

**A Multivariate Analysis of the Human Factors and Preferences Towards
Digital Publishing Platforms for the iPad**

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A Thesis submitted in partial fulfillment of the requirements
for the degree of Master of Science
in the School of Media Sciences
in the College of Imaging Arts and Sciences
of the Rochester Institute of Technology

December 13th, 2012

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Abstract

Tablet computers are widely adopted in America today, with 34% of American adults ages 18+ owning these type of devices (PEW, 2013). With the emergence of new portable computer technology, reading has become more popular than ever before on digital devices. In particular, tablet computers have enabled users to read enhanced E-Book material that, while still text driven, incorporate all facets of multimedia and technology. With many different digital publishing solutions available for publishers to deploy their content, the goal of this research study was to determine if there are significant differences in user preferences and comprehension for a publication recreated with three different digital publishing solutions (Adobe DPS, iBooks Author, and EPUB).

The methodology of this research study was a human factors experiment testing for a significant difference in the reading experience of subjects exposed to one of three digital publications. A field experiment consisting of ninety individuals assessed these publications, thirty for each of the three output formats. Each publication was evaluated by the subjects in terms of the following criteria:

- The value added by the multimedia elements of the publication
- Their pleasure with the overall experience
- Their interaction with the multimedia elements
- Their ability to recognize information and comprehend material from the publication

The key results of this experiment determined that:

- No significant difference among the publications was found for:
 - The pleasure with the overall experience
 - The interaction with the multimedia elements
- A marginally significant difference among the publications was found for:
 - The value added by the multimedia elements of the publication
- A significant differences among the publications was found for:
 - The ability to recognize information and comprehend material from the publication

Ultimately, these results showed a trend that readers' of the digital publishing platforms that allowed for greater interactivity experienced more value added by the multimedia elements of the publication and increased ability to recognize information from the publication. However, the pleasure with the overall experience of the publication and the readers' interaction with the multimedia elements in the publication was determined to not have a significant difference between the publications.

Therefore, while readers' did not tend to interact differently with the multimedia content or experience any greater pleasure based on the publication they read, readers' of more interactive publications did tend to see more value added by the multimedia elements and were better able to recognize the information they had experienced.

Chapter 1

Introduction

Statement of the Problem

Reading has empowered education and human advancement for thousands of years. Sending a man to the moon, harnessing nuclear energy, conceptualizing and developing computers; these are some of mankind's most important and influential achievements. None of these accomplishments, however, would have been made possible if it wasn't for reading and learning. With the emergence of new portable computer technology, reading has become more popular than ever on digital devices. In particular, tablet computers have been introduced into the market, enabling users to read enhanced E-Book material that, while still text driven, incorporate all facets of multimedia and technology.

Background

Today, the opportunity to publish onto digital devices is increasing. Every year, new tablet devices are released into the market that are more powerful and more affordable than their predecessors. The demand for these devices has increased, with a growing range of everyday usage that is convincing people to spend their money to acquire this new technology. Tablet devices are widely adopted today with 34% of American adults ages 18+ owning a tablet computer. As seen in Figure 1, this trend of tablet ownership has been increasing exponentially over the past three years. With so

many devices already on the market and an increase projected for the near future, a new realm of opportunity for content producers and publishers has presented itself.

