph into the Go To function text box to jump to that position in the e-book.
- **Global Search Function** – Users can search for text in the entire e-book by typing a search term into the Global Search's text box. Users can find the next occurrence of a search term by clicking the green down arrow next to the text box. The green up arrow next to that finds the previous occurrence of the search term. Users can also click the dropdown arrow connected to the text box to browse through previous searches.
- **Flow Mode Toggle** – When this toggle button is depressed, users scroll through the text page-by-page as opposed to line-by-line. That is, when the user scrolls the text, it will shift by an entire page rather than a few lines. When the toggle button is pressed, the text will shift by a few lines at a time when scrolled.
- **Interface Toggle** – This button allows users to switch between Calibre's interface and Adventurous Reader's interface.
- **Show All Labels** – When this button is depressed, only the labels of the nodes on the users' current path and the nodes connected to the users' current position are displayed by default. When pressed, the labels of all the nodes are displayed.
- **Go to Cover** – Users can click this button to return to the first page, usually the cover, of the e-book.
- **Clear All Links** – This button clears all of the links in the network.
- **Table of Contents Search Function** – With this function, users can search for text in the titles of the e-book's sections. Users click the button to the right of the text box to loop through the sections that contain the search terms. Users can also browse through previous searches by clicking the dropdown arrow connected to the text box. This control existed in Calibre's table of contents panel and was adapted to work with the network interface in Adventurous Reader.
- **Divider** – When the table of contents panel is open, an area to the right of the table of contents scrollbar can be clicked and dragged to resize the panel. Figure 7 demonstrates this action.

- **Table of Contents Scrollbar** – In Calibre's interface, this scrollbar allows users to scroll through the e-book's hierarchical list of sections as shown in Figure 2. In Adventurous Reader, this scrollbar is a quirk of the interface.
- **Text Scrollbar** – This scrollbar is used to scroll through the text of the e-book.
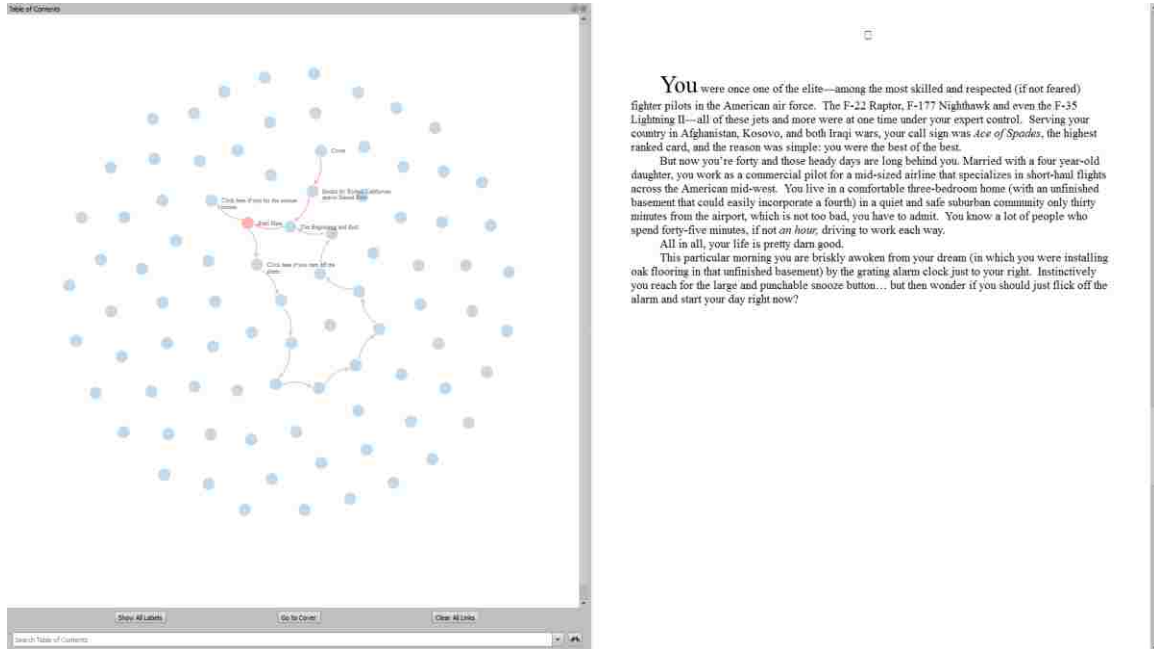
Figure 6: An example of what Adventurous Reader looks like in full screen mode.
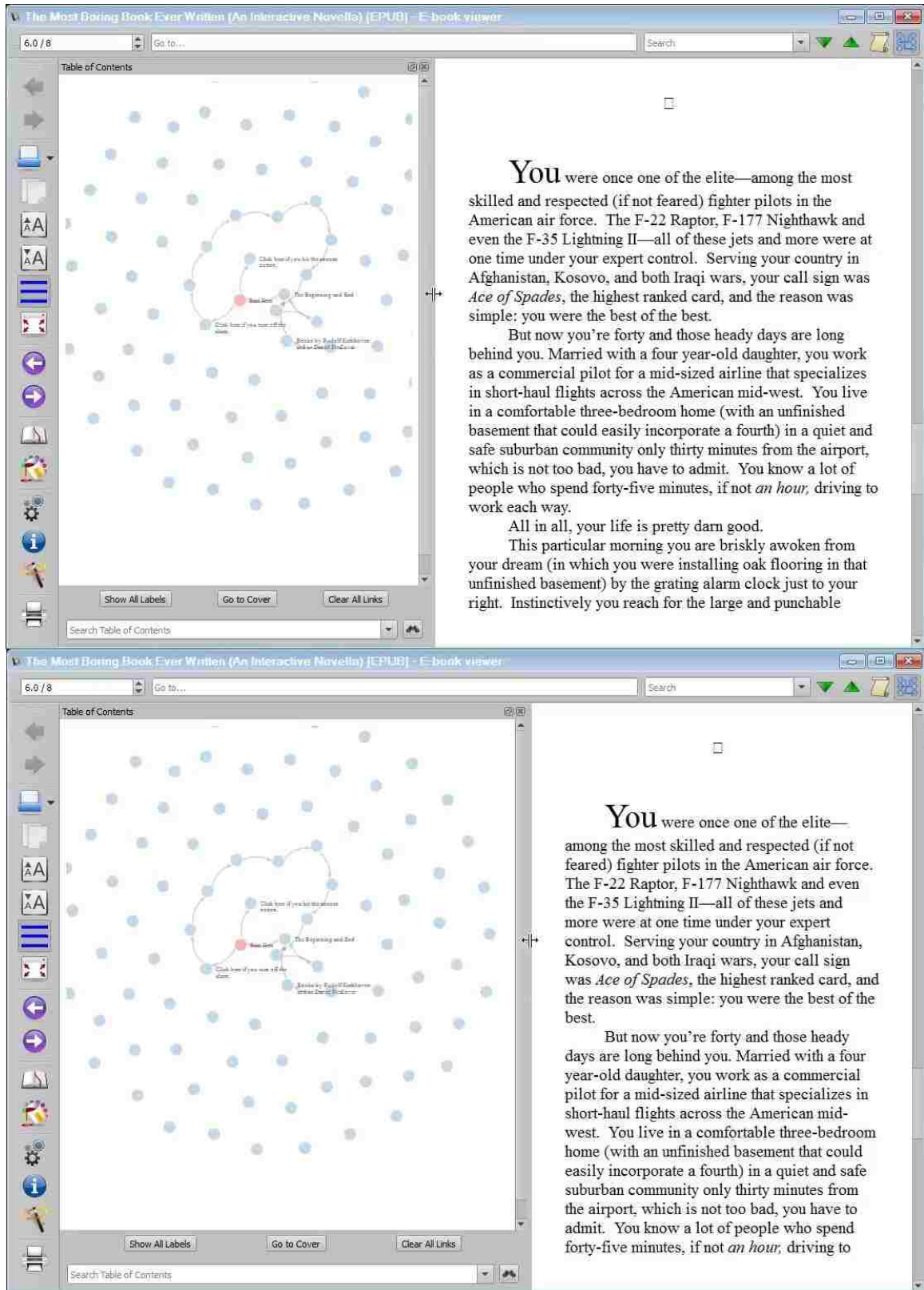
Figure 7: Users can resize the table of contents panel by clicking and dragging the divider between it and the text.
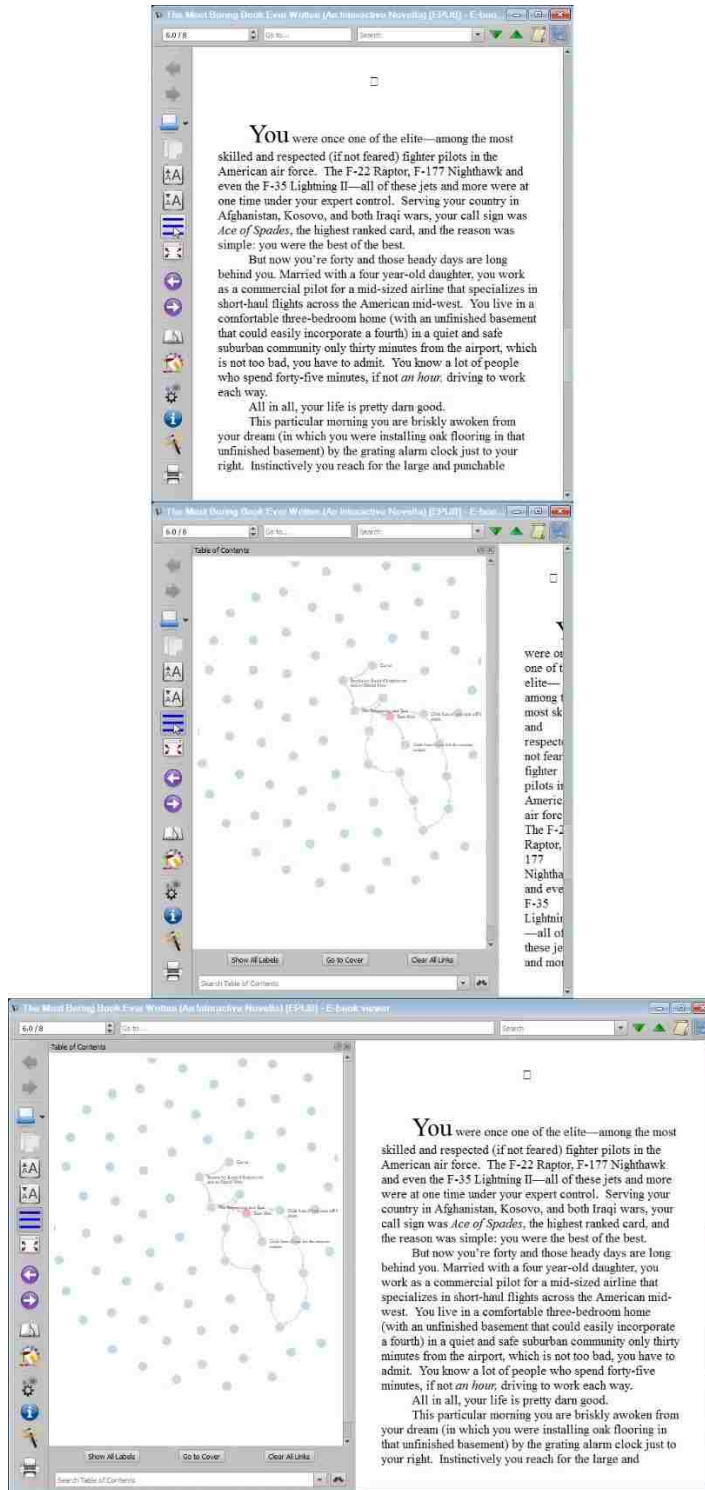
Figure 8: A demonstration of how to open the table of contents and resize the application to view the text and the map side-by-side. In the top-most image, the window is at its default size. In the center image, the table of contents has been opened by clicking the Table of Contents button. In the bottom image, the application has been resized by clicking and dragging the edge of the window.

3.1.2 Network Interface Functions

The network interface provides several more functions for adjusting the view of the network or navigating between sections in the text. Users can pan their view of the network by clicking and dragging the background as shown in Figure 9. They can also scale the network by hovering the mouse pointer over the background and using the mouse wheel as shown in Figure 10. While nodes are placed automatically using a force-directed layout, users can drag and drop nodes manually as demonstrated in Figure 11. Double-clicking a node that has been placed in such a way frees it to move again by the force-directed layout. Hovering the mouse over any node will display its label and the labels of the nodes connected to it also shown in Figure 11. Finally, users can click any node to view the corresponding section in the book as shown in Figure 12.
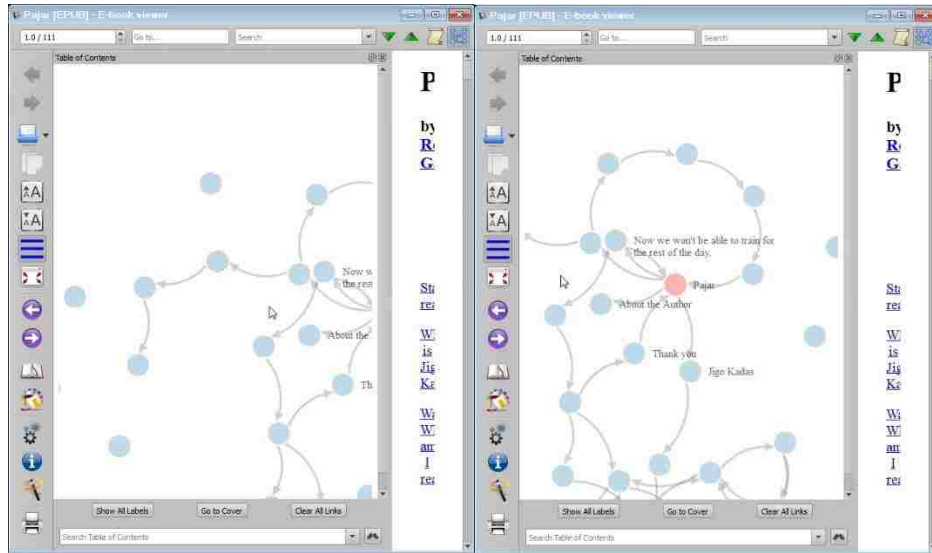
Figure 9: Users can pan their view of the network by clicking and dragging the background.
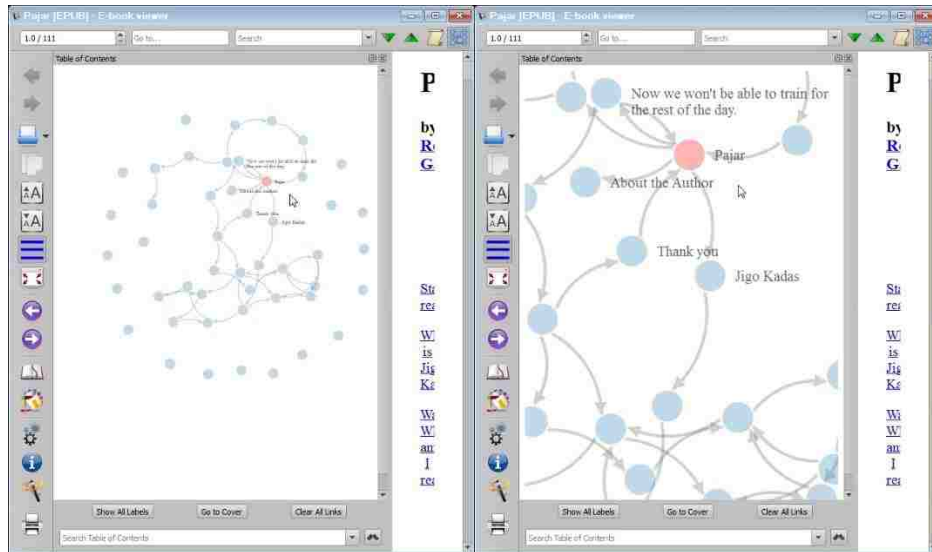
Figure 10: Users can scale the network by hovering the mouse over the background and scrolling the mouse wheel.