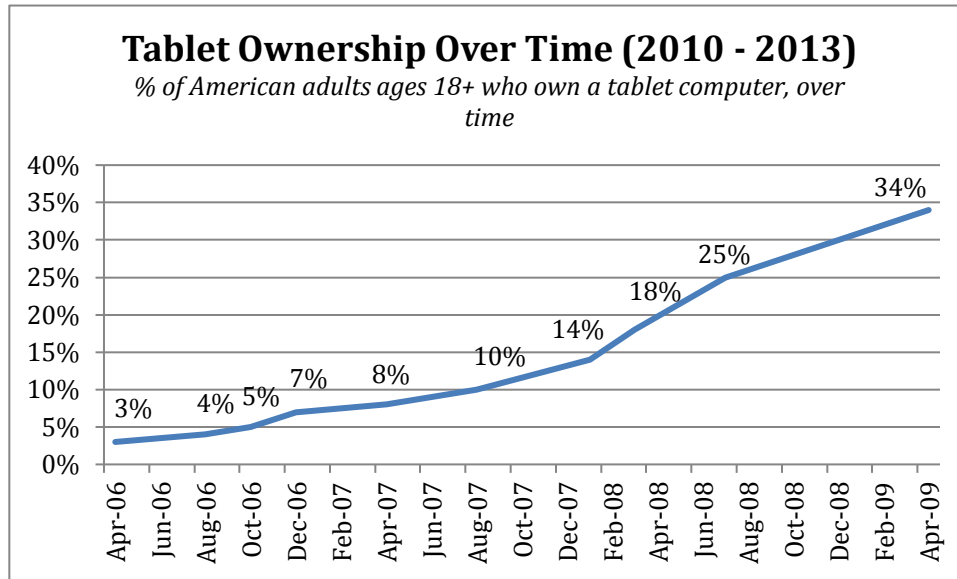


Figure 1 – Tablet Ownership Over Time (Zickuhr, 2013)

Reason for Interest

Reading has been an important aspect of my life. Growing up, I would read the newspaper every day, browsed through lots of magazines, and read many printed books. While at the University of Ottawa completing a Bachelor’s degree in Communication and Sociology, I did a lot of writing while maintaining a text and photo blog. I also focused on video production, working part time for the local television station. Before college I played Violin for 18 years including 3 years with the Rochester Philharmonic Youth Orchestra. Having come from a background with exposure to many types of media and art has driven my interest to investigate the production and adoption of various media.

“The medium IS the message!” Marshall McLuhan once proclaimed, and the harmony of this medium and the message has had a special impact on me. It is what fundamentally drives my interest and passion in quantifying the creation and development of the best experience of electronic reading.

Chapter 2

Preliminary Literature Review

Introduction

A variety of topics are important to consider as background for research relating to the production of digital publications. These topics include E-Books, Hypermedia, Content Markup, E-Book Files, Design, Readability, Digital Publishing Software, and Human-Computer Interaction.

E-Books

“An E-Book is a computer file. The file is formatted to look and read like a book. It can be viewed on your computer monitor and various handheld devices or printed to your printer” (Chillemi, 2007). To pinpoint when the E-Book was first developed is difficult, since the concept of the E-Book in the past has been vague and people may not have even realized that what they were producing was an E-Book. However, Michael S. Hart was the first person to really concentrate on the concept. On July 4th, 1971, Hart who had been studying computing power at the University of Illinois and inspired by the a free printed copy of the U.S. Declaration of Independence, decided to hand type the text into the computer. This began a project that still exists today known as Project

Gutenberg, which distributes millions of electronic books via the Internet for free (Project Gutenberg, 2012).

“Sharing information on the early Internet however was not easy... Download speeds were slow and basic transfer protocols were in their earliest iterations” (Polanka, 2011). As expanding bandwidth, technological innovations, and more people reading on digital devices drove the development of the Internet, the adoption of the E-Book began to flourish. In November of 2009, the Internet Archive’s Text Collection was at 1,716,115 items (Polanka, 2011). As demand began to increase for digital books, businesses and individuals began to focus on how to make money creating valued content. “It was only after the successful transition from print to electronic journals proved the viability and profitability of electronic that publishers warmed up to the idea of E-Books” (Polanka, 2011). Sony released the first portable E-Reader in the early 90’s, with limited success, but the idea caught on as technology began to improve. Various other devices began emerging on the market from companies like Barnes and Noble, Amazon, and PocketBook. Larger companies like Apple, whose iPad has recently seen tremendous growth, are now trying to lock-in customers and dominate the E-Reader market. With 29% of Americans now owning some sort of E-Reader (Rainie, 2012) the rise of a new type of digital reading that incorporates multimedia elements is becoming increasingly popular and relevant. However, simply having many different media types jumbled together is not sufficient to deliver an effective reading experience, the mindful design of content is critical.