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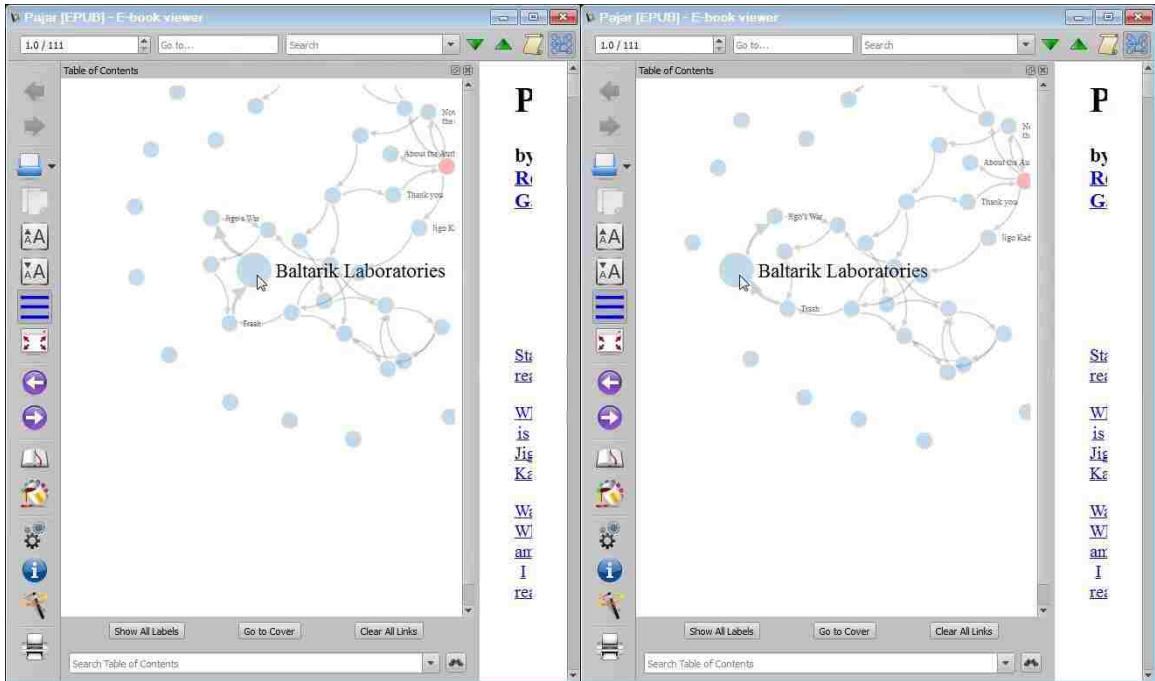
Figure 11: Users can click and drag nodes to position them manually.
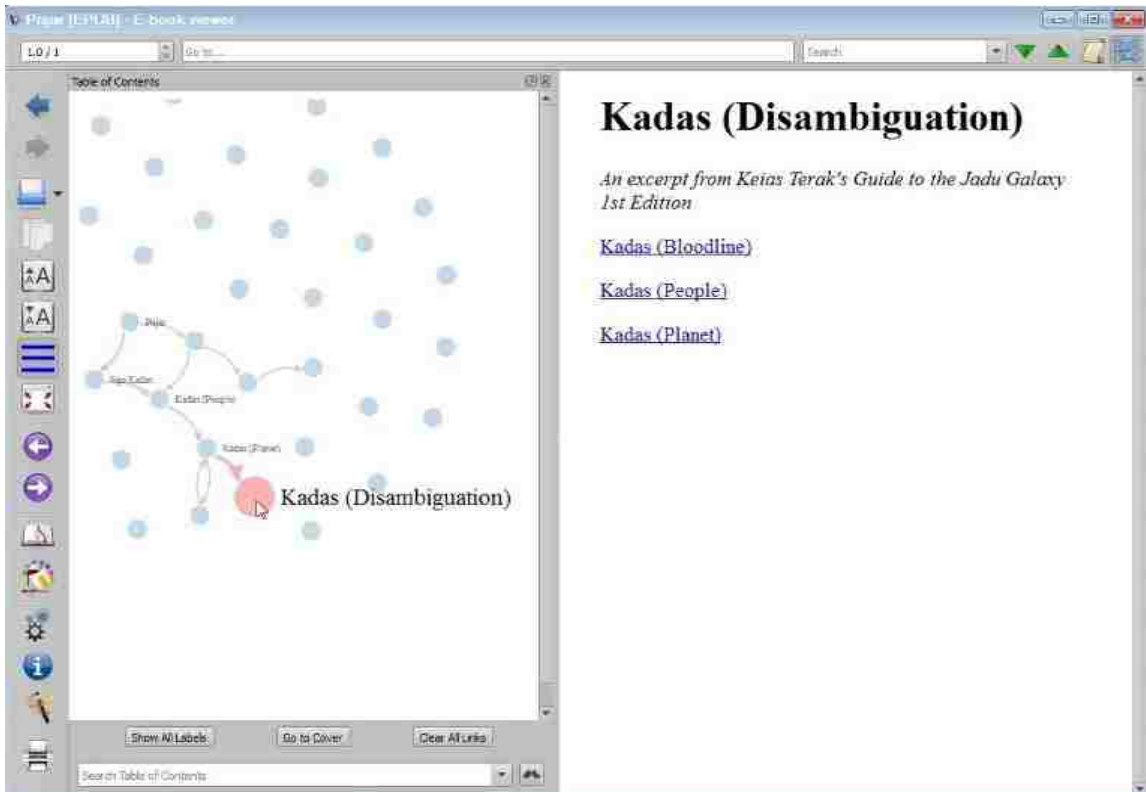
Figure 12: Users can click any node to view the corresponding section in the text.

3.2 Implementation

Creating Adventurous Reader required integrating Python, Javascript, and HTML using the D3, PyQt, and Networkx libraries. Adventurous Reader is built as a modification of Calibre's (Goyal, 2015) e-book viewer, which is written primarily in Python and Javascript. The interface was designed using PyQt. Adventurous Reader's network interface was written in Javascript and HTML with the D3 library. The Networkx and PyQt libraries were used to pass data between the Python and Javascript components of the network interface. To generate the network, the spine and table of contents data e-book files contain is used in a non-standard way.

3.2.1   Network Interface

The primary modification Adventurous Reader makes to Calibre is the addition of its network interface. PyQt's hierarchical controls provided in Calibre's e-book viewer were replaced with a web browser control. Adventurous Reader's network is implemented in an HTML file displayed in this web browser. The network is an HTML5 SVG element, which was designed and programmed using the D3 Javascript library.

In Python, nodes and links are stored in an object defined by the Networkx library, which is converted to JSON when needed. To save the user's progress, this JSON data is saved to a file when the user closes the e-book viewer. It is also passed to the Javascript application containing the network every time a new link is added or the network is regenerated. Using this passed data, D3 generates a new force-directed network. Communications to and from the Javascript application are made using PyQt.

In the network, a path of links from the first section of the book to the user's current position is always colored if a path exists. This path is found using the user's history and a shortest distance search. The history is a list of positions that the user has visited since opening the e-book. A position is added every time the user clicks a hyperlink that leads to another position in the book. The user can jump between these positions using Back and Forward buttons. In this way, the history in an e-reader is very similar to the history found in a web browser. Links connecting a series of nodes in the user's history to the user's current position are always colored unless those links create a loop. If a loop is created, then only links from the user's current position to the node starting and ending the loop are colored. If this search ends before the first section of the book is found, the remaining links are colored using a shortest distance search from the last node found to the first section of the book. If a path does not exist, then no links are colored.

Node labels are visible based on what path is highlighted and how many links are in the network. The labels of all the nodes on the highlighted path are visible. In addition, the node containing the user's current position is also highlighted and the labels of the nodes connected to it are visible. The rest of the node labels are hidden. If there are no links in the network, then all labels are visible.

3.2.2   Calibre Integration

Modifications to Calibre's e-book viewer were not limited to the addition of the network interface. Adventurous Reader also displays the sections of the e-book as if they were

separate documents. In an effort to make the code easy to integrate into the Calibre code repository, additional efforts were made to make switching between Calibre's and Adventurous Reader's views simple for users and programmers. Two files from Calibre's source code were modified to incorporate these new classes and changes to the interface.

There are two major modifications that Adventurous Reader makes to Calibre's default behavior: it displays sections of the book differently and it displays the table of contents differently. Thus, two class hierarchies were created to encapsulate these differing behaviors: a `TOCContainer` hierarchy and a `BaseBehavior` hierarchy. Classes extending `TOCContainer` define how the table of contents should be displayed. `TreeTOCContainer` defines Calibre's default table of contents interface. `NetworkTOCContainer` defines Adventurous Reader's network interface.

Classes extending `BaseBehavior` define the behavior of the scrollbar and page numbers. `CalibreBehavior` extends `BaseBehavior` and specifies that the interface allow readers to scroll freely between all sections of the book. `AdventurousBehavior` specifies that the interface only allow the user to scroll through the current section. The maximum number of pages is also set to the maximum number of pages in the section and the current page number is set relative to the beginning of the section instead of relative to the beginning of the book. In this way, Adventurous Reader does not actually split any files. It only limits the range of the scrollbar and modifies the total and current page numbers displayed.

`BaseBehavior` and `TOCContainer` classes can be used in any combination. To keep track of which combination is in use, a `BehaviorManager` class was created. This class stores and updates a `BaseBehavior` and `TOCContainer` class to use for viewing an e-book. A `SwitchBehaviorManager`, which extends `BehaviorManager`, was also created. This class stores two pairs of `BaseBehavior` and `TOCContainer` objects and specifies a toggle button in the interface to use to toggle between which pair is in use.

`BehaviorManagerBuilder` defines the `BehaviorManager` to use for each e-book. The `BehaviorManager` that should be created when possible is specified in the code, but if an e-book is not open or the open e-book does not have a table of contents, then Calibre's default behaviors are always used in lieu of this specified `BehaviorManager`. This is because Adventurous Reader relies on the table of contents data more heavily than Calibre does and is not useful without it.

3.2.3 E-Book Table of Contents

In order to determine how to split an e-book into sections, Adventurous Reader uses the open e-book's table of contents and spine data in a non-standard way. These data are defined by the author or publisher.

The table of contents is a hierarchical listing of the e-book's sections, not unlike the table of contents found in textbooks. This data is used by Calibre, and other e-readers, to generate a table of contents interface. Calibre's interface allows users to view all the sections of the book in a hierarchy and to navigate between those sections by clicking an entry. In Adventurous Reader, one node is added to the network interface for each unique entry in the table of contents.

The spine data is a list of all the HTML files compressed in the e-book file. This list determines the order in which files should be displayed when the e-book is rendered as a continuous document.

The table of contents data and the spine data do not need to correspond in any particular way. Multiple entries in the table of contents can refer to a single entry in the spine, an entry in the spine may not appear in the table of contents, and table of contents entries may appear in a different order than they appear in the spine.

1. Part 1
   a. Part 2
      i. Part 3
2. Ending 1
3. Ending 2
4. Side Note 1
5. Side Note 2
6. Side Note 3

Figure 13: Example table of contents data.
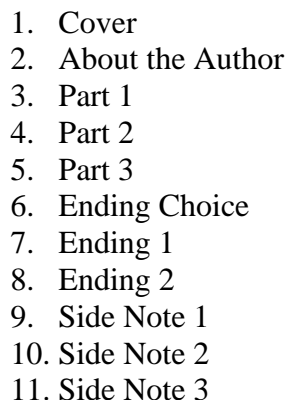
1. Cover
2. About the Author
3. Part 1
4. Part 2
5. Part 3
6. Ending Choice
7. Ending 1
8. Ending 2
9. Side Note 1
10. Side Note 2
11. Side Note 3

Figure 14: Example spine data.

Adventurous Reader uses the hierarchical data and the spine to determine how to separate the book into sections. This is best explained with an example. Figure 13 and Figure 14 show the table of contents and spine of an example e-book. This e-book is an axial fiction where Part 1, Part 2, and Part 3 are meant to be read linearly. Part 3 ends with a decision point where the user can choose between one of two endings. In addition, Part 1 contains a link to Side Note 1, Part 2 contains a link to Side Note 2, and Part 3 contains a link to Side Note 3. The book also has HTML files with a cover and an About the Author section, which appear before Part 1.

This e-book would be displayed in six sections. The first section contains the Cover, About the Author, Part 1, Part 2, Part 3, and Ending Choice HTML files. The remaining files are each displayed in their own section. The first five files are grouped together for several reasons. First, Part 2 is grouped with Part 1 because it is a sub-section of Part 1. Part 3 is also included in the group because it is a sub-section of Part 2, which is a sub-section of Part 1. Next, because Ending Choice does not appear in the table of contents, it is grouped with the nearest previous HTML file that does appear in the table of contents. Finally, because Cover and About the Author do not have table of contents entries and

are the first files in the book, they are grouped with the first file that is in the table of contents, which is Part 1.

In the network, links would be created from Part 1 to Side Note 1, Part 2 to Side Note 2, and Part 3 to Side Note 3 when the user clicks the hyperlinks connecting the Parts to the Side Notes. As the user scrolls from Cover to Ending Choice, links would also be created from Part 1 to Part 2 and from Part 2 to Part 3. Finally, when the user selects the choices from the Ending Choice file, links would be added from Part 3 to Ending 1 and from Part 3 to Ending 2. These links begin at Part 3 because Ending Choice is grouped with it.

In this way, authors and publishers can define sections composed of multiple files if desired. Those files can have nodes by making them sub-sections or not by excluding them from the table of contents and placing them where desired in the spine.

4 Research Questions and Hypothesis

Average readers need to have an intuitive and informative interface to use while navigating non-linear digital content in order to have a pleasant experience with the author's work (Pope, 2007). **This research asserts that Adventurous Reader provides users with their position in the context of the narrative and the overall text to reduce feelings of disorientation while reading non-linear e-books.** User testing sought to supply evidence to support or refute this claim and also test if the interface was intuitive at a basic level. In this research, "intuitive" refers to the ease with which users can find buttons and functions and understand how they work. The hypothesis was examined with the following research questions:

Research Questions
1. Do users understand their position in the narrative?
2. Do users understand the relationship between the e-book's text and the network?
3. Can users estimate their progress through the e-book from the network?
4. Do users understand how to advance through the text?
5. Do users experience less disorientation in Adventurous Reader than in Calibre?

In addition, Adventurous Reader's basic usability was explored by answering the following usability questions:

Usability Questions
1. Can users find buttons and functions when needed?
2. Can users find specific nodes when prompted?

This section explains these questions and their expected results in more detail.

4.1 Research Questions
1. Do users understand their position in the narrative?
A path from the first section of the book to the user's current position is always highlighted in red in the map, and the node containing the user's position is also

highlighted. Users should be able to understand that this highlighting shows how they arrived at their current position in the narrative. They should also be able to interpret what this position means in the context of the book.

2. **Do users understand the relationship between the e-book's text and the network?**

The network interface is a visual representation of the structure of the e-book where nodes represent sections of text and links represent hyperlinks and other types of connections between sections. Users will need to understand this relationship in order to see that their position shown in the network is also their position in the narrative and that the network shows their progress through the e-book. They should also understand what text is contained in a section.

3. **Can users estimate their progress through the e-book from the network?**

In the network, connected nodes represent sections the user has visited and disconnected nodes represent sections that the user has not visited yet, assuming that there is at least one connection to or from every section in the book's text. After reading several sections of the book and noting this information in the network, users should be able to estimate how much of the e-book they have read, how much they have left to read, and how long the book is in total.

4. **Do users understand how to advance through the text?**

Users are presented with the paradigm that they will be reading an e-book where traditionally users advance by turning pages or navigating between anchor points in a long document. In Adventurous Reader, however, users are required to click hyperlinks in order to advance between separated sections of text. These users will likely be frequent Internet users, and so should be able to adapt to this requirement easily. To advance through the overall text, users also need an understanding of what they have already read and what is left to read. Users should be able to see this information in the network to avoid paths that they have already followed and find new sections to read.

5. **Do users experience less disorientation in Adventurous Reader than in Calibre?**

Adventurous Reader shows users how they arrived at their current location and what sections have been viewed unlike standard e-readers such as Calibre (Goyal, 2015). Sections are also displayed separately, which frequent Internet users may be more comfortable with than long documents of text as displayed in standard e-readers. With these improvements users should know how they got to their current position, what sections they have read, and how to advance to new sections more often than they do in Calibre's interface. For these reasons, AR should also be preferable to use.

4.2 Usability Questions

1. **Can users find buttons and functions when needed?**

While elements of Adventurous Reader's interface are non-standard, buttons and functions that are common to other e-readers are placed similarly. Users should still be

able to find these basic functions as well as Adventurous Reader's added features when prompted and as needed.

2. Can users find specific nodes when prompted?

Sections will be more difficult to find in a network of nodes than in a hierarchical list of elements as found in other e-readers. Consequently, users should be able to find and use the provided search function to assist them.

5 User Testing

5.1 Research Method

Adventurous Reader (AR) was tested using two types of user testing studies with twelve participants. A study taking place in a laboratory setting focused more on testing the usability and understandability of the interface. A long-term study allowed testers to take AR and Calibre home to use them in a natural setting and compare their experience with using both. The tests made use of three pick-a-path e-books provided by Rudolf Kerkhoven and Daniel Pitts: *The Most Boring Book Ever Written* (*Boring*) (2012), *The Adventures of Whatley Tupper* (*Whatley Tupper*) (2011), and *The Redemption of Mr. Sturlubok* (*Mr. Sturlubok*) (2011).

5.1.1 Laboratory Study

In a laboratory setting, eight testers were observed performing a list of scenarios and tasks. Before beginning the test, participants were read an introductory script, and at the end of the test, they filled out a questionnaire. Following the questionnaire was an informal interview where testers answered additional questions as needed and any confusions testers expressed during their test were answered.

5.1.1.1 Setting

Seven of the eight tests were conducted in a rented room in the Mansfield Library. The other tester performed it in his office. Tests were conducted individually with only the tester and the researcher present. A machine with AR installed was provided. This version of AR did not have the Interface Toggle button in the upper-right so that testers could not use Calibre's interface. While performing the scenarios and tasks, testers were recorded using screen capture software, which captured the testers' actions in AR and their voice. The network that testers created while exploring *Boring* was also saved for analysis. Each test took an average of about 35 minutes to complete from the reading of the test script to the end of the interview with all testers completing it in 20-55 minutes.

Testers were told that they would not receive help, but most testers required at least one hint to complete the test. Testers were given several minutes to perform each task. After this time, if the tester verbally expressed that they did not know how to proceed, appeared to be struggling or frustrated, or had strayed from the tasks because of their uncertainty, a brief hint was provided. Most often this hint was to point out the Table of Contents button or the search function.

Before beginning the scenarios and tasks, testers were read a script that gave them a general description of AR, introduced the e-books they would be using it to view, and reminded the testers of the purpose of the test. This included informing testers that their own abilities were not being tested, that video and audio of the session would be captured and destroyed at the end of the analysis, and that they would not receive help but were encouraged to speak their thoughts. The complete text for this script can be found in the Appendix section 9.1.1.

5.1.1.3   Scenarios and Tasks

The tasks testers were asked to perform were included in three scenarios and explored research questions 1-6. In the first scenario, testers were asked to find and use several buttons, identify their current position in *Boring* by section title, and estimate how long the e-book was and how much of it they had viewed. The second scenario invited testers to read a complete path through *Boring* and then re-estimate the length of the book and how much of it they had viewed. Finally, the third scenario asked testers to find several sections in *Whatley Tupper* and then tested their understanding of each section's position in relation to the beginning of the book and in relation to other sections. This scenario was re-worded across four versions of the test as all the testers found it confusing. The complete text of version 2 is found in the Appendix section 9.1.2. The fourth version of scenario 3 can also be found in section 9.1.3.

5.1.1.3.1   Scenario 1

The tasks presented in scenario 1 explored research questions 1-4 and usability questions 1-2. Readers completed the tasks in this scenario while exploring the first four sections of *Boring*. These sections included the cover and title page ("Cover"); a list of books by the authors ("Books by…"); a bit of text imploring readers to rate the book online, which readers always returned to after finishing a path ("The Beginning and End"); and author-provided instructions on how to read the book, the first scenario of the book, and the first decision point that asked the reader, "What do you do?" ("Start Here").

Table 2 shows how the tasks assigned to the testers corresponded to the research questions explored in this scenario. See section 9.1.2 for the complete task list. Tasks 1ci, 1cii, 1ciii, and 1i were intended to introduce the testers to the network and assess their understanding or confusions with it. Task 1ci and 1ciii asked users to write down what section of the book contained the cover and "What do you do?" respectively. Task 1cii asked users to write down all the sections they had viewed, which would be all four sections as they were all linked together. Task 1i asked users to answer "What do you do?" by clicking a decision hyperlink to see if they expressed any confusion about the link that was consequently added to the network.

Tasks 1fi and 1gi assessed the testers' understanding of the Back and Forward buttons as well as their understanding of their position in the network. Tasks 1d and 1e asked users to navigate to "The Beginning and End" section and then the "Start Here" section using the network. In task 1f, testers were asked to click the Back button, which would send them to "The Beginning and End" section. Similarly, task 1g, which asked users to click

the Forward button, sent them to the "Start Here" section. Tasks 1fi and 1gi asked testers to write down what section they were viewing after 1f and 1g respectively.

Tasks 1hi and 1hii asked testers to estimate the length of the book and the percent of the book they had viewed. Before beginning, task 1h asked them to read the "Start Here" section, which included the first scenario of the book, to get a sense of the length of each section to use in their estimations.

Tasks 1a and 1b introduced testers to how the text in the book was displayed in sections and also tested if they showed any confusions about it. These tasks asked users to scroll down to "What do you do?" and then back up to the cover, through the length of scrollable text in other words.

Finally, task 1k, which asked users to return to the cover of the book after clicking a decision hyperlink could be completed in several ways. Testers could 1) click the Back button to return to the "Start Here" section and then scroll up to the cover, 2) click the Go to Cover button, 3) click the "Cover" node in the network, or 4) search for "Cover" using the table of contents search function. Completing the task using method 1 demonstrated an understanding of position and the network's relationship to the text. Using method 2 showed an ability to find functions in the interface. Methods 3 and 4 demonstrated an understanding of the network-text relationship and an ability to find nodes in the network. Method 4 additionally showed the user's ability to find and use the search function.

Table 2: A summary of what tasks explored which research (R) and usability (U) questions in scenario 1.

Task #	Basic Action	Purpose	Q
1ci, 1ciii, 1i	Identify what a section contains	Assess understanding of network-text relationship	R2
1cii	Identify the sections viewed	Assess understanding of position in the text	R4
1fi, 1gi	Identify current position	Assess understanding of position and understanding of functions	R1, U1
1hi, 1hii	Estimate the percent viewed and how long the book is	Assess ability to estimate length and progress	R3
1a, 1b	Scroll to a section	Assess ability to advance through the text	R4
1c, 1d, 1e, 1f, 1g, 1j	Use the map to go to sections and find Table of Contents, Back, Forward, and Clear All Links	Assess ability to find functions and ability to use network	U1
1k	Go to the cover	Assess understanding of position, understanding of network-text relationship, ability to find functions, and ability to find nodes	R1, R2, U1, U2

5.1.1.3.2   Scenario 2

Scenario 2 also explored research questions 1-4 and usability questions 1-2 and began where scenario 1 left off in *Boring*. Table 3 shows how each task relates to the research questions. See section 9.1.2 for the complete task list. Task 2 asked testers to go to the end of the "Start Here" section from their current position at the cover. Like task 1k, this task could be accomplished in several ways. Testers could 1) scroll down to reach "Start

Here," 2) click the "Start Here" node, or 3) search for "Start Here" using the search function. Using method 1 demonstrated the user's understanding of "Start Here's" position and the relationship between the network and the text. Completing the task using method 2 or 3 would show the user's ability to find nodes. Finding the search function would also demonstrate the user's ability to find functions.

Tasks 3 and 4 invited testers to freely read a complete path through the book and asked them to stop when they returned to "The Beginning and End" section. During this time, users could be observed to see if they understood how to advance and what the network interface was displaying. After they finished reading, testers were asked to re-estimate how much of the book they had read and how long the book was.

Table 3: A summary of what tasks explored which research (R) and usability (U) questions in scenario 2.

Task #	Basic Action	Purpose	Q
2	Go to "Start Here"	Assess understanding of position, understanding of network-text relationship, ability to find functions, and ability to find nodes	R1, R2, U1, U2
3, 4	Read *Boring*	Assess understanding of network-text relationship and ability to advance through the text	R2, R4
4i, 4ii	Estimate the percent viewed and how long the book is	Assess ability to estimate length and progress	R3

5.1.1.3.3 Scenario 3

Finally, scenario 3 explored research questions 1-2 and usability questions 1-2. In this scenario, testers were asked to find the nodes "Should he continue down the hallway towards the boiler room?" ("boiler room"), "Should he resist temptation and simply push the box back into its hiding place?" ("temptation"), "Should he take up Rick's challenge and have an arm wrestling match?" ("Rick's challenge"), and "Should Whatley try to escape through the door?" ("escape") in *Whatley Tupper*. Unlike the scenarios performed with *Boring* where users started with a network that had no links, testers were provided a complete map of *Whatley Tupper* to use.

Testers could find nodes with a manual search or by using the search function. These methods demonstrated the user's ability to find nodes and to find the search function. While performing searches, the testers were also observed to see if they discovered and used the pan and scale function in the network, which would demonstrate the interface's ease of use. For users performing a manual search, they could also toggle on the Show All Labels button if they discovered it and its purpose.

Once testers found each node, they were asked to demonstrate their understanding of that node's position. This was asked for in different ways depending on the version of the test the tester was given. All the testers were asked to list the sections on the path from the beginning of the book to "boiler room." In some versions of the test, testers were also asked to list the sections on the path from the beginning of the book to "temptation." Other testers were asked if "boiler room" was on the path to "temptation," "Rick's challenge," or "escape" from the beginning of the book. Some questions also asked

testers to interpret the nodes' positions in the context of the story, which would demonstrate the tester's understanding of the network's relationship to the text. Scenario 3 as found in versions 2 and 4 of the scenarios and tasks can be found in the Appendix sections 9.1.2 and 9.1.3.

5.1.1.3.4　　Version History

Four versions of the laboratory study were used. Most of the changes between versions were to scenario 3, which all the testers were confused by in some way. In version 2, task 1c was reworded from "Find the Table of Contents" to "Open the Table of Contents" and a task prompting testers to completely read scenario 3 was added. Version 3 asked users to interpret the position of the sections they found in scenario 3 with the wording, "Based on what you see in the Table of Contents, can Whatley have his flashlight in this section?" which was changed from "Can Whatley have his flashlight in this section?" The final version of the test completely reworded the tasks in scenario 3, removed the task that asked users to completely read scenario 3, and changed the wording of task 5 to "Open *The Adventures of Whatley Tupper* (located on the Desktop) using a button in Adventurous Reader." from "Open *The Adventures of Whatley Tupper* (located on the Desktop)." These versions are discussed in more detail in section 5.3.1. The complete text of version 2 of the test can be found in section 9.1.2 and scenario 3 as found in version 4 can be found in section 9.1.3.

5.1.1.4　　Post-Test Questionnaire

After completing the scenarios and tasks, testers were given a questionnaire to assess their prior experience with e-readers and non-linear stories and to share their opinion of AR. The complete document can be found in the Appendix section 9.1.4. Questions 1-5 asked testers about their reading habits, the mediums of entertainment that they used for reading, and their previous experience with e-readers and CYOA e-books. Testers were also asked several free-form questions inviting them to express their opinion of AR and suggest improvements.

5.1.2　Long-Term Study

The long-term study allowed testers to use AR in a natural setting. At the start of the study, testers were provided with Calibre (Goyal, 2015) and AR to use on their personal computers, two e-book files, a document with their instructions and tasks, and a readme document explaining the basic functions of both e-readers. When they had completed their tasks, testers were given a final questionnaire and asked additional questions as needed. Four testers completed the study.

5.1.2.1　　Setting

Testers performed the test at their leisure on their personal computers. All the testers performed the study remotely with the researcher corresponding with them only by email. Midway through their designated time, testers were sent a reminder email. If testers had not contacted the researcher by the end of their three-week time limit, the researcher sent another email to ask if they had finished testing. The final questionnaire was sent at the tester's request. Three testers required and were allowed more time to complete the study. The study was completed in 3-6 weeks, taking an average of 4.5 weeks from the time

testers were given their materials to the time they requested the questionnaire. At the end of the study, testers emailed their finished questionnaire and two files containing the networks they created in the e-books for analysis.

5.1.2.2   Application
Testers were provided with a copy of AR to use on their personal computers. Unlike the version used in the laboratory study, this version of AR did have the Interface Toggle button that allowed users to switch between Calibre's interface and AR's interface. As a portable executable, testers could run the application on Windows machines without installing or setting up anything. The e-book files were also provided with the application and the relative path to these files had already been setup in Calibre.

5.1.2.3   Instructions
An instructional document provided at the start of the study explained the purpose of the test, introduced the e-books the testers would be viewing, explained the toggle button to switch between the AR and Calibre interfaces, and gave testers an overview of what they would be using the interfaces for. An attempt was made to write this document in a neutral way such that the testers would not be biased towards liking AR more than Calibre or vice versa. The complete document can be found in section 9.2.1.

In addition to free reading as much of the books as they liked, testers were asked to find and follow every link at every decision point and to every side note in both e-books using the interface assigned. This was to see if testers found the map in AR useful for keeping track of what sections they had viewed and avoiding sections they had already explored.

5.1.2.4   Tasks
Included in each Instructions document, testers were provided a personalized list of tasks and information. This information included AR's location on the user's machine, the location of the e-books on the user's machine, the end date of the user's test session, and an ordered list of tasks the tester was to perform. The location of AR and the e-books was provided for the benefit of testers who had met with the researcher to have the application and e-books manually installed. This ended up being unnecessary in all cases.

The task list informed the tester of what interface they should use to read each e-book and in what order. Half of the testers were asked to use AR to read *Whatley Tupper*, and then use Calibre to read *Mr. Sturlubok*. The other half were asked to use Calibre to read *Whatley Tupper*, and then use AR to read *Mr. Sturlubok*. This was intended to avoid biasing all the testers towards Calibre's interface or AR's interface by starting all testers with the same interface. Both versions of the task lists can be found in section 9.2.2.

5.1.2.5   Readme
The readme document contained instructions on how to open the e-reader application and how to use the Open ebook, Back and Forward, and Table of Contents buttons. This document targeted inexperienced computer users and infrequent e-reader users. It was intended to ensure that all testers began the test with the same knowledge that they would need to use either interface's basic functions. This document is in section 9.2.3.

5.1.2.6   Post-Test Questionnaire

The post-test questionnaire focused on research questions 1-5 and usability question 1 by assessing the testers' experience with both books and both interfaces. Refer to section 9.1.4 for the complete questionnaire. Questions 1-5 were identical to the first five questions of the post-test questionnaire used in the laboratory study. Testers were asked about their reading habits, the mediums of entertainment that they used for reading, and their previous experience with e-readers and CYOA e-books. Table 4 shows how the answers to the rest of the questions corresponded to the research and usability questions.

Questions 6-17 asked testers to share their experience with reading both e-books in the context of what interface they had been asked to use. Questions 6-11 asked about the testers' experience while reading *Whatley Tupper*. Questions 12-17 asked the same series of questions about *Mr. Sturlubok*.

While testers were asked to explore the entirety of both books, they were not required to read all of them. Therefore, questions 6, 9, 10, 12, 15, and 16 began the questionnaire by assessing how much of the books the testers had actually read, what reading strategy they employed, and their confidence that they had followed all the hyperlinks. These answers would assist in interpreting the testers' answers to the rest of the questions. Questions 6 and 12 asked how much of the book the tester had actually read. This question only gauged if the user could make any sort of estimation with the map or otherwise; there was not a way to check the answer for accuracy. Questions 9 and 15 asked how confident users were that they had found every link and section in the e-book. These answers could be checked for accuracy by examining the network files testers emailed with their questionnaire and also tested if users were more confident while using the network interface in AR. Questions 10 and 16 checked if testers had used any systematic strategy while reading the book that may have assisted them in or hindered them from keeping track of the sections and paths they had followed without the map.

Questions 7, 8, 13, and 14 asked users about how much they enjoyed reading the books and what factors made them less enjoyable to see if the interfaces had any effect on their experience. Questions 8 and 14 gave users a list of options to select from to describe why their experience was less enjoyable than it could have been. These included "The assigned interface was difficult or confusing to use," "I was concerned by how large the book was," "I couldn't tell how much of the book I'd read," and "I was worried about losing track of what paths I'd read." There was also a free-form "Other" option.

Finally, questions 11 and 17 asked a series of sub-questions to determine how often users had trouble keeping track of what paths and sections they had visited and how much of the book they had read. It also asked how often the interface assisted them in keeping track of this information. These questions assessed if users knew how to advance and could estimate how much of the book they had read.

Questions 18-21 asked if users had ever disobeyed the instructions about what interface they were supposed to use to determine if users showed a preference for either interface

in this way. Questions 18 and 19 asked if the user had ever disobeyed their instructions by using the AR interface when they had been asked to use Calibre. Questions 20 and 21 were identical except they asked if the user had disobeyed the instructions by using Calibre in place of AR. If users indicated in questions 18 or 20 that they had disobeyed the instructions, then they were asked to explain why by selecting from a series of choices presented in questions 19 and 21. These included "I wanted to see how long the book was," "I was checking to see if I'd viewed the current section before," "Calibre's (Adventurous Reader's in question 21) Table of Contents was confusing," and "I liked how Adventurous Reader (Calibre in question 21) displayed the book's sections more." There was also a free-form "Other" option.

Questions 22-26 asked users about what features they had discovered on their own while exploring the e-books. Questions 22 and 23 asked testers how much time they had spent in each interface to see if testers who spent more time with the interfaces tended to discover more functions. These results would also be comparable to what the participants in the laboratory study discovered in less than an hour. Questions 24 and 25 gave testers a list of common buttons and functions that were in both interfaces or specific to AR. These functions had not been explained in the instructions or readme document. Testers were to check all the functions they had discovered and used on their own while conducting the test. Question 26 was a free-form question, asking if the user found any of these functions confusing.

Finally, questions 27-30 assessed if the user preferred using AR over Calibre. Question 27 asked what interface the user preferred, if either, and question 28 asked the user to elaborate on their choice in their own words. Questions 29 and 30 were also free-form questions asking if testers would use AR to read other CYOA e-books and if they had any suggestions for improving it.

Table 4: A summary of what questions in the post-test questionnaire explored which research (R) and usability (U) questions.

Q #	Basic Action	Purpose	Q
6, 12	Estimate the percent read	Assess ability to estimate progress	R3
7, 8, 13, 14	Share if you liked the book and what factors made it less enjoyable	Assess understanding of network-text relationship, ability to estimate length, ability to estimate progress, ability to advance through the text, understanding of functions, and ability to use network and compare Calibre and AR	R2, R3, R4, R5, U1
9, 15	Share confidence at having found and followed all paths	Assess understanding of network-text relationship and compare Calibre and AR	R2, R5
11, 17	Share how often estimations of progress could be made	Assess ability to estimate progress and understanding of position in the text and compare Calibre and AR	R3, R4, R5
18-21	Share if the instructions about what interface to use had been disobeyed and why	Assess understanding of position, understanding of network-text relationship, ability to estimate length, ability to estimate progress, understanding of position in the text, and ability to use network and compare Calibre and AR	R1, R2, R3, R4, U1, R5

22-26	Share what functions were discovered	Assess ability to find functions and understanding of functions	U1
27-30	Share experience with AR and Calibre	Compare Calibre and AR	R5

5.1.2.7   *Problems with Execution*

The execution of this study had several significant problems. Only four out of six testers completed the study. All the testers who completed the study disregarded the instructions, the readme document, or both in some way. Only one tester made a serious effort to find all the links in both books *and* found the table of contents interface in AR. Finally, the wording of many of the questions in the final questionnaire made determining which interface each tester was evaluating at any time difficult. Consequently, a comprehensive analysis of the results could not be conducted.

Testers 1 and 7 were assigned to read *Whatley Tupper* with AR first and then *Mr. Sturlubok* with Calibre, and testers 3 and 5 were assigned to read *Whatley Tupper* with Calibre and then *Mr. Sturlubok* with AR. Testers 1 and 7 disregarded the instructions, preferring instead to explore the AR and Calibre interfaces with both e-books for a couple of hours and then give their opinion on them. Tester 5 disregarded his tasks and read *Mr. Sturlubok* in AR first and then *Whatley Tupper* with both Calibre and AR. Testers 1 and 3 disregarded the readme document and consequently did not find the Table of Contents button while performing the test.