Hypermedia

Hypermedia and multimedia are similar and interrelated, but have some key differences that are important to consider in the creation of digitally published content. Multimedia is “the amalgamation of various information sources (written, text, sound, pictures, video) which exist in parallel. Each source uses a different technique of retention and delivery, and the data are heterogeneous” (Dauphin-Tinturier, 2007). In other words, multimedia incorporates various channels of media that are appropriately used together to give the user information on a subject. With the most basic multimedia, the author creates content that “only represents information in an essentially linear manner. Thus the author has to go through a linearization process to convert his knowledge to a linear representation” (Lowe & Hall, 1998). For example, the author uses a non-linear process to develop ideas and create valued content, but then dictates the information to the reader in a linear style where the user’s interactions are anticipated step by step. This thought process has been displayed in Figure 2.

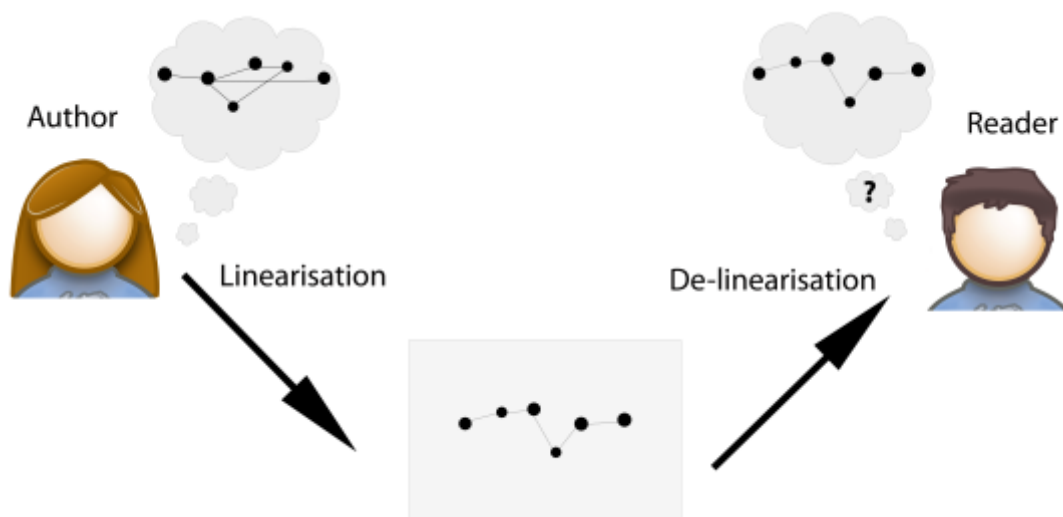


Figure 2 – Traditional Authoring Thought Process (Lowe & Hall, 1998)

Hypermedia on the other hand, takes a user-based approach towards incorporating different forms of media. Hypermedia can be classified in its “ability to incorporate various media, interactivity, vast data sources, distributed data sources, and powerful search engines. These (applications) make hypermedia a very powerful tool to create, store, access and manipulate information.” (Lowe & Hall, 1998).