The wording of the final questionnaire assumed that each tester would primarily use one interface, the assigned one, for each e-book. In reality, testers 1 and 7 used both interfaces equally for both books. Tester 5 started reading *Whatley Tupper* with Calibre but preferred using AR. The wording of the questionnaire only worked for tester 3, who primarily used the assigned interface for each e-book.

5.2 Participants

Testers were recruited from three groups and had varying degrees of experience with e-readers, non-linear digital stories, and computers. Eight testers, referred to as testers 2, 8, 9, 10, 11, 12, 14, and 15 in this document, participated in the laboratory study. Four testers, referred to as testers 1, 3, 5, and 7 completed the long-term study.

5.2.1   IRB Approval

Before participants were recruited and testing began, approval was obtained from the Institutional Review Board. The user studies performed here were approved under the Exempt category of review.

5.2.2   Recruiting

Participants had to be over the age of 18 and ideally would enjoy reading for recreation, but otherwise, there were no restrictions on who could participate. Testers were primarily recruited through the university's Anime Club and computer science department and from acquaintances of the researcher who were unfamiliar with AR. One participant was recruited by another tester. The members of the Anime Club, a club that celebrates all

forms of Japanese entertainment, were targeted for their interest in visual novels and similar text-based games. These digital non-linear stories are a popular form of entertainment in Japan and are thus familiar to most members of the club. The computer science department was also targeted to gather advanced computer users, classified in this research as former or current computer science students or professionals, to compare their performance with average computer users. Acquaintances with and without advanced computer skills and experience with non-linear books were also invited to participate.

Testers were recruited with presentations, sign-up sheets, and personal correspondence. The Anime Club was given a short presentation of the research and a sign-up sheet was provided. An email was sent through the computer science department's news feeds, and interested individuals were invited to contact the researcher by email. Acquaintances were recruited through email or verbal correspondence.

5.2.3 Summary of Participants

In the post-test questionnaires used in both studies, participants were asked five questions about their reading habits, the mediums of entertainment that they used for reading, and their previous experience with e-readers and CYOA e-books. These questions were intended to assess their interests in reading for entertainment, their experience with reading non-linear narratives, and their experience with e-readers and e-books. Table 5, Table 6, and Table 7 summarize the information gathered. See the beginning of section 9.1.4 or 9.2.4 for the complete text of the post-test questionnaires and the exact questions used to gather this data.

Table 5: A summary of the mediums that testers use for recreational reading.

Tester	Books	E-Books	Video games	Text adventures	CYOA games	Visual novels	Internet
1	X		X				X
2	X		X			X	X
3	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X
7	X		X				X
8	X		X			X	X
9	X	X	X			X	X
10	X	X	X		X		X
11	X	X	X			X	X
12	X						X
14	X	X	X				X
15	X	X	X				X

Table 6: A summary of how often testers read for entertainment and how often they use e-readers.

How many hours do you read in any of the above mediums for entertainment per week?	
Rarely	
1-9	3, 7, 12, 15
10-20	1, 2, 5, 9, 10, 11, 14

>20	8											

How often do you use e-readers for viewing e-books?	
Daily	3, 5, 10
Weekly	8, 9, 14
Monthly	11
Rarely	1, 2, 7, 15
Never	12

Table 7: A summary of other information about the participants.

Tester	1	2	3	5	7	8	9	10	11	12	14	15
Tester has read a CYOA e-book	X	X			X						X	
Tester has used Calibre before				X								
Tester is or was a CS major or professional		X	X	X			X			X	X	
Recruitment method (A=Acquaintance, C=Anime Club, D=CS Department, O=Other)	A	A	D	D	A	C	D	C	C	D	A	O

Table 8 aggregates these data to classify each tester in three ways. Testers are considered frequent e-reader users if they use an e-reader daily or weekly; avid non-linear story readers if they use text adventures, CYOA games, or visual novels and read more than 10 hours per week for entertainment; and advanced computer users if they are computer science students or professionals.

Table 8: How each tester was classified based on the data gathered in the questionnaires and interviews.

Tester	1	2	3	5	7	8	9	10	11	12	14	15
Frequent e-reader user			X	X		X	X	X			X	
Avid non-linear narrative reader		X		X		X	X	X	X			
Advanced computer user		X	X	X			X			X	X	

5.3 Research Results

In this section, the answers to the research questions are presented. These questions were:

1. Do users understand their position in the narrative?
2. Do users understand the relationship between the e-book's text and the network?
3. Can users estimate their progress through the e-book from the network?
4. Do users understand how to advance through the text?
5. Do users experience less disorientation in Adventurous Reader than in Calibre?

The evidence from the user studies indicate that AR is somewhat successful in communicating progress and position, but it could not be determined if users experience less disorientation in Adventurous Reader as compared to Calibre. While using the map, testers seemed to understand their position in the narrative and the relationship between the text and the network. The requirement that users needed to click hyperlinks to advance seemed natural and intuitive, and most testers could identify what sections they

had viewed. Testers could also estimate how much of the book they had read from the map, but only half of the testers recognized that it could be used for this purpose.

5.3.1 Do users understand their position in the narrative?

The evidence that was gathered from the laboratory study supports that AR's map communicates position, but it could not be determined if testers can interpret that position in the context of the book. Scenario 3 of this study, which was created to formally test this feature, was misinterpreted by the majority of the testers. While all the testers demonstrated that they understood how to get to their current position and the relationship between the text and the map (as explained in section 5.3.2), testers could not interpret the position of the nodes in the context of the narrative.

Scenario 3 was intended to measure the testers' understanding of their position in relation to the start of the book and in relation to other sections. Unfortunately, the wording of the question led most testers to believe that the answer was found in the text of the book instead of in the map. Testers were described a scenario where a character, Whatley, in *Whatley Tupper* permanently lost his flashlight in the "boiler room" section. Because Whatley lost his flashlight in this section, it was impossible for him to have it in any section in a path branching off of it. Testers were given a complete map of *Whatley Tupper* and asked to find three sections in the book "temptation," "Rick's challenge," and "escape." For each section, they were asked if Whatley could have his flashlight. "Temptation" and "Rick's challenge" were in paths branching off of "boiler room" so Whatley could not have his flashlight. The path to "escape," however, did not contain "boiler room," so it was possible for Whatley to have it.

Testers 2, 8, and 9 were given a version of the test where for each of the three sections they were asked to find, they were asked, "Can Whatley have his flashlight in this section?" (tasks 8ii, 9i, and 10i). Their answers are summarized in Table 9. Tester 2 did not completely read the scenario and so did not understand the context of any of the questions. Tester 8 claimed to have understood the question but could not see the paths to any of the sections because they were obscured by node labels. The tester performed most of the test with the Show All Labels button toggled on. Tester 9 reasoned that he could not know if Whatley had his flashlight because he did not read the book. All three testers read part of "temptation," "Rick's challenge," and "escape" and based their answers on whether they found that the flashlight was mentioned in the section or not. In all three sections in the book, Whatley did actually use his flashlight. In the last two sections, the flashlight was mentioned right away, but in the first section, the reference was harder to find. The testers felt after receiving an explanation after the test that they could have used the map to answer the question had they known what it was asking.

Testers 10 and 11 were given version 3 of the test where for each of the three sections they were asked to find, they were asked, "Based on what you see in the Table of Contents, can Whatley have his flashlight in this section?" (tasks 8ii, 9i, and 10i). Their answers are also summarized in Table 9. Tester 10 reasoned that she could not know because she had not read the book for all three questions. Tester 11 searched the table of contents for clues but did not know what she was looking for. Tester 10 argued after the

question had been explained that she still could not know because Whatley could have retrieved his flashlight in which case she would still need to read the book. Tester 11 felt that she could have answered the question with the map if she had understood what was being asked during the test.

Table 9: A summary of tester answers to version 1-3 of scenario 3. Questions are numbered based on versions 2 and 3.

Tester	2	8	9	10	11	Key
Version of study	1	2	2	3	3	
Felt that they could answer 8ii-10i after explanation	Yes	Yes	Yes	No	Yes	
Correctly answered 7i	Yes	Yes	Yes	Yes	Yes	
Correctly answered 8i	Yes	Yes	Yes	Yes	Yes	
Answer to 8ii	I can't tell	I can't tell	I can't tell	I can't tell	I can't tell	No
Answer to 9i	I can't tell	Yes	Yes	I can't tell	I can't tell	No
Answer to 10i	Yes	Yes	Yes	I can't tell	I can't tell	Yes

The scenario was rewritten for testers 12, 14, and 15. The results of version 4 of the test are summarized in Table 10. For each section, testers were asked two questions. The first question (tasks 7i, 8i, and 9i) asked directly if "boiler room" was on the path from the beginning of the book to the section they had been asked to find. The second question was, "Considering that Whatley lost his flashlight in 'boiler room' and has not had a chance to recover it, should he be able to have his flashlight now?" (tasks 7ii, 8ii, and 9ii). All three testers were able to answer the first question correctly. Tester 12's one incorrect response appeared to be because the path he was examining was obscured by labels. Tester 14 answered all six questions correctly after figuring out what was being asked. Testers 12 and 15, however, still struggled to understand the second question. They examined the map rather than reading the text while composing their answers but did not speak aloud to explain their thought process and were not asked about it after the test. These testers also did not receive an explanation of the scenario after the test.

Table 10: A summary of tester answers to version 4 of scenario 3.

Tester	12	14	15	Key
Correctly answered 6i	Yes	No	Yes	
Answer to 7i	No	Yes	Yes	Yes
Answer to 7ii	I can't tell	No	I can't tell	No
Answer to 8i	Yes	Yes	Yes	Yes
Answer to 8ii	No	No	Yes	No
Answer to 9i	No	No	No	No
Answer to 9ii	No	Yes	I can't tell	Yes

All the testers were also asked one or two other questions in scenario 3 to assess their understanding. Seven of the eight testers answered "List the section(s) on the path from 'Start Here' to 'boiler room'" (question 6i in versions 1 and 4 and question 7i in versions 2 and 3) correctly. Tester 14 listed the sections that were linked to "boiler room" and explained after the test that he had misread the question. The five testers who completed

version 1, 2, or 3 of the test were also asked to "List the section(s) on the path from 'Start Here' to 'temptation.'" All five testers answered correctly.

These results suggest that the testers understood where a section was in the map, how to get there from the beginning of the book, and how to get there from other sections. Asking users to answer this positional question in the context of a book that they had not read, however, seemed to be confusing. Most testers were led to believe that they needed to read the book in order to interpret the node's position in the context of the story. Given its few results, it is possible that had version four been used with more testers, more useful results could have been obtained.

5.3.2   Do users understand the relationship between the e-book's text and the network?

Testers in both studies demonstrated in some way that they understood that nodes represented sections in the text and links represented hyperlinks or other connections between sections. In certain cases where nodes and sections were not logically connected, testers were confused by this relationship, but overall, testers who discovered the network interface understood that it represented the structure of the e-book.

Laboratory Study Results

Scenario 1 contained several questions intended to identify if users understood what each node represented and the contents of each section. This scenario asked testers to explore four nodes at the beginning of *Boring*, which were connected together by scrolling instead of by clicking hyperlinks. Testers seemed to find this confusing, but they demonstrated their understanding of what nodes represented in the e-book in other ways throughout the test.

The "Cover," "Books by...," "The Beginning and End," and "Start Here" nodes found at the beginning of *Boring* were a special case in that users could scroll through the content contained in these four sections without clicking any hyperlinks unlike the sections in the rest of the book. There were no clear delineations in the text through headers or page breaks that marked where one of these sections ended and the next began, and the content of each section was not always logically connected. The "Start Here" node for example contained instructions, the first scenario of the book, and the first decision point. The labels for three nodes also were not logically connected to the content of the section. "The Beginning and End" section, for example, contained text that implored readers to rate the book online.

These factors likely caused the confusion that testers demonstrated in their responses to questions 1ci, 1cii, and 1ciii. These answers are summarized in Table 11. Testers 9, 10, and 15 most clearly voiced their confusion. Tester 9 expected the labels of the nodes to be mirrored in the text of the e-book as headings. In response to 1ci, this tester responded by writing the title of the book instead of "Cover" and wrote the list of books by Rudolf Kerkhoven and Daniel Pitts found in the text in response to 1cii instead of "Books by...." From 1ciii on, the tester adopted the intended meaning of "titles of the sections" terminology and wrote labels of the nodes. Tester 10 appeared to expect the decision

point at the end of the "Start Here" section to appear in a separate node. The tester ended up clicking one of the decision hyperlinks and writing down the title of the resulting section. Tester 15 was so confused about the test's use of "titles of the sections" that it had to be explained during the test.

Table 11: Summary of the answers that testers provided for questions 1ci, 1cii, and 1ciii.

Tester	2	8	9	10	11	12	14	15
1ci Write the title of the section that contains the cover of the book below.								
Cover	X	X		X	X	X	X	X
1cii Write the titles of the sections you viewed below.								
Cover	X	X			X	X	X	X
Books by Rudolf Kerkhoven and Daniel Pitts	X	X		X	X	X		X
The Beginning and End	X	X		X	X	X		X
Start Here	X	X		X	X	X	X	
1ciii Write the title of the section that contains "What do you do?" below.								
Start Here	X	X	X		X		X	

Still, all the testers demonstrated their understanding of the map's relationship with the text in other ways at some point during the test. Table 12 gives a summary of how testers demonstrated this understanding.

Table 12: Summary of how testers demonstrated their understanding of the relationship between the map and the text.

Tester	2	8	9	10	11	12	14	15
Correctly answered "Write the title of the section that contains the cover of the book below."	X	X		X	X	X	X	X
Correctly answered "Write the titles of the sections you viewed below."	X	X			X	X		
Correctly answered "Write the title of the section that contains 'What do you do?' below."	X	X	X		X		X	
Used the map to estimate length and percent complete	X		X	X		X		
Clicked the Cover node to return to the cover of the book			X			X		
Navigated to a section through the text when prompted	X	X						X
Stated their understanding of the network	X	X	X	X	X			
Correctly answered Scenario 3							X	
Felt able to answer Scenario 3 after explanation	X	X	X		X		X	

Long-Term Study Results
The three testers who discovered the network interface at some point during this study generally seemed to understand what it showed and how it was related to the text. Tester 5's answers in the questionnaire demonstrated a clear understanding. He wrote that the map was "helpful in determining which sequences of choices led to a given outcome." He also felt that it kept track of his progress especially across multiple reading sessions. The free-form comments provided by testers 3 and 7 in the questionnaire and post-test interviews suggested that they generally understood what links and nodes represented.

Tester 3 wanted to be able to see in the network how to get to disconnected nodes in the context of the story. Tester 7 liked creating links as he went through paths in the story.

5.3.3   Can users estimate their progress through the e-book from the network?

Considering that half of the testers did not recognize that the map could be used to make estimations about length of or progress through an e-book, it appeared to be unintuitive to use it for this purpose. Estimations with the map were also about as accurate as guesses.

Laboratory Study Results
Only half of the testers used the map to estimate the length of *Boring* and their progress through it, and estimations were about as accurate as estimations made by testers who guessed. Testers were asked to make these estimations at two points during the test, before and after following a path through the book to an ending.

Table 13 and Table 14 summarize the testers' estimations. An X in the Guess column indicates that the tester appeared to guess rather than use the map in their estimations. Tester 2 and 9 spoke aloud to explain their thought process. Tester 10 had the map closed the first time she was asked for estimations but spoke aloud while using the map the second time. Tester 12 appeared to be using the map while making both sets of estimations but did not speak aloud. The rest of the testers appeared to be guessing. Testers 8 and 14 had the map closed while answering the questions at both points in the test. Tester 11 clicked Clear All Links shortly before making both sets of estimations, which made the map unhelpful. Tester 15 had the map open but did not appear to look at it to make her estimations. The second time these questions were asked, most of the linked nodes were even off screen.

Testers who guessed how much of the book they had read and testers who estimated based on the map had similarly accurate answers as shown in Table 13. All the testers who used the map, however, could make an estimation. Tester 14, who did not use the map, could not even guess how much of the book he had read. The actual final percent viewed was calculated by dividing the number of connected nodes in the network at the time users were asked to make their estimations by the total number of nodes in the network, which was 88. The number of connected nodes in each tester's network is shown in parenthesis in the Actual Final Percent Viewed column. Percentages are rounded to the nearest whole number.

Table 13: A summary of testers' answers to "Based on what you've seen so far, how much of the book would you estimate that you've viewed?" before and after following a path through Boring.

Tester	Before	Guess	After	Guess	Actual Final Percent Viewed
2	Less than 5%		about 20%		11% (10 nodes)
8	Less than 5%	X	about 10%	X	15% (13 nodes)
9	Less than 5%		about 20%		18% (16 nodes)
10	Less than 5%	X	about 30%		17% (15 nodes)
11	Less than 5%	X	about 30%	X	13% (11 nodes)

12	Less than 5%		about 10%		11% (10 nodes)
14	Less than 5%	X	I can't tell	X	20% (18 nodes)
15	Less than 5%	X	about 10%	X	16% (14 nodes)

Table 14 summarizes the testers' estimations of the total length of the book at both points during the test. It was estimated that most average readers could finish *Boring* in 4-5 hours, or less than a day. Most of the testers who used the map also drew this conclusion. The testers who did not use the map tended to overestimate. As expected, most of the testers improved their estimation after they had followed a path through the book.