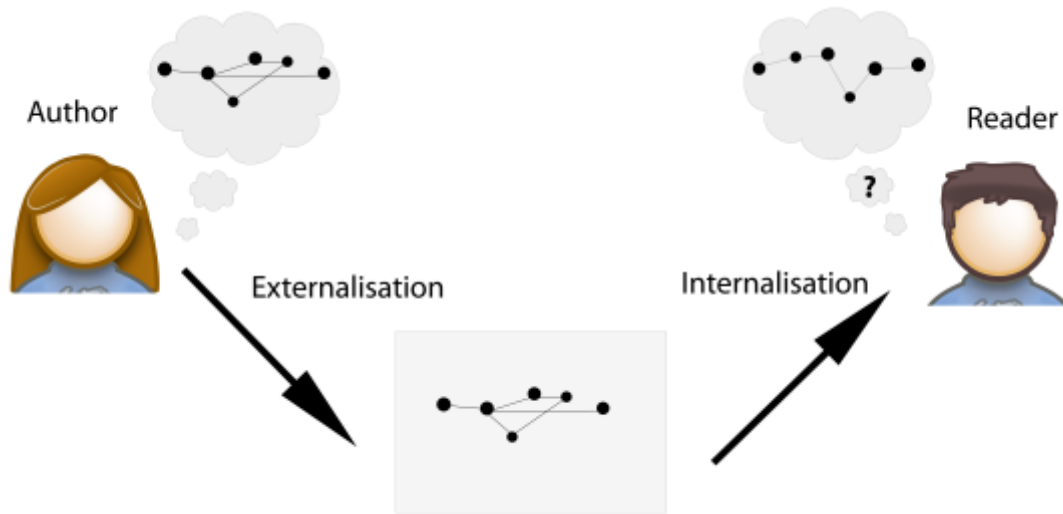


Figure 3 – Hypermedia Authoring Thought Process (Lowe & Hall, 1998)

While hypermedia, like multimedia, incorporates many media types together to create valued content, the end-user’s experience is taken into consideration while designing the content. As seen if Figure 2, this non-linear approach used in hypermedia creation allows the reader to explore further and interact with the content on a more individualistic basis. This can ultimately lead to a deeper, more fulfilling experience in which the end-user attains a personal understanding of the content being expressed.

“Hypermedia... allows us to partially mimic writing and reading processes as they take place inside our brain” (Lowe & Hall, 1998). The way that hypermedia content is shaped is designed to create an optimal experience for the user and to most accurately reflect their mental model. This is important because it means that the content being published is not the only factor. Developers need to consider the way in which information is designed and displayed to compliment user preferences for various media elements and interaction.

Content Markup

It is important to understand the rationale behind using markup languages to handle content. When dealing with any sort of valued content, from a publisher's perspective, it is beneficial to separate the content elements of the document from its presentational design. In order to do so, the creation of semantic markup separate from the presentational components for each output device is imperative. Semantically marking up a document requires “explicitly distinguishing (and accordingly ‘marking up’ within a document) the structure and semantic content of a document. It does not mark up the way in which the document will appear to the reader, in print or otherwise” (Walsh & Muellner, 1999). When marking up content semantically, the goal is to classify the content within tags that are meaningful to what the content describes, not what the content looks like.

An example of the importance of separating semantic from presentational markup is seen with lists. Without separating content from presentation, it would seem natural to

markup list items as indented, italicized or any other of its presentation. However, proper content markup is to declare those items to be within a list. The list can then be handled many ways, depending on the output device. Handling the list's appearance then comes from presentational markup where the specifications of how much it is indented and the font styles can be further specified. The beauty in using such a system is that even though in the beginning it may seem like the longer way of doing things, it ultimately will save massive amounts of time and energy if changes to the document itself occur.

One of the first uses of this concept of separating content from presentation is Standard Generalized Markup Language (SGML). SGML was developed and standardized by the International Organization for Standards (ISO) in 1986 (DeRose, 1997). "The foundation of SGML is very simple: it lets you describe document structures directly, rather than describing something temporary like formatting, that depends on the structure. Simply put, SGML lets you tell the truth about your documents" (DeRose 1997). Five key characteristics of SGML that build the basis include descriptive markup (tagging objects called elements), hierarchical structure, flexibility, formal specifications, and human-readability (DeRose, 1997). These fundamental aspects of SGML are the core to marking up content and have been carried forward to other markup specifications that have developed over the years.

Extensible Markup Language (XML) is a markup language derived from SGML and came about in 1998. It is a markup language that is defined by a set of rules for encoding documents in a format that is both human-readable and machine readable (Powell, 2006). Applying XML with Extensible Stylesheet Language (XSL), allows for

the automation and processing of large amounts data relatively quickly. “XSL is a formatting language that applies templating to consistent data repetitions inside XML documents” (Powell, 2006). This can be very powerful, especially in situations arising in publishing where a lot of content needs to be handled almost exactly the same way and comes in from various different sources. Using XML, an output file meeting specific requirements can easily be generated (as long as the content is properly tagged). Additionally, “XML can be considered an extensible form of HTML. This is because HTML is restrictive in terms of tags it is allowed to use.” (Powell, 2006). HTML, is more like its own version of XML. By using XML, marking up information can be done to the exact specification of what the individual finds appropriate for that information. Various other markup languages like DocBook have stemmed from the XML model.

In 1989, Tim Berners-Lee developed HTML in collaboration with Robert Caillau while working at the CERN (Mercer, 2003). HTML itself is a subset of Standard Generalized Markup Language using tags to markup documents by inserting commands. “The goal of HTML was to create a platform-independent language for constructing hypertext documents to communicate multimedia information easily over the Internet” (Mercer, 2003). The World Wide Web Consortium (W3C) is the organization responsible for maintaining and updating the specifications of HTML. “Rather than continuing to develop HTML, the W3C has begun recasting HTML into XHTML, a more formal version of HTML that follows the design principles of Extensible Markup Language (XML).” (Mercer, 2003). Using XML rules changed authoring requirements. For example, when writing in HTML, “broken” HTML markup can still work in a web browser and by some estimates, over 99% of HTML pages have at least one error in them

(Pilgrim, 2010). With an XHTML page, web browsers have no choice when encountering an error but to stop processing and display an error message to the end user.

More recently, the newest version of HTML, HTML5, has been introduced. HTML5 introduces many new tools to marking up that should be helpful. To start, the <head> of an HTML5 page has been simplified so there is much less text and only a few lines. The most notable new feature, however, is the addition of many new application programming interfaces (API) that can be used with JavaScript (W3C, 2012). Some of these added APIs, which do not seem to have as much relevance to the publishing industry but are important to web design, include APIs that prompt the user for information and allow for base64 conversion. Some of these APIs, however, seem as though they should have a major impact on the digital publishing industry, examples including: video and audio elements with APIs for controlling various aspects of the media, printing documents, prompting the user, enabling offline web applications, and forms (W3C, 2012). These new features give content developers the ability to interact with users like never before, and their implementation in the publishing world should become even more relevant as devices like the iPad and Kindle increasingly use HTML5 as a file format for the distribution of E-Reading materials.

E-Book File Formats

EPUB, short for electronic publication, is an electronic file format. It is the distribution and interchange format standard for digital publications and documents based on Web Standards (IDFP, 2012). Recently, the EPUB standard has been updated to

EPUB3. “EPUB3 is a new exciting format, which is set to unleash a content revolution and become the new accessible standard for E-Books” (Garrish, 2012). EPUB3 is based upon HTML5, so all the new APIs that add new interactivity are available on EPUB3 as well (Garrish, 2012). One particularly important example of EPUB3 is the new media tags and controls now available. EPUB3 plus HTML5 and the available APIs are enabling the redefinition not only what an EPUB document is, but what a book is. “Want to go fancy and add a video clip of a speech (to your document)? No problem... embedding your clip is still as easy as adding the HTML5 video element” (Garrish, 2012). With the easy to use new feature-sets, the attitude towards incorporating all multimedia together to produce content that can be classified as hypermedia is becoming a reality.

There are some limitations to using EPUB file format. “As an open standard widely supported by nearly all major E-Reader devices (with one notable exception), EPUB is an excellent option for doing HTML E-Book development” (Kleinfeld, 2011). One exception however is the Kindle, which operates using the Mobi format. Kindle does offer a tool called Kindlegen for conversion from EPUB to Mobi, however Kindle does not support the embedded audio and video tags that are typical in HTML5 (Kleinfeld, 2011). This problem is similar to that created by Apple with its iBooks format.

DocBook is a standard for creating well-formatted plain text documents. The main intention of DocBook is for writing books and papers, but it is not limited to only these applications. Docbook is an XML vocabulary for writing that has existed since 1991. Originally designed with exchange in mind, DocBook has now largely become an

authoring schema (Walsh & Hamilton, 2010). DocBook is particularly suited for creating books and papers about computer hardware and software as well as to handle academic and scientific papers, but can now be used for much more (Hunter, 2004). Many resources are available to read up on the various tags of DocBook, which have been revised and redone to simplify the process over the past five versions.