Table 14: A summary of testers' answers to "Based on what you've seen so far, what would you estimate about this book's length?" before and after following a path through Boring.

Tester	Before	Guess	After	Guess
2	A		B	
8	A	X	B	X
9	A		B	
10	A	X	C	
11	A	X	C	X
12	E		B	
14	E	X	C	X
15	C	X	C	X

A)   It's a short story; I could easily read it in an hour or two.
B)   It's longer than a short story, but I could still read it within a day.
C)   I would need at least several days to read this.
D)   It would take me at least a week or more to read this.
E)   I can't tell

Long-Term Study Results
Testers 5 and 7, who discovered the network interface while taking the test, had contradicting views about the map's usefulness for displaying progress and length. Tester 5, who made a serious effort to find all the paths through each e-book, felt that it was very helpful for determining how much of the book he had read and what sections he had viewed. Tester 7, however, who spent very little time exploring and reading the e-books, did not see the interface as helpful in this regard. This tester even used Calibre's interface to check the total length of the books.

Tester 3 did not discover the network interface until after the test and, consequently, could not make an estimation of how much of *Whatley Tupper* he had read. He replied "Unsure" in response to question 6, "About how much of *The Adventures of Whatley Tupper* did you read?"

5.3.4   Do users understand how to advance through the text?
Even when presented with the paradigm that they would be exploring e-books, testers did not seem confused when the e-books they viewed were displayed in separated sections in AR. The requirement that users needed to click hyperlinks to see the next section of text seemed natural. Additionally, 8/11 testers who used the network interface demonstrated

an understanding of their position in the overall text, what they had read and what they had left to read, as shown in Table 15. Despite having this information, both testers in the long-term study who made a serious effort to read all the paths through both assigned e-books expressed a desire to know additional information in order to avoid paths they had already read and find new paths to read.

Table 15: Summary of how testers demonstrated understanding of their position in the text.

Tester	2	3	5	7	8	9	10	11	12	14	15
Correctly answered "Write the titles of the sections you viewed below."	X				X			X	X		
Used the map to estimate length and percent complete	X		X			X	X		X		
Discussed ability to see traversed and untraversed paths		X	X					X			

Laboratory Study Results
Testers in the laboratory study easily recognized that they needed to click hyperlinks to advance. Tester 9 was the only tester who attempted to continue scrolling past the end of a section to get to the next one. This appeared to be because the tester did not recognize that "The End" at the end of that particular section was a hyperlink.

Six testers also demonstrated that they understood what sections they had viewed, what sections they had left to view, or both. Question 1cii "Write the titles of the sections you viewed below" asked directly for testers to identify what they had read based on what nodes had links in the network. In order to use the map to estimate the e-book's length and percent complete, testers also needed to recognize what sections they had viewed.

Long-Term Study Results
Two of the three testers in the long-term study who discovered the map interface expressed that they understood how the network showed what they had read and what they had left to read, but both of them wanted more information to avoid paths they had already followed or find new paths to follow. Tester 3 did not discover the map until after the test, but after exploring it, he stated that he wanted the ability to see paths that had not been traversed yet so they were easier to find. Tester 5 found the map useful for avoiding paths that he had already followed, but he did not feel that it helped him find new paths to follow. He suggested displaying numbers next to the nodes to indicate how many hyperlinks the section contained to make it easier to find new paths. In contrast, tester 7 did not feel that the interface was very helpful for determining what paths he had followed or what new paths he could follow. Unlike testers 3 and 5 though, tester 7 did not attempt to find all the paths through both e-books.

5.3.5 Do users experience less disorientation in Adventurous Reader than in Calibre?

Because of the problems in the execution of the long-term study, it cannot be determined whether users experience less disorientation while reading a non-linear e-book in Adventurous Reader than they do in Calibre. The data that was gathered suggests that

testers who used the map did experience less disorientation than testers who never discovered the map or did not use it, but there is too little data to be conclusive. Nonetheless, all four testers preferred AR to Calibre either because of its map or because of how it separated sections.

5.3.5.1 Comparison of Disorientation

The results of this study support that AR's network interface prevents users from becoming disoriented in non-linear texts. Testers who did not use or discover the map were somewhat disoriented whether the text was split into sections in AR or displayed in a long document in Calibre. The two testers who used the interface were less disoriented but had contradicting views about its helpfulness in determining progress and position.

Table 16 and Table 17 show the responses to questions 11 and 17, which were two of the questions used to determine the testers' feelings of disorientation as they were reading. Tester 1 and 7 did not use a systematic reading strategy to explore the books. Tester 3 used a depth-first search, and tester 5 clicked the Back button when he reached the end of a path until he found a decision that he had not explored before. Testers 3 and 5 made a serious effort to find all the paths in both e-books and read all the sections. Tester 1 read a few paths through both e-books. Tester 7 explored a few paths through the books without reading them.

Table 16: Responses to questions 11 and 17 from testers who used the network interface.

	Always	Often	About half	Sometimes	Rarely	Never
a) I had trouble remembering which paths I'd followed.		5^M			7	
b) I didn't know how much of the book I had viewed.					5^M, 7	
c) I had to re-read sections to determine if they were new.					7	5^M
d) I had trouble finding where I'd left off between reading sessions.		5^M			7	
e) The interface informed me how much of the book I had left to view.	5^M			7		
f) The interface helped me determine which paths I'd followed.		5^M		7		
g) The interface helped me find new paths to follow.			7	5^M		

Table 17: Responses to questions 11 and 17 from testers who did not use the network interface.

	Always	Often	About half	Sometimes	Rarely	Never
a) I had trouble remembering which paths I'd followed.	5^W	1^M		1^W	3^W	3^M

b) I didn't know how much of the book I had viewed.	3^M, 5^W		1^M	1^W		3^W
c) I had to re-read sections to determine if they were new.	5^W		1^M	1^W, 3^W		3^M
d) I had trouble finding where I'd left off between reading sessions.	5^W				1, 3	
e) The interface informed me how much of the book I had left to view.					1^W	1^M, 3, 5^W
f) The interface helped me determine which paths I'd followed.				1	3	5^W
g) The interface helped me find new paths to follow.		3		5^W		1

^{W} – Tester's response to *The Adventures of Whatley Tupper*
^{M} – Tester's response to *The Redemption of Mr. Sturlubok*
(no superscript) – Tester's response to both e-books

Testers 1 and 3, who did not discover the network interface, seemed to experience some disorientation in both e-books and both interfaces. Both testers felt that the interfaces were unhelpful for determining how much of the book had been read or what paths had been followed. Tester 1 reported in response to *Whatley Tupper* in question 8 that she was afraid of losing track of what paths she had followed, which took away from her enjoyment of the book. In response to both e-books, she also reported that she had trouble determining which paths she had followed and how much of the book she viewed.

Tester 3 had some contradictory responses that may indicate some confusion or disorientation from the lack of positional information. This tester primarily used Calibre to read *Whatley Tupper* and AR without the map to read *Mr. Sturlubok*. The tester overall thought that it was easy to keep track of what sections he had read, but he also had trouble estimating his progress. In response to *Whatley Tupper*, the tester indicated in question 11b that he always knew how much of the book he had read. In question 8, however, he marked that he could not enjoy the book because he did not know how much of it he had read, and in question 6, he could not provide an estimation of this information. In response to *Mr. Sturlubok*, the tester indicated in question 17b that he never knew how much of the book he had read, but he was able to provide an estimation of progress in question 12. After discovering the network interface, he wrote that he felt that it was critical to have to enjoy the e-books perhaps because of the disorientation he felt while conducting the test.

The tester's contradictory answers may also be the result of the tester misunderstanding question 11b and 17b or the tester's response to the content of the e-books. *Whatley Tupper* contains several long, very similar paths that are difficult to distinguish without a map or re-reading one or more sections, and the tester indicated in question 8 that he

found the book boring. The paths through *Mr. Sturlubok* are more distinct, and the tester wrote a free-form response to question 14 about how he enjoyed the book.

Testers 5 and 7 used the network interface to view one or both e-books and experienced less disorientation than the other testers. Tester 5 indicated in his responses to questions 11 and 17 that he experienced more disorientation while using Calibre's interface than he did while using the map in AR. Tester 7 did not find the network interface as helpful as tester 5 did and even looked up the total length of the books in Calibre's interface, but he did not express any other feelings of confusion or disorientation.

5.3.5.2   *Preference for Adventurous Reader*

The testers who completed the long-term study preferred AR to Calibre even if they had not discovered the network interface or did not find it as useful as hoped. Tester 1 thought that the books were easier to read when they were split into sections and thought that displaying the text in a long document in Calibre was confusing. Tester 3 felt that the network interface was "critical to the overall enjoyment of the book." Testers 3 and 7 felt that the interface was also superior to paper CYOA books. Tester 5 was strongly aligned towards AR's interface and found Calibre's table of contents confusing. Tester 7 liked how AR split the book into sections and liked its table of contents more than Calibre's.

Testers 3, 7, and 11 commented on how AR preserves the surprise of pick-a-path books by hiding the endings and paths until the reader discovers them. Tester 7 thought that this was AR's strongest property. Splitting the book into sections hid what was coming next to make reading more suspenseful and prevented accidental or intentional cheating. Tester 11 agreed in the laboratory study, stating that she liked that AR did not provide a complete map when an e-book was first opened because that would give away the endings. In contrast, tester 3 wanted to be able to see the paths that had not been traversed yet for the benefit of readers that had trouble finding some paths on their own.

5.4 Usability Results

This section presents the answers to the usability questions. These questions were:

1. Can users find buttons and functions when needed?
2. Can users find specific nodes when prompted?

AR was overall not very intuitive to use particularly for average computer users and casual readers. Testers often failed to find critical buttons and functions, most importantly the Table of Contents button that opened the map interface. Often, testers could not find nodes easily and using the search function was not an immediate thought.

5.4.1   Can users find buttons and functions when needed?

Testers in both studies struggled to find, use, and understand functions when prompted and as needed. In the laboratory study, half of the testers failed to find or were confused by each of the functions that were tested. Most glaringly, half of the testers could not find the Table of Contents button without help. Testers learned how to interact with the network interface fairly easily, but they also found it difficult to read node labels.

Laboratory Study Overview

In this study, the user's ability to find and use buttons and functions when prompted and as needed and to find specific nodes in the network when prompted was used as a measurement of how intuitive the interface was. Testers were also observed to see if they appeared to find any of the functions confusing. Table 18 and Table 19 summarize what functions each tester found. Table 20 summarizes common complains about the interface.

Overall, AR does not appear to be very user-friendly but did have some small successes. All the testers struggled to find functions, were confused by a function, or misused a function at least once during the test. The network interface was easy to learn and understand for most of the testers, but most testers also felt that it was difficult to read or find. The Show All Labels and Clear All Links buttons were also confusing.

Table 18: A summary of what testers found which functions in the laboratory study.

Tester	Resize Window	Resize TOC	Full Screen Mode	Zoom	Pan	Node Drag	Search**
2	X			X	X		X
8	+	X					X
9	X	X	X				X
10	X	X	X		X		+
11	X		X	X	X		X
12	X	X					+
14			X	X			+
15	X			X	X	X	+

Table 19: A summary of what testers found which buttons in the laboratory study.

Tester	Forward and Back**	TOC**	Show All Labels	Clear All Links**	Go to Cover
2	X	X	*	*	X
8	*	X	*	*	X
9		X		X	
10		X#+			
11	X	+	*+	*!	X!
12	X	+	X	X	!
14	X	X		X	
15		+#		X	X

X – Tester found and understood function

* - Tester found and was confused by function

+ - Tester required a hint to use or find function

- Tester forgot where function was after using it

! - Tester misused the function

** - The testers' ability to use this function was specifically tested

Table 20: A summary of common complaints about the interface.

Tester	Scroll Sensitive	Trouble Finding Beginning	TOC Hard to Read	Difficult to Find Nodes
2	X		X	
8			X	
9		X	X	X
10	X	X		X
11			X	
12		X	X	X
14			X	X
15				X

Long-Term Study Overview

Considering that testers 1 and 3 did not find the network interface while taking the test and testers 1 and 7 showed an aversion to exploring the functions available to them, AR was overall found to be unintuitive to testers in the long-term study. Like in the laboratory study, the network interface was found to be easy to learn and use with two of the three testers who discovered it also discovering most of its extra features. Tester 7 liked the network interface's extra features after he was made aware of them at the end of the study but felt that the excess of buttons in the application was intimidating and discouraging for end-users. The results of which testers found which functions are summarized in Table 21 and Table 22.

Table 21: A summary of what testers found which functions in the long-term study.

Tester	Resize Window	Resize TOC	Full Screen Mode	Zoom	Pan	Node Drag	Global Search	TOC Search
1	X							
3	X	X	X	X	X	X	X	X
5	X	X	X	X	X		X	X
7	X	X						

Table 22: A summary of what testers found which buttons in the long-term study.

Tester	Previous Page	Next Page	TOC	Show All Labels	Clear All Links	Go to Cover
1						
3	X	X	+	X	X	X
5	X	X	X	X	*	X
7	X	X	X			X

X – Tester found and understood function
* - Tester found and was confused by function
+ - Tester found and understood function with help

5.4.1.1   Scrollbar

The application for all tests was set to shift the text of the e-books by a page when the text scrollbar or mouse wheel was used, and this was confusing to the testers in the laboratory study. Tester 2 and 10 felt that scrolling was too sensitive. Testers 9, 10, and 12 had trouble finding "What do you do?" because they did not scroll down far enough perhaps because of this setting. Testers 9 and 10 eventually found it on their own, but tester 12 had to be prompted to scroll down farther.

5.4.1.2   Forward and Back Buttons

As shown in Table 19, five testers in the laboratory study correctly identified the Forward and Back buttons when prompted to use them. The other three testers incorrectly used the similarly placed Previous Page and Next Page buttons instead. The position of these buttons is shown in Figure 5. In addition, tester 8, who used the correct buttons, was confused by the Back button.

Tester 8, who answered 1f and 1g with "Start Here," explained after the test that she had become confused when the Back button did not behave as she expected. The tester had clicked "The Beginning and End" node when prompted but then scrolled up to "Books by…" before clicking the "Start Here" node. This caused the Back and Forward buttons to jump between the "Books by…" and "Start Here" sections instead of "The Beginning and End" and "Start Here" sections as expected.

The testers who did not find the Forward and Back buttons seemed to understand the function of the buttons and why they had experienced some confusion during the test after the actual Forward and Back buttons were pointed out at the end of the test. Tester 10 said that it was confusing that there were two sets of arrow buttons in the interface, and tester 8 recommended debugging the Back button.

5.4.1.3   Table of Contents

Most testers seemed to find the table of contents to be easy to learn, use, and understand. Many of the testers also commented positively on the network interface for its animated elements, interactivity, and relationship with the text. Finding the button to open the interface, however, proved to be a challenge for half of the testers, and node labels were also difficult to read.

Laboratory Study Results

Four testers commented positively on the network interface. Tester 2 wrote, "The dynamic map setup is really cool!" in the final questionnaire. During the test she said that she liked creating links and liked that the map updated in real time. Tester 8 liked seeing the paths through the story. Tester 10 liked watching the network's animations, verbally exclaiming, "That was cool!" after she discovered that hovering her mouse over a node caused it to grow and shrink and when the network nodes auto-arranged. Tester 11 said that she liked the table of contents during the test and in her final questionnaire.

These testers and others, however, also noted that it had problems with its usability. These included problems finding the button to open the interface and using critical resizing and positioning features. Six testers also found node labels hard to read.

5.4.1.3.1   Button

Finding the table of contents proved to be a significant barrier for four testers as shown in Table 19. Only testers 9 and 14 began by searching for a button when they were prompted to find the table of contents. The other six testers scrolled up and down through the text of the book first. Only testers 2 and 8 began searching the buttons after searching the scrollable sections. The remaining testers had to be prompted to search the buttons. Tester 11 said after finding the table of contents that where it was, was confusing.

Two testers also forgot where this button was located during the test. Tester 10 found the Table of Contents button while exploring the interface on her own. When she was prompted to open the table of contents in the tasks, however, she had to be reminded about it. Tester 15 closed the table of contents during scenario 3 and then forgot how to open it for a couple of minutes.

5.4.1.3.2   Functions

Once testers found the network interface, it appeared to be easy to learn and interact with for most testers. All the testers discovered that nodes could be clicked and that by hovering their mouse over a node, its label would be displayed. Testers were required to use these functions to complete the test. Seven testers felt that the pan and zoom functions were also crucial, either making frequent use of them or expressing a desire for them if they were not discovered. Five of these testers discovered that the network could be panned or zoomed. The three testers who did not discover either function resized the interface instead. The Window Resizing section discusses the relationship between the pan and scale functions and resizing the table of contents in more detail. The results of which testers discovered the pan and scale functions are summarized in Table 23.

Table 23: A summary of how testers interacted with the network interface.

Tester	2	8	9	10	11	12	14	15
Discovered ability to zoom network	X				X		X	X
Discovered ability to pan network	X			X	X			X
Discovered ability to drag nodes								X
Expressed desire to know about zoom			X			X		
Expressed desire to know about pan						X	X	

Some testers tried other methods of performing certain actions with the network before discovering the actual method to use. Testers 11 and 15 attempted to use the table of contents scrollbar to pan the network before discovering that the view was actually panned by clicking and dragging the background. Testers 8, 14, and 15 attempted to interact with the node labels rather than the nodes themselves first. On several occasions, tester 14 attempted to zoom in or zoom out while the mouse was hovering over a node. In this case, zooming is disabled, and the tester only scrolled the table of contents panel. The tester recognized that the mouse had to be in an empty area to zoom in and out.