Like any markup language, the value is found within the automation of the process. When there is only one copy of a document, using markup languages seems like overkill since you can edit that single document to meet your own specific demands and requirements. Many people involved with electronic publishing are only familiar with this, as they are typically not writing their information so it can be easily transcribed and distributed. However, if that document needed to be submitted to a professional journal, or it was to become a chapter of a book, XML and DocBook would be appropriate since they standardize the content so it becomes platform agnostic. The beauty is that once the content is prepared properly in DocBook (or any XML) format, it can be published into a variety of formats including HTML, XHTML, EPUB, and PDFs. This is very powerful since this allows for the process of publishing to become automated to the point where the middleman between content creation and design layout is eliminated allowing people to work on the important aspects of publishing; the content development aspect and design layout (i.e. Creating Valued Content).

Design

“It is common to think of interaction between a person and technology as communicating with the technology, the real communication is between designer and person, where the technology is the medium” (Norman, 2004).

In Donald Norman’s *The Design of Everyday Things*, many key design elements are introduced that are relevant to the development of most every functioning object. These “psychological principles” as Norman calls them “can be followed to make everyday things understandable and usable” (Norman, 1990). Norman is usually analyzing analog single purpose goods, like a teapot, throughout the book. However, the principles that he discusses are applicable in the context of digital publishing as well since the user is actively interacting with the book similarly to an analog device.

The most important principle of design is visibility. “The correct parts must be visible, and they must convey the correct message” (Norman, 1990). This is applicable to design needs of digital publications, since the only things the user will process are the elements that they perceive. If an image is out of focus or text is not visible or doesn’t appear appropriately on the screen, the user’s experience will be fundamentally flawed.

Norman also discusses affordances, another principle very closely related to visibility. Affordances “refers to the perceived and actual properties of the (object), primarily those fundamental properties that determine just how the thing could possibly

be used” (Norman, 1990). Affordances are triggers to the user that there is some way to interact with the object.



Figure 3 – Affordance Example (Norman, 1990)

As we can see in Figure 3, two examples of affordances can be found as they relate to doors. In example A, the door has a long horizontal bar that “affords no operations except pushing” (Norman, 1990). In example B, there is a small and vertical bar that signifies to the user to pull (Norman, 1990). Norman would later revise this classification of affordances, stating that “affordances do not have to be perceivable or even knowable – they simply exist” (Norman, 2008). Instead, Norman decided a better term would be signifiers. A “signifier is some sort of indicator, some signal in the physical or social world that can be interpreted meaningfully” (Norman, 2008). The term signifiers, according to Norman, better encompasses all of the traits of these powerful clues that dictate the way in which we interact with something. In E-Book design, it is

important for there to be clearly represented and intuitive signifiers of the media elements that allows the user to interact with the content.

Mapping is another important principle relating to creating an effective design of a digital publication. “Mapping is a technical term meaning the relationship between two things... between the controls and their movements and the results in the world” (Norman, 1990). A digital publication should have mapping throughout its design to give the user a guide of where the content can take them. The orientation of the page swipes needs to be clear to the point where it is intuitive for the user. “Mapping problems are one of the fundamental causes of difficulties” (Norman, 1990). If the reader does not understand where the device can take them, they cannot enjoy the content that has been produced.

Norman also states that people understand how things work because before interacting with the device, they have a conceptual model of how it works (Norman, 1990). This conceptual model is often created from past experiences with the object as well as affordances, constraints, and feedback. Reading on tablet devices is a somewhat new phenomenon, so the conceptual model of how an E-Book should operate may not be completely understood; however there are certain aspects of multimedia that have been cemented over the years. Some of these include the play button symbols, arrows, X's, and scroll bars.