Testers 9, 11, 12, and 14 expressed during or after the test that scaling, panning, or both were critical functions to have. Tester 9 did not vocalize a desire to know about these functions but did attempt to increase the size of the text in the table of contents by clicking the Increase Text Size button, which suggests that he was looking for a scaling ability. Tester 11 voiced that she liked being able to zoom in and out of the map. Tester 12 liked that the table of contents could be zoomed and panned when the functions were explained after the test. Both tester 12 and 14 wished they had known about both of these functions while taking the test.

Tester 2 and 14 offered some suggestions for improving these functions. Tester 2 commented in the final questionnaire that she accidentally scaled the map instead of scrolling down in the text sometimes and suggested adding a light highlighting to the interface to emphasize which panel the user was controlling. Tester 14 requested adding a tutorial to demonstrate the pan and zoom functions.

Long-Term Study Results
Like the laboratory study, this study found that the network interface was difficult for testers to find but intuitive to use for the most part. Only testers 5 and 7 discovered the interface during the test. Two of the three testers who eventually found the interface explored and discovered many of the network interface's additional functions. These results are summarized in Table 21 and Table 22.

Tester 3, an advanced computer user and a frequent e-reader user, overlooked the Table of Contents button in both Calibre and AR until it was asked about in the questionnaire. After exploring the interface, the tester felt that the network was critical to the overall enjoyment of the book and wished he had discovered the function while performing the test. He suggested it would be easier to find if it were not a simple replacement for Calibre's standard table of contents because it was so easy to ignore.

Tester 5 discovered the network interface and many of its functions but had several recommendations to improve its readability. Among them, he suggested disallowing "dead-end" nodes from connecting back to nodes at the beginning of the book; distinguishing between nodes that were decision points, subtext, and starting nodes; and centering the view when a new link is created. The tester also noted that the interface became choppy when processing large numbers of nodes and links and recommended optimizing the back-end code to make it more usable and appealing.

Tester 7 stated that he was hesitant to explore the interface because of the excess of buttons surrounding it, but his results can also be explained by comparing them to the results of the laboratory study. Tester 7 discovered that the application and the table of contents could be resized. In the laboratory study, testers who discovered both of these resize functions tended not to also discover the pan and zoom functions (see Table 23 and Table 24 and section 5.4.1.6). These testers instead resized the interface until they could see the map reasonably well. It is possible that tester 7 viewed the map in the same way and had no reason to find the pan and zoom functions.

5.4.1.4   Show All Labels and Clear All Links Toggle Buttons

One or both of these buttons were confusing or unhelpful to half of the testers. Three testers found it overwhelming and confusing when all the labels in the network were displayed, which happened when the Show All Labels button was toggled on or after Clear All Links was clicked and no links were in the network. One tester expressed that displaying all the labels was unhelpful. Four testers accidentally deleted their history by clicking the Clear All Links button.

Laboratory Study Results

Of the seven testers who performed task 1j "Find and click the Clear All Links button," all of them found the button easily, but three of them were confused by it and its relationship to Show All Labels. Testers 2, 8, 11, and 12 used the Show All Labels button while exploring the interface on their own. All of them commented negatively on or expressed confusion with this button and its relationship to Clear All Links. Table 19 summarizes what testers found these buttons and their reactions.

Tester 2 was confused by both Show All Labels and Clear All Links. This tester clicked the Show All Labels button while exploring the interface. She was startled and quickly toggled the labels off again. After she clicked the Clear All Links button as directed in the tasks, she was "alarmed and confused" that all the labels were showing and the Show All Labels button would not hide them. She even thought she had broken the application. Before starting scenario 3, tester 2 clicked the Clear All Links button to clear the *Whatley Tupper* map, which she interpreted as being someone else's history. She soon realized that she would be unable to complete the test without this map, and the scenario had to be restarted. The tester voiced during and after the test that she had no impression that Clear All Links was permanent.

Similar to tester 2's reaction to Show All Labels, tester 8 was startled when all the labels were displayed after she clicked Clear All Links. The tester attempted to click the Show All Labels button to toggle off the labels. When it did not do anything, she closed the table of contents without toggling off Show All Labels. This button remained toggled on for the remainder of the test, which caused the tester to have trouble reading the labels in the network interface, particularly while attempting scenario 3.

Tester 11 was startled by the Show All Labels button and did not recognize the Clear All Links button's purpose. While exploring the interface, tester 11 toggled on Show All Labels and became alarmed when all the labels displayed. She clicked the Go to Cover and Clear All Links buttons to try to turn off the labels again but did not toggle off Show All Labels. This button remained toggled on until she was directed to toggle it off shortly after she started scenario 3. She also clicked the Clear All Links button a few times in scenarios 1 and 2 and did not see that it was removing the links from the network. She wondered aloud what its purpose was. It is possible that because Show All Labels was toggled on, there was not a large enough visual change in the map for the tester to notice what was happening.

Finally, tester 12 was not confused by either of the buttons but did find Show All Labels to be unhelpful. He toggled on Show All Labels while manually searching for "temptation" in scenario 3. He quickly toggled it off and voiced that he did not feel it would aid his search.

These testers did not offer direct suggestions for improving the Show All Labels button, but tester 2 made several suggestions for the Clear All Links button, and three testers discussed when labels should be visible. In the questionnaire and interview, tester 2 recommended that the user be warned about the permanence and purpose of Clear All Links or to move this function outside the e-book viewer to Calibre's E-Book Library. As for when labels should be displayed, tester 11 liked when only the labels for the nodes on her current path were visible as opposed to all labels being visible. Tester 12, however, argued that the map was too detailed even when not all the labels were showing. He wanted to see only the labels around his current position. Tester 2 similarly thought that it was hard to read overlapping text in the table of contents.

Long-Term Study Results
All the testers who found the network interface either did not use the Clear All Links button or accidentally deleted their history with it. Tester 5 wrote in the questionnaire that while testing the interface he sadly deleted all his progress once by clicking this button. Tester 3 also appeared to have deleted all his history in both e-books while exploring the network interface. Neither of them reported any confusion about Show All Labels. Tester 7 did not attempt to use either the Clear All Links or Show All Labels buttons.

5.4.1.5   Go to Cover Button
In the laboratory study, this button was useful to four of the six testers who completed task 1k but was also misused or ignored by three testers. Testers 2, 8, 11 and 15 completed task 1k "Return to the cover of the book" by using the Go to Cover button. Testers 9 and 12, however, found it more intuitive to search the nodes manually, and testers 11 and 12 attempted to use the button for other purposes. Tester 11 attempted to toggle off Show All Labels and tester 12 attempted accomplish task 2 "Go to the end of the 'Start Here' section" with it. These results are summarized in Table 19 and Table 26.

5.4.1.6   Window Resizing
While using the network interface, all the testers in the laboratory study found the ability to resize the window or the table of contents to be as important as the ability to pan and scale the network. Most testers succeeded in resizing the window or table of contents to their satisfaction.

When testers first opened the map, the view of the text was mostly obscured by the network interface as shown in the center image in Figure 8. Testers either had to resize the application to view the text and map at the same time or close the network interface to see the text. The application could be resized by clicking and dragging the edges of the window. It could also be maximized. The table of contents could be resized by dragging the divider between it and the text.

Table 24 summarizes what resize functions all the testers used as some point during the test. Seven testers used the resize window or resize table of contents functions. Tester 14 did not discover either function. Testers 9, 10, 11, and 14 discovered full screen mode but did not use it for long. Tester 9 did not see it as useful because it hid all the buttons on the left as shown in Figure 6. Tester 11 used it briefly but preferred to maximize the application instead. Testers 10 and 14 clicked the button to toggle it on while exploring the interface on their own but did not use it.

Comparing Table 23 and Table 24 reveals a near inverse relationship between the testers' discovery of the pan and zoom functions and the resize table of contents function. Testers who resized the table of contents tended not to also discover that the network could be panned and scaled. This may be because they had a full view of the network and had no need to explore how to manipulate it. Conversely, testers who discovered the pan and scale functions tended not to discover that the table of contents could be resized. This suggests that the pan and scale functions and resizing the table of contents satisfied a similar visibility requirement and could somewhat compensate for the lack of the other. Testers who did not discover that the map could be panned or scaled, however, tended to be dissatisfied with their view even if they resized the table of contents, which suggests that resizing alone is only minimally adequate. Tester 14, who did not discover that the table of contents could be resized or that the network could be panned, was the most dissatisfied with his view of the application.

Table 24: A summary of what functions testers used to resize the application during the test.

Tester	2	8	9	10	11	12	14	15
Discovered ability to resize the window	X		X	X	X	X		X
Discovered ability to resize the table of contents		X	X	X		X		
Discovered full screen mode			X	X	X		X	
Expressed desire to know about ability to resize the table of contents					X		X	
Expressed desire to know about ability to resize the window							X	

Table 25 summarizes how testers used the resize functions throughout the test. Five testers preferred to view the map and text side-by-side with testers 2, 11, and 15 resizing the application and leaving the map at its default size and testers 9 and 12 resizing both the map and the application. Testers 8 and 10 preferred to have the map closed most of the time while performing the first two scenarios. Tester 10 maximized the application and resized the table of contents panel shortly after starting scenario 3. Tester 8 was prompted to resize the window when it appeared that she had begun reading *Whatley Tupper* to determine how to complete scenario 3. She resized the map on her own. Tester 14 left the application at its default size, performing scenarios 1 and 2 with the network closed most of the time and performing scenario 3 entirely in the network interface.

Table 25: A summary of how testers viewed the map and text most of the time for each scenario.

Tester	2	8	9	10	11	12	14	15

Scenario 1 and 2	MT	T	RT	T	MT	RT	T	MT
Scenario 3	MT	RT	RT	RT	MT	RT	M	MT

MT – Tester resized the application to view the map at its default size and the text side-by-side
RT – Tester resized the application and the map to view the map and the text side-by-side
T – The application was at its default size and the map was closed most of the time
M – The tester left the application at its default size while viewing the map only

Testers 11 and 14 expressed after the test that they wished they had one or both resize functions. Tester 11 wrote in the final questionnaire that she wanted the table of contents to open side-by side with the text because "it's a little hard to read." Presumably she wanted the map and the text to be equally split when the map was first opened so that it was easier to see. At the end of the test, tester 14 was shown that the window and table of contents could be resized. The tester wished he had known about these functions during the test and felt that a tutorial would have helped.

5.4.2   Can users find specific nodes when prompted?
All the testers used the table of contents search function in the laboratory study at least once and seemed to find it useful once they knew it existed. Using the search function, however, did not appear to be intuitive to the majority of the testers. When asked to find particular nodes, most testers started with a manual search and rarely looked for a search function. Tester 2 was the only participant who did not resort to manually searching for nodes at any point in the test.

Table 26 summarizes the methods that testers used to find specific nodes. Scenario 3 was designed to test this ability, but half of the testers also chose to manually find the "Cover" and "Start Here" nodes to complete task 1k and task 2. The four testers who found the "Cover" node manually found it easily. Finding the "Start Here" node was more difficult. Two testers found the node within a few seconds, but tester 9 stated that finding nodes was difficult, and tester 12 struggled for a couple minutes. Tester 15 also spent a few minutes searching for the "Start Here" node but then scrolled through the text from the cover page to get to the section instead.

In scenario 3, three testers went directly to the table of contents search function when asked to search for specified nodes. The other five testers spent at least a few minutes manually searching nodes before using the search function. Testers 8 and 15 started their search by reading some of the e-book. Four testers had to be told about the table of contents search function.

Table 26: A summary of methods testers used to find specific nodes.

Tester	2	8	9	10	11	12	14	15
Scenario 1 and 2								
"Cover"	B	B	M	N	B	M	N	B
"Start Here"	R	R	M	N	M	MB	M	MR
Scenario 3								
"boiler room"	S	R	S	MG	S	M	M	RMS+
"temptation"	S	MS	S	G	S	S+	M	S

"Rick's challenge"	S	S	S	M	S	S	M	S
"escape"	S	S	S	S+	S	S	S+	S

B – Tester used the Go to Cover button
G – Tester found the node using the global search function
M – Tester searched for the node manually
N – Tester accidently skipped the task asking them to find this node
R – Tester found the node by scrolling through and/or clicking hyperlinks in the text
S – Tester found the node using the table of contents search function
+ - Tester was informed of the table of contents search function

When prompted to find the "boiler room" section, tester 8 read the path from "Start Here" to "Should Whatley investigate the washroom for more clues?" which happens to pass through "boiler room." The tester used this knowledge to answer "List the section(s) on the path from 'Start Here' to 'boiler room.'" She then spent a few minutes manually searching for "temptation" before finding and using the table of contents search function to complete the task and find the other two sections.

Tester 10 began by manually searching for "boiler room" and then wondered aloud, "Is there a search function?" She then attempted to use the Go To function as a search function, which is not its purpose. The global search function, which searches through all the text in the e-book, was then used to find "boiler room" and "temptation." For some reason, this function could not find "Rick's challenge" or "escape" though. The tester manually found "Rick's challenge," and she was prompted to use the table of contents search function to find "escape."

Tester 15 began by scrolling down to the first decision point in *Whatley Tupper*, looking through the decisions, and then closing the table of contents. After a few minutes of scrolling up and down through the sections at the beginning of the book, clicking the Previous Page and Next Page buttons, and considering clicking one of the decision hyperlinks, the tester said, "What'd I do? The map side disappeared." She then re-found the Table of Contents button and began manually searching for "boiler room." She was prompted to use the table of contents search function after a few minutes.

Several of the testers offered suggestions for how to remedy this problem of finding nodes or the search function. While searching for "Start Here," tester 9 stated that he wanted the option to layout the nodes like a classic table of contents to ease his search. The tester elaborated in the questionnaire and interview, recommending that users be able to toggle between a force-directed layout and a rainbow-graph layout of the network. The tester also suggested visually emphasizing the importance of the "Cover" node and the other nodes at the beginning of the book. Testers 14 and 15 requested adding a tutorial that included the search function in their questionnaires and interviews.

5.5 User Testing Summary and Conclusions

These studies tested if Adventurous Reader successfully communicates position and progress in non-linear books to readers. The evidence gathered supports that AR does

communicate this information to a degree, but it also has several problems that impedes its basic usability. Most important among these is the user's inability to find the map interface. The following sub-sections summarize the results of the user studies and present solutions to the interface problems uncovered.

5.5.1 Answers to Research Questions

The research questions explored if users had an understanding of their position and progress while using Adventurous Reader and if that information made it less disorienting than Calibre (Goyal, 2015). The results of user testing revealed that AR's map overall communicates position in the text and the narrative, but users could not estimate their progress and a conclusive comparison to Calibre could not be made.

1. **Do users understand their position in the narrative?**

Somewhat. Based on the evidence collected in the laboratory study, testers appeared to understand their current position, their position in relation to the first section of the book, and their position in relation to other sections. It could not be determined if testers could interpret this position in the context of the book though.

2. **Do users understand the relationship between the e-book's text and the network?**

Yes. When sections were clearly delineated in the text and associated with appropriately labeled nodes, testers seemed to understand the relationship between nodes and sections and links and hyperlinks.

3. **Can users estimate their progress through the e-book from the network?**

No. Testers could make estimations of length and progress using the map, but only half of the testers recognized that the map could be used for this purpose, and estimations were only slightly more accurate than ones made without using the map.

4. **Do users understand how to advance through the text?**

Somewhat. Testers quickly recognized that they would need to click hyperlinks in order to advance through the books. Most testers also expressed that they understood what sections they had viewed and had left to view. The testers in the long-term study, however, wanted more information to help them find new paths.

5. **Do users experience less disorientation in Adventurous Reader than in Calibre?**

This could not be determined. While the evidence gathered in the long-term study suggests that readers do experience less disorientation with the help of AR's map, not enough evidence was gathered for this to be conclusive. Even when Adventurous Reader did not communicate progress and position testers preferred it to Calibre for how it separated sections.

5.5.2 Answers to Usability Questions

In addition to gathering evidence to support the hypothesis, proving that average readers could figure out how to use AR was also important. AR was much less successful in

providing readers with an intuitive interface. Most of the testers failed to find important buttons and functions and also found the node labels in the table of contents difficult to read. Most testers could not find specific nodes easily either.

1. Can users find buttons and functions when needed?

No. Most testers had trouble locating one or more buttons that they were prompted to use during the laboratory study. In the tasks where users were asked to use the search function, the Forward and Back buttons, and the Table of Contents button, half of the testers in each case needed to be shown where the function was. Half of the testers in the long-term study also failed to find the table of contents interface, and half of the testers were wary of exploring the interface.

2. Can users find specific nodes when prompted?

No. All the testers, except tester 2, had trouble finding nodes at some point during the laboratory test. The search function, which only half of the testers discovered on their own, was the only reliable way to quickly find nodes.

5.5.3 Answers to Hypothesis

The results of the studies support that AR communicates position, but it could not be established that this information is enough to reduce disorientation. AR provides readers of non-linear texts with information about their position in the text and the narrative. Overall, testers understood how they got to their current position from the first section of the e-books, showing an understanding of their position in the narrative. Testers also understood what sections they had viewed and had left to view, showing an understanding of their position in the text. All the testers seemed to understand that the map was a representation of the e-book's structure. This information alone, however, was not enough for testers to understand how to estimate their progress or always know where to find a new section of text. It also could not be established whether testers can interpret their current position as shown in the map in the context of the text.

Because users at least understand their position though, this suggests that users of AR would experience less disorientation than they would in other interfaces. While testers in the long-term study who used the map seemed to experience less disorientation, they had contradicting opinions about its usefulness. A tester who did not use the map also thought that keeping track of what he had read was easy without it. These mixed results in combination with the small sample size and the problems in executing the study made drawing conclusions difficult.

5.5.4 Future Modifications

AR shows promise in helping readers to navigate non-linear texts, but its interface needs more work to make it more useful, user-friendly, and attractive. Once users discovered the map interface, it proved to be somewhat understandable and informative, but testers struggled to find it in the first place. Other problems included confusion with buttons, unreadable labels, and an overwhelming number of functions in the interface.

The following modifications will be made to make the interface more intuitive and helpful:

- Display only the labels around the user's current position by default.
- When no links are in the network, display only the label of the user's current position by default.
- Remove the Show All Labels button.
- Emphasize nodes at the beginning of the book with color.
- Emphasize nodes on the user's current path with transparency.
- Emphasize nodes the user hovers their mouse over with transparency.
- Show what nodes have all possible outgoing edges and what nodes do not.
- Calculate percentage viewed and display it in the panel containing the network.
- Display the total length in the panel containing the network.
- Allow users to zoom in and out with their mouse over a node.
- Focus the network view on new node/edge relationships as they are formed.
- Optimize the performance of the map to handle large numbers of nodes and links.
- Do not update the map when the interface is closed to save computing resources.
- Provide users with rainbow graph and force-directed layouts of the nodes.
- Add a warning message to the Clear All Links button.
- Do not associate AR's network interface with a standard table of contents.
  - Change the Table of Contents button to display an image more suggestive of a map.
  - Change the tool tip message of the table of contents button to "Map."
- Create video and written tutorials demonstrating how to use AR and what it is for.

It is clear that the labels displayed in the table of contents should be reduced even further. Even when only the labels on the current path were displayed, testers found them hard to read and even obscuring. Tester 12's suggestion of only displaying the label's around the user's current position will be employed.

The confusing discontinuities between Show All Labels and Clear All Links will also need to be fixed. Showing all the labels was alarming for three testers. Show All Labels was left toggled on twice when it did not seem to do anything in combination with Clear All Links. Testers also seemed averse to using the table of contents with all the labels displayed. For these reasons, the ability to hide distant labels should always exist, and the default state for a map that does not contain any links should be to only display the label of the current node. In a force-directed layout, the ability to view all the labels at once does not seem to be helpful, so it may be best to remove the Show All Labels button.

To further improve the legibility of the interface, suggestions given by testers 5 and 9 will also be implemented. Both testers felt that distinguishing the nodes at the beginning of the book, where users will likely return repeatedly, was important and recommended coloring them differently. This would also assist users who do not find the Go to Cover

button. Tester 5 also recommended decreasing the transparency of distant nodes and edges to make seeing the current path and emphasized nodes easier.

The two testers in the long-term study who attempted to explore the entirety of the given e-books wanted more information to help them find new paths to follow. Tester 3 recommended showing untraversed paths in the network with dashed lines, but this would be undesirable to readers who want to explore pick-a-path books without having the endings spoiled. Tester 5 recommended adding another label to each node to show the maximum number of outgoing edges. These extra labels could make the current labels difficult to read and clutter to network interface though. Instead, the nodes will be colored so that nodes that do not have the maximum number of outgoing links are colored differently than nodes that do.

AR also fails to communicate how much of the book the user has read and has left to read and the book's length. Rather than relying on the reader to accurately estimate this information, it will be calculated and displayed directly in the network interface panel.

Nodes were also hard to find for most of the testers. In an attempt to remedy this, tester 9's suggestion of adding a rainbow graph layout will be implemented. This will allow users to systematically search nodes arranged like a classic table of contents if desired. Users will also be able to toggle between Calibre's interface and Adventurous Reader.

Several other minor usability problems with the interface will also be fixed. The ability to zoom in and out while the mouse is over a node will be allowed. Testers 2, 5, 7, and 10 liked creating new connections in the map and watching it auto-arrange. Tester 5 wrote, however, that sometimes these connections are formed off screen, and the network does not adjust the view automatically. Implementing this feature may also encourage readers who do not discover that the network can be panned and scaled on their own to try these manipulations. Tester 5 also noted that the map performed poorly with a large number of nodes and links. These problems will be addressed.

Tester 2's suggestion of adding a warning message to the Clear All Links button will also be added. This will reduce the occurrence of accidental deletion as was done by testers 2, 3, 5, and 11. It will also explain what the function is, which tester 11 seemed to need.

Finding the button that opened the network interface was problematic for half of the testers. Tester 3, who uses an e-reader daily but did not find this function on his own, stated that it was easy to overlook and that it did not make sense to associate AR's map with a table of contents. This tester's advice will be included in AR's improvements.

Finally, a video and written tutorial on how to use AR's crucial functions and their purpose will be released with the application. Testers 14 and 15 felt that a tutorial would have helped them. These tutorials will be included separately of the application to avoid interfering with Calibre's interface, but the results of the long-term study reveals the well-known fact that most people are unwilling to read readme documents. A short video demonstrating AR will hopefully be more helpful to interested users.

5.5.4.2   Calibre

Adventurous Reader's modifications to Calibre aimed to change Calibre's basic layout as little as possible so the two interfaces could co-exist in the same application without disturbing existing users. Many of the users testing AR, however, had problems with Calibre's basic functions that are also crucial to AR. The following modifications to Calibre are recommended based on the results of this user study but will not be implemented without consulting Kovid Goyal:

- Reduce the number of buttons and functions available to the user by default in the viewer.
  - o Remove the Load a Theme button from the main interface. Make advanced users go through Preferences to change this setting.
  - o Hide the Reference Mode button and the Go To function by default. Make advanced users opt-in to see these elements in the viewer Preferences.
  - o Collapse the Increase Font Size and Decrease Font Size buttons into a Font menu button that also gives users the option to change font styles.
  - o Consider removing the Copy to Clipboard and Show Book Metadata buttons, making them opt-in features, or collapsing them into an Advanced Features menu button with the Print function.
- Make the Previous Page and Next Page buttons large buttons to either side of the text viewer panel or transparent buttons that overlay the text viewer panel when the mouse is moved.

The excess of buttons in the interface did not seem to be friendly to inexperienced users. Testers 1, 7, 10, 11, 12, and 15 showed an aversion to exploring the buttons and functions in the e-book viewer or commented negatively on the excess of options available. Tester 12 had never used an e-reader before and the other testers were not advanced computer users. Tester 8, the only average computer user who searched the buttons without being prompted, spent more time reading for entertainment than any other tester. A comment made by tester 7 explains these results well:

"…the current layout of the app in general reminded me more of software creation tools (like a game engine or 3D modeling program or word processing program) than a user-friendly app designed for speed and ease of use by the end user… the onslaught of buttons tends to suggest to the uninitiated 'I better not click those lest I break something.'"

Three of the testers in the laboratory study also used the Previous Page and Next Page buttons in place of the Forward and Back buttons because of their similar placement and look. Placing these buttons somewhere that might better convey their function may reduce the occurrence of this confusion.

6 Future Work

Once the next stage of development is complete, AR could be subject to more user testing to determine if the planned modifications are successful in improving its usability. Given the flaws in the studies conducted in this research, additional testing to support that AR can orient users in non-linear spaces, particularly in other types of non-linear fiction and non-fiction, would be welcome. Now that it is publicly available, it can be used for practical purposes, and additional feedback about its usefulness can be gathered from developers, scholars, readers, and writers.

6.1 Release

Adventurous Reader was developed so that it could be merged into Calibre's (Goyal, 2015) source code with as little interference as possible. Users of Calibre would have the ability to toggle between Calibre's default interface and Adventurous Reader's interface, depending on what interface they want to use and would best suit the open e-book. For now, AR will be released as a modified version of Calibre until sufficient documentation, proof of its effectiveness, and interest can be obtained.

AR's source code can be found on GitHub (https://github.com/silentfuzzle/calibre), and installers and tutorials are currently available at https://gatesmediablog.wordpress.com/adventurous-reader/. The installers support modern 32- and 64-bit Linux, 32- and 64-bit Windows, and 64-bit Macintosh operating systems. In other words, all operating systems that the current version of Calibre (2.28.0 at the time of this writing) supports are supported by Adventurous Reader. Installers for several versions of AR are available. Version "2.27.0 Original AR" is the version of AR that was tested in the user studies in this research with some bug fixes. Version 2.23.0 includes some of the proposed modifications, and version 2.28.0 includes all of the proposed modifications except the performance optimizations to the network interface and coloring nodes to show whether all outgoing links have been explored or not.

6.2 Future User Testing

With the improvements made to its interface, Adventurous Reader could be subject to more tests of its general usability, to investigate the hypothesis in this research, and to determine how helpful an understanding of position is in the comprehension of non-linear texts. Because of suspected flaws in the user studies, it could not be determined whether readers can interpret the position of a node in the context of the story or whether users feel less disoriented while using Adventurous Reader as compared to Calibre. The long-term and laboratory studies could be conducted again with some modifications. A new study to determine if understanding their position helps users to comprehend and enjoy non-linear books with more complex structures could also be performed.

Before the laboratory study is performed again, two modifications are recommended. First, the Table of Contents should be referred to as a Map to match the new interface design and the user's expectations. Second, the fourth version of scenario 3 may be sufficient for re-testing, but it could also be rewritten again or conducted with a different e-book or scenario. The motivation behind the current scenario was to have testers

investigate a potential mistake in *Whatley Tupper* where a character has an object that it is impossible for him to have given the current path through the book. This scenario could be flipped so that a character obtains an object in a particular section, and the testers must determine if the character has that object in several other sections. This may reduce the complexity of the question.

The long-term study can also be improved in two ways. First, the researcher should meet with the testers face-to-face to talk through the instructions and introduce the basics of both interfaces. The testers should not be relied on to read the given instructions. Second, the e-books used in the study should be much shorter. Short stories to novella-length books may encourage more testers to complete the study as assigned.

In this research, arborescent fictions were used in user testing and demonstrations, but AR's uses in displaying books with network or axial structures is also of interest. Understanding of position and progress is important for readers of arborescent fictions who want to find all the paths through a book or want to find the "perfect ending." For network and axial fictions though, this information can not only help readers find all the sections in the book but could also increase their enjoyment and comprehension of it (Pope, 2007). Future testing could include comparing feelings of comprehension, enjoyment, and unease between testers reading a book such as *253* (Ryman, 1996) in its original form as a website and testers reading an e-book version in Adventurous Reader.

7 Conclusion

This research sought to ease the creation and publication of non-linear digital texts by creating an e-reader that allowed authors to take advantage of the strengths of e-books while providing readers with an informational and intuitive interface. An overview of current publishing methods revealed that digital non-linear books are difficult for authors to sell if desired and create and are prone to presenting readers with unintuitive and uninformative interfaces. E-books were argued to be a promising medium for these books as they have many strengths that make publishing convenient for authors and readers. An e-reader called Adventurous Reader was developed and presented as a solution for readers to use in the viewing of non-linear e-books. This interface was tested and shown to provide users with positional information that is necessary in non-linear spaces.

E-books were selected as the platform for this research for their strengths. They are visible and familiar to authors and readers, easy to create, and easy to distribute and sell. Applications and websites, more common platforms for publishing non-linear texts, are more flexible in format than e-books, but they are not easy to get in front of potentially interested readers and are sometimes difficult to create. Despite their strengths, e-books have been ignored for the traditional and unintuitive way they are displayed in e-readers as well as their limitations in supporting multimedia.

To improve the way that non-linear e-books are displayed, Adventurous Reader was developed in accordance with the theories presented by James Pope about the importance of user interface design in the presentation of digital, non-linear texts (Pope, 2007). Pope argues that when average readers are presented with these texts, they are often frustrated

and disoriented by interfaces that do not have adequate information about progress or position. Thus, Adventurous Reader provides users with a map that tracks this information to reduce feelings of disorientation. In addition, the sections of the e-book were divided to provide an interface that is argued to be more familiar to Internet users and also preserved the separation of sections that intrigues authors.

User testing of Adventurous Reader revealed that it successfully provides readers with information about their position in the narrative and the text, but it had some usability problems and it could not be established as a superior interface for orienting users. AR conveys the user's position in relation to the beginning of books and in relation to other sections. Users praised how AR separated sections but wanted more information to help them find new sections to read. Its interface also had several problems that impeded its usability. The excess of buttons overwhelmed inexperienced users, the network interface was difficult to read, and some buttons were confusing.

AR was developed with the idea that it would improve the reader's experience in reading non-linear works, but more user testing is required to determine if this is true. In this research, user testing focused on general usability and understanding of position in the relatively simple structure of pick-a-path books. Little evidence was gathered to support that readers will find non-linear books more enjoyable or understandable in Adventurous Reader. Once AR's interface has been improved to be more friendly to users and provide more information, more testing is required to determine if the information it provides makes the reading of more complex non-linear works such as network fictions less daunting and more enjoyable for average readers.

While Adventurous Reader may be an interesting research subject for its uses with hypertexts, network fiction, and electronic literature, it was most of all developed for readers and authors to use. It is hoped to be a useful tool for readers to use in exploring existing and future non-linear e-books. For authors, it is hoped to inspire them to use the strengths of e-books as they explore the possibilities of non-linear books for education and entertainment in digital, hypertext environments.

8 Acknowledgments

9 Appendix

9.1 Laboratory Study Testing Materials

9.1.1 Introductory Script

Hello. And welcome to Adventurous Reader, an e-reader for non-linear e-books. I'd like to take this opportunity to thank you for volunteering your time to help me test this new interface for interactive and experimental narratives. I will be reading from this script to ensure consistency between all of my participants.

Adventurous Reader keeps track of the reader's progress and position in the complex structures of Choose Your Own Adventure e-books and experimental fiction and non-fiction. Today you'll be using it to view *The Most Boring Book Ever Written* and *The Adventures of Whatley Tupper*, two Choose-Your-Own-Adventure style books by Rudolf Kerkhoven and Daniel Pitts. Please note that Adventurous Reader is still in its development stage and that it may break down under certain circumstances. If that does happen, I will restart the program.

Understand that this exercise is to test the product and its usability and in no way implies your abilities. If at any time you feel uncomfortable, please inform me and I will terminate the exercise immediately. I will be recording video and audio during this exercise using screen capture software so that I can gather as much information as possible. The map that you produce in Adventurous Reader will also be saved. These items will be destroyed when I've finished analyzing them.

Your opinions and ideas are important. Whenever possible, please speak your thoughts freely. Do not be concerned about offending me. If you forget to think aloud, I'll remind you to keep talking.

As you're working with Adventurous Reader, I won't be able to provide help or answer questions. This is because I want to create the most realistic situation possible. Even though I won't be able to answer your questions during the exercise, please ask them. I'll note your questions and answer them at the end of the exercise.

Do you have any questions?

9.1.2 Scenarios and Tasks (Version 2)

Scenario 1: You've just installed Adventurous Reader and are eager to see if it makes *The Most Boring Book Ever Written* more interesting.

1 Explore the interface.
    a Scroll down until you find "What do you do?"
    b Scroll back up to the cover.
    c Open the Table of Contents.
        i Write the title of the section that contains the cover of the book below.

      ii Write the titles of the sections you viewed below.

      iii Write the title of the section that contains "What do you do?" below.

d   Using the Table of Contents, go to "The Beginning and End" section.
e   Using the Table of Contents, go to the "Start Here" section.
f   Find and click the Back button.
      i Write the title of the section you're viewing below.

g   Find and click the Forward button.
      i Write the title of the section you're viewing below.

h   Read the "Start Here" section.
      i Based on what you've seen so far, how much of the book would you estimate that you've viewed? (Circle one)
         a) less than 5%
         b) about 10%
         c) about 20%
         d) about 30%
         e) I can't tell

      ii Based on what you've seen so far, what would you estimate about this book's length? (Circle one)
         a) It's a short story; I could easily read it in an hour or two.
         b) It's longer than a short story, but I could still read it within a day.
         c) I would need at least several days to read this.
         d) It would take me at least a week or more to read this.
         e) I can't tell

j

      i   Answer the question "What do you do?"
     j   Find and click the Clear All Links button.
    k   Return to the cover of the book.

Scenario 2: You're done exploring Adventurous Reader's interface for the moment and are ready to start reading *The Most Boring Book Ever Written*.

2   Go to the end of the "Start Here" section.
3   Answer the question "What do you do?"
4   Continue reading and answering questions until you reach "The Beginning and End" section. (Note: While you are encouraged to read as must as you'd like, you will not be tested on this book's content. You may skip reading, but do continue selecting choices until you reach "The Beginning and End." I will give you up to twenty minutes to read before prompting you to finish and move on.)

      i   Based on what you've seen so far, how much of the book would you estimate that you've viewed? (Circle one)
          a) less than 5%
          b) about 10%
          c) about 20%
          d) about 30%
          e) I can't tell

     ii   Based on what you've seen so far, what would you estimate about this book's length? (Circle one)
          a) It's a short story; I could easily read it in an hour or two.
          b) It's longer than a short story, but I could still read it within a day.
          c) I would need at least several days to read this.
          d) It would take me at least a week or more to read this.
          e) I can't tell

Scenario 3: You've had Adventurous Reader for a while and have used it to read *The Adventures of Whatley Tupper*. While reading the book, you noticed something strange. In the section titled "Should he continue down the hallway towards the boiler room?" Whatley loses his trusty flashlight, but you think you remember Whatley using it in paths branching off of this section. This would be impossible because the flashlight is lost. You decide to investigate with Adventurous Reader.

5   Open *The Adventures of Whatley Tupper* (located on the Desktop).
6   Ensure that you have completely read Scenario 3.
7   Find "Should he continue down the hallway towards the boiler room?" in the Table of Contents.
      i   List the section(s) on the path from "Start Here" to "Should he continue down the hallway towards the boiler room?"

8   Find "Should he resist temptation and simply push the box back into its hiding place?"

        i   List the section(s) on the path from "Start Here" to "Should he resist temptation and simply push the box back into its hiding place?"

        ii   Can Whatley have his flashlight in this section? (Circle One)
            a)   Yes
            b)   No
            c)   I can't tell

9   Find "Should he take up Rick's challenge and have an arm wrestling match?"
        i   Can Whatley have his flashlight in this section? (Circle One)
            a)   Yes
            b)   No
            c)   I can't tell

10 Find "Should Whatley try to escape through the door?"
        i   Can Whatley have his flashlight in this section? (Circle One)
            a)   Yes
            b)   No
            c)   I can't tell

9.1.3   Scenario 3 (Version 4)

Scenario 3: You've had Adventurous Reader for a while and have used it to read *The Adventures of Whatley Tupper*. While reading the book, you noticed something strange. In the section titled "Should he continue down the hallway towards the boiler room?" Whatley loses his trusty flashlight, but you think you remember Whatley using it in paths branching off of this section. This would be impossible because the flashlight is lost. You decide to investigate if the author made a mistake with Adventurous Reader.

1   Open *The Adventures of Whatley Tupper* (located on the Desktop) using a button in Adventurous Reader.
2   Find "Should he continue down the hallway towards the boiler room?" in the Table of Contents.
    i   List the section(s) on the path from "Start Here" to "Should he continue down the hallway towards the boiler room?"

3   Find "Should he resist temptation and simply push the box back into its hiding place?"
    i   Is "Should he continue down the hallway towards the boiler room?" on the path from "Start Here" to "Should he resist temptation and simply push the box back into its hiding place?" (Circle One)
         a) Yes
         b) No
         c) I can't tell

    ii   Considering that Whatley lost his flashlight in "Should he continue down the hallway towards the boiler room?" and has not had a chance to recover it, should he be able to have his flashlight now? (Circle One)
         a) Yes
         b) No
         c) I can't tell

4   Find "Should he take up Rick's challenge and have an arm wrestling match?"
    i   Is "Should he continue down the hallway towards the boiler room?" on the path from "Start Here" to "Should he take up Rick's challenge and have an arm wrestling match?" (Circle One)
         a) Yes
         b) No
         c) I can't tell

    ii   Considering that Whatley lost his flashlight in "Should he continue down the hallway towards the boiler room?" and has not had a chance to recover it, should he be able to have his flashlight now? (Circle One)
         a) Yes
         b) No
         c) I can't tell

5   Find "Should Whatley try to escape through the door?"
    i   Is "Should he continue down the hallway towards the boiler room?" on the path from "Start Here" to "Should Whatley try to escape through the door?" (Circle One)
         a) Yes
         b) No
         c) I can't tell

    ii   Considering that Whatley lost his flashlight in "Should he continue down the hallway towards the boiler room?" and has not had a chance to recover it, should he be able to have his flashlight now? (Circle One)

a) Yes
b) No
c) I can't tell

9.1.4 [Post-Test Questionnaire](#)

1. Which of the following mediums have you used for entertainment? (Select all that apply)
   ____ Books
   ____ E-books
   ____ Video games
   ____ Text adventures
   ____ Choice of… games/Choose-Your-Own-Adventure style games
   ____ Visual novels
   ____ The Internet

2. How often do you read in any of the above mediums for entertainment? (Circle one)
   a. Rarely
   b. 1-9 hours a week
   c. 10-20 hours a week
   d. More than 20 hours a week

3. How often do you use e-readers for viewing e-books? (Circle one)
   a. I use an e-reader daily.
   b. I use an e-reader one or more times per week.
   c. I use an e-reader a few times a month.
   d. I use an e-reader rarely.
   e. I've never used an e-reader.

4. Have you ever used the Calibre e-reader before? (Circle one)
   a. Yes
   b. No
   c. Unsure

5. Have you ever read a Choose-Your-Own-Adventure style e-book? (Circle one)
   a. Yes
   b. No
   c. Unsure

6. What did you like about Adventurous Reader?

7. What did you dislike about Adventurous Reader?

8. Do you have any suggestions for improving Adventurous Reader?

9.2 Long-Term Study Testing Materials

9.2.1 Instructions

Thank you for participating in this study of the Calibre and Adventurous Reader e-book viewer interfaces. This document contains your instructions for this test. If you have any questions, you can contact me Emily Palmieri at emily.palmieri@umontana.edu.

In this study, you'll be using two e-reader interfaces to read *The Adventures of Whatley Tupper* and *The Redemption of Mr. Sturlubok*, two Choose-Your-Own-Adventure style e-books by Rudolf Kerkhoven and Daniel Pitts. At this point, you should have the software you'll be using installed on your machine and have two e-book files I've provided.

The application I've installed is a modified version of Calibre, an open-source e-book viewer, editor, converter, and library organizer. You'll be testing the e-book viewer, which has been modified for the purposes of this test. Please note that this Calibre modification is in development and that it may break down under certain circumstances. If that does happen, restart the program. Contact me if you encounter persistent problems. If you are ever asked to update Calibre, select "No."

In the e-book viewer, you'll find a toggle button in the upper right that will allow you to switch between the two interfaces you'll use during this study. When it is depressed, you'll be viewing the "Calibre" interface where all the sections in the open e-book are listed in the Table of Contents. When it is pressed, you'll be viewing the "Adventurous Reader" interface where the "Table of Contents" is a network of nodes representing sections.

You are encouraged to read as much of the e-books I've provided as you would like, but know that you will not be tested on their content. Given the time constraints, asking you to read the full length of both books is unreasonable and not the goal of this exercise. The e-books will be yours to keep, so do not feel rushed to read them if you enjoy them. Your goal is rather to find and follow all the hyperlinks in each e-book. You should complete this task in two or more reading sessions where a session begins when the e-book viewer is opened and ends when it is closed. Preferably, at least two of these sessions should be a day or more apart. In other words, you should simulate reading the entire e-book even if you don't actually read all of it.

You will have at most three weeks to complete the study. I will contact you after the first week to check your progress and after the third week to schedule a final meeting. At that time, you will fill out a questionnaire, and I will make a copy of the files containing your progress through both books for analysis. The questionnaire will focus on your experience with using the Calibre and Adventurous Reader interfaces and ask you to compare them. It will also ask you about the ease with which you were able to find all the links in each e-book. If you finish your tasks before the three week limit ends, feel free to contact me to schedule this final meeting. At any time, you may end your participation in the study. When you've completed the study or otherwise ended your participation, I will help you uninstall the software if you wish.

Attached to this document you will find which interface you should use to read each e-book. Please complete these tasks in order. Thank you again, and if you have any questions, please contact me.

9.2.2   Tasks

Tasks received by testers 3 and 5:
Calibre is installed here: _____
The e-books can be found here: _____
End date: _____
Your Tasks:
Task 1: Use Calibre to read *The Adventures of Whatley Tupper*.
Task 2: Use Adventurous Reader to read *The Redemption of Mr. Sturlubok*.

Tasks received by testers 1 and 7:
Calibre is installed here: _____
The e-books can be found here: _____
End date: _____
Your Tasks:
Task 1: Use Adventurous Reader to read *The Adventures of Whatley Tupper*.
Task 2: Use Calibre to read *The Redemption of Mr. Sturlubok*.

9.2.3   Readme

The e-book viewer you'll be using is included as part of a modified version of Calibre, an open-source e-book viewer, editor, converter, and library organizer. You've been given a complete install of Calibre with all its parts, but you are only required to use the e-book viewer, which has been modified for this test. Before beginning, you should be familiar with how to open the e-book viewer, how to open an e-book, and the Back, Forward, and Table of Contents functions in the viewer. If you're unsure, please read over this document and contact me if you have further questions.

How to open Calibre's e-book viewer
There are a several ways in which you can open the e-book viewer. Here is one example:
1. Open the Calibre Portable folder. The location where I've saved this folder on your machine can be found on your Instructions sheet.
2. Open the calibre-portable.exe executable. This opens Calibre's library organizer.

3. Select the e-book you wish to open from the table.
4. Click the View button located at the top of the window.

You can also open the e-book viewer directly using the ebook-viewer.exe executable located in the Calibre sub-folder.

Open ebook Function
You can open an e-book through Calibre's library organizer as described in the steps above, or you can use the Open ebook button, the third button from the top in the e-book viewer, to select an e-book from your file system or from a list of recently opened e-books. The location of the e-books I've given you for this test can be found on your Instructions sheet.

Back and Forward Functions
The Back and Forward buttons located at the upper left of the e-book viewer work similarly to the Back and Forward buttons in a web browser. When you click hyperlinks in an e-book's text, your current position is added to your history before you jump to the location the link points to. The Back and Forward buttons allow you to jump between these positions in both the Calibre and Adventurous Reader interfaces.

Table of Contents Function
The Table of Contents button, the button with the blue bars on the left in the e-book viewer, displays and hides the Table of Contents, an interface that displays all the sections in the open e-book. While the Calibre and Adventurous Reader interfaces display this information differently, they have similar features. For example, you can click a title in Calibre's Table of Contents or click a node in Adventurous Reader's Table of Contents to jump to the location of the corresponding section in the text.

9.2.4   Post-Test Questionnaire

1. Which of the following mediums have you used for entertainment? (Select all that apply)
   ____ Books
   ____ E-books
   ____ Video games
   ____ Text adventures
   ____ Choice of… games/Choose-Your-Own-Adventure style games
   ____ Visual novels
   ____ The Internet

2. How often do you read in any of the above mediums for entertainment? (Circle one)
   a. Rarely
   b. 1-9 hours a week
   c. 10-20 hours a week
   d. More than 20 hours a week

3. How often do you use e-readers for viewing e-books? (Circle one)
   a. I use an e-reader daily.
   b. I use an e-reader one or more times per week.
   c. I use an e-reader a few times a month.
   d. I use an e-reader rarely.
   e. I've never used an e-reader.

4. Have you ever used the Calibre e-reader before? (Circle one)
   a. Yes
   b. No
   c. Unsure

5. Have you ever read a Choose-Your-Own-Adventure style e-book? (Circle one)
   a. Yes
   b. No
   c. Unsure

6. About how much of *The Adventures of Whatley Tupper* did you read? (Circle one)
   a. Less than 1/4
   b. More than 1/4 but less than 1/2
   c. More than 1/2 but less than 3/4
   d. More than 3/4 but not all of it
   e. I read everything.
   f. Unsure

7. Did you enjoy what you read of the book? (Circle one)
   a. Yes
   b. No
   c. I read too little of it to tell.

8. Did any of the following prevent you from enjoying the book? (Select all that apply)
   ____ I found the book boring.
   ____ The book does not match my tastes.
   ____ I was focused on the assigned task.
   ____ My time was too constrained to enjoy reading.
   ____ The assigned interface was difficult or confusing to use.
   ____ I was concerned by how large the book was.
   ____ I couldn't tell how much of the book I'd read.
   ____ I was worried about losing track of what paths I'd read.
   ____ Other (Please explain in the space below)

9. How confident are you that you followed every link and found every section in *The Adventures of Whatley Tupper*? (Circle one)
   a. Very confident
   b. Somewhat confident
   c. Neutral
   d. Somewhat unconfident
   e. Very unconfident

10. What strategy did you use to find every link in *The Adventures of Whatley Tupper?* (Circle one)
    a. When I reached the end of a path, I started at the beginning of the book and picked the nearest new path to follow.
    b. When I reached the end of a path, I started at the beginning of the book and picked a random new path to follow.
    c. When I reached the end of a path, I clicked the Back button until I found a new path to follow.
    d. I used a mix of a, b, and c.
    e. I viewed the book linearly. For each link I found, I clicked it, clicked the Back button, and continued scrolling down to the next link.
    f. I didn't use a systematic strategy.
    g. Other (Please explain in the space below)

11. For each statement, mark the box that best describes how often you encountered the corresponding scenario while reading *The Adventures of Whatley Tupper*.

	Always	Often	About half	Sometimes	Rarely	Never
a) I had trouble remembering which paths I'd followed.						
b) I didn't know how much of the book I had viewed.						
c) I had to re-read sections to determine if they were new.						
d) I had trouble finding where I'd left off between reading sessions.						
e) The interface informed me how much of the book I had left to view.						

f) The interface helped me determine which paths I'd followed.					
g) The interface helped me find new paths to follow.					

12. About how much of *The Redemption of Mr. Sturlubok* did you read? (Circle one)
    a. Less than 1/4
    b. More than 1/4 but less than 1/2
    c. More than 1/2 but less than 3/4
    d. More than 3/4 but not all of it
    e. I read everything.
    f. Unsure

13. Did you enjoy what you read of the book? (Circle one)
    a. Yes
    b. No
    c. I read too little of it to tell.

14. Did any of the following prevent you from enjoying the book? (Select all that apply)
    ____ I found the book boring.
    ____ The book does not match my tastes.
    ____ I was focused on the assigned task.
    ____ My time was too constrained to enjoy reading.
    ____ The assigned interface was difficult or confusing to use.
    ____ I was concerned by how large the book was.
    ____ I couldn't tell how much of the book I'd read.
    ____ I was worried about losing track of what paths I'd read.
    ____ Other (Please explain in the space below)

15. How confident are you that you followed every link and found every section in *The Redemption of Mr. Sturlubok*? (Circle one)
    a. Very confident
    b. Somewhat confident
    c. Neutral
    d. Somewhat unconfident
    e. Very unconfident

16. What strategy did you use to find every link in *The Redemption of Mr. Sturlubok?* (Circle one)

a. When I reached the end of a path, I started at the beginning of the book and picked the nearest new path to follow.
b. When I reached the end of a path, I started at the beginning of the book and picked a random new path to follow.
c. When I reached the end of a path, I clicked the Back button until I found a new path to follow.
d. I used a mix of a, b, and c.
e. I viewed the book linearly. For each link I found, I clicked it, clicked the Back button, and continued scrolling down to the next link.
f. I didn't use a systematic strategy.
g. Other (Please explain in the space below)

17. For each statement, mark the box that best describes how often you encountered the corresponding scenario while reading *The Redemption of Mr. Sturlubok*.

	Always	Often	About half	Sometimes	Rarely	Never
a) I had trouble remembering which paths I'd followed.						
b) I didn't know how much of the book I had viewed.						
c) I had to re-read sections to determine if they were new.						
d) I had trouble finding where I'd left off between reading sessions.						
e) The interface informed me how much of the book I had left to view.						
f) The interface helped me determine which paths I'd followed.						
g) The interface helped me find new paths to follow.						

18. In the task where you were assigned to read a book in Calibre, did you ever use the Adventurous Reader interface? (Circle one)
    a. Yes
    b. No
    c. Unsure

19. If you answered "Yes" to the previous question, why did you use the Adventurous Reader interface? (Select all that apply)

____ I wanted to see how much of the book I had left to explore.

____ I wanted to see how long the book was.

____ I was checking to see if I'd viewed the current section before.

____ Calibre's Table of Contents was confusing.

____ Calibre's display of the book's text was confusing.

____ I liked how Adventurous Reader displayed the book's sections more.

____ I liked Adventurous Reader's Table of Contents more.

____ I was curious what the book looked like in the Adventurous Reader interface.

____ I could complete the task faster with Adventurous Reader.

____ Other (Please explain in the space below)

20. In the task where you were assigned to read a book in the Adventurous Reader interface, did you ever use the Calibre interface?

    a. Yes

    b. No

    c. Unsure

21. If you answered "Yes" to the previous question, why did you use the Calibre interface? (Select all that apply)

____ I wanted to see how much of the book I had left to explore.

____ I wanted to see how long the book was.

____ I was checking to see if I'd viewed the current section before.

____ Adventurous Reader's Table of Contents was confusing.

____ Adventurous Reader's display of the book's text was confusing.

____ I liked how Calibre displayed the book's sections more.

____ I liked Calibre's Table of Contents more.

____ I was curious what the book looked like in Calibre.

____ I could complete the task faster with Calibre.

____ Other (Please explain in the space below)

22. About how much time did you spend in the Adventurous Reader interface?

    a. Less than an hour

    b. 1-2 hours

    c. 2-10 hours

    d. More than 10 hours

23. About how much time did you spend in the Calibre interface?
    a. Less than an hour
    b. 1-2 hours
    c. 2-10 hours
    d. More than 10 hours

24. Which of the following functions did you discover in either interface? (Select all that apply)
    ____ The application is resizable.
    ____ The table of contents panel is resizable.
    ____ There is a full screen mode.
    ____ There is a table of contents search function.
    ____ There is a global search function.
    ____ The Next Page button
    ____ The Previous Page button

25. Which of the following functions did you discover in the Adventurous Reader interface? (Select all that apply)
    ____ The network can be panned.
    ____ The network can be scaled.
    ____ You can click and drag nodes to manually place them.
    ____ You can double-click manually placed nodes to allow them to float freely again.
    ____ You can click links to center the view over the target node.
    ____ The Show All Labels button
    ____ The Clear All Links button
    ____ The Go to Cover button

26. Of the functions that you discovered in questions 24 and 25, did you find any of them confusing? If so, explain.

27. Did you prefer using either interface? (Circle one)
    a. I preferred the Calibre interface over the Adventurous Reader interface.
    b. I preferred the Adventurous Reader interface over the Calibre interface.
    c. I liked both of them.
    d. I didn't like either of them.

28. Explain your answer to the previous question.

29. Would you use the Adventurous Reader interface to read other Choose-Your-Own-Adventure style books? Why or why not?

30. Do you have any suggestions for improving the Adventurous Reader interface?

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