Gestalt psychology, developed by Austrian and German psychologists in the 1920's, “refers to a structure, configuration, or layout that is unified and has specified

properties that are greater than the simple sum of its individual parts... Gestalt theory provides rational explanations for why shifts in spacing, timing, and configuration can have a profound effect on the meaning of presented information” (Graham, 2008). Some principles of design have been developed from Gestalt’s theory on why simple changes in spacing can dramatically change meaning. These principles can also be applied to interactive media development, as described by Lisa Graham in *Gestalt Theory in Interactive Media Design*, and include: figure/ground, proximity, closure, continuation, and similarity.

Figure/ground is a fundamental law of gestalt and it identifies objects from their surroundings. “The law of perception is dependent on contrast. Images and text must be visible to be understood” (Graham, 2008). This can be seen on a website when you hover over text and it changes color so the user knows that is what is being selected.

Proximity is important to interactive design as it dictates the groupings of the content on the page (Graham, 2008). On a micro scale, letters that are located closer together allow the user to know that there is text. On a macro scale, in the design of E-Books grouping content together on a page will signify to the user that this content is all related to each other. If a video, for example, appears on a page it will be related to the text that is on that page.

Closure is the idea that ”humans have a natural tendency to visually close gaps in a form, especially in familiar forms” (Graham, 2008). When the user has missing information, they tend to focus on what is presented to them and disregard the missing

parts, filling in the spaces with something that is familiar. This can be useful for designing the background as it “often works closely with the law of continuation to form a stronger experience or perception” (Graham, 2008). A good example of closure can be found in Figure 4.



Figure 4 – Closure Example

“Continuation occurs when the eye follows along a line, curve, or a sequence of shapes, even when it crosses over negative and positive shapes” (Graham, 2008). In other words, humans try to continue shapes and sequences when it is possible. An example of continuation can be seen in Figure 5. “These sequences of screen shots from an animation show the law of continuation at work. Our eyes follow the arrow as it fades in turns and fades out”



Figure 5 – Continuation Example (Graham, 2008)

Finally, similarity is a key principle of Gestalt psychology. “Visual elements that are similar in shape, size, color, proximity, and direction are perceived as part of a group, even if the items are spatially separated” (Graham, 2008). With E-Books, it is important that similarities and consistency are maintained throughout the book, and that perhaps more importantly dissimilar content are thought out appropriately to differentiate them from the rest. One font should be selected for use throughout the publication, and if a different font appears it should be with the intention of differentiating it from the rest of the content.

Readability

Readability can be defined as “the sum total (including interactions) of all those elements within a given piece of printed material that affect the success that a group of readers have with it” (Chall and Edgar, 1949). The term readability is often associated with the difficulty of the linguistic features of the text. Formulas exist using primarily sentence length in words and frequency of difficult words to define how readable a particular passage is. The Flesch Reading Ease Score (FRES) is a highly regarded reading difficulty measurement and is based on a scale of 0-100 with lower values for harder text

and higher values for easier text. The following equation shows how it is calculated (Flesch, 1948).

$$206.835 - 1.015 \left(\frac{\text{total words}}{\text{total sentences}} \right) - 84.6 \left(\frac{\text{total syllables}}{\text{total words}} \right)$$

Figure 6 – FRES Equation

“Readability may be improved with interface designs” (Wooyang, 2011). In other words, the platform by which a person reads content can have an effect on their ability to comprehend it. This includes the appearance of font, spacing, background color, and possibly the publishing software that is used to output a digital publications.

In Bill Hill’s *The Magic of Reading*, the essential elements of readability were analyzed. Hill’s goal was to find out if electronic books would ever be readable to the extent that a reader would spend the same amount of time looking at the screen as they did with print at the time. Hill concludes that “reading is a complex and highly automated mental and visual process but makes no demands on conscious processing, leaving the reader free to distill meaning, to visualize, and to enter the world created by the writer. That world is in reality a combination of the writer’s creation and the reader’s own interpretation of it” (Hill, 1999).

Hill makes some impressive predictions about E-Books evolution. He envisioned that there would be “more than one type of electronic book” including one device “that is smaller, more portable, and equates more or less to the printed paperback” and another device that “will have color and support for sound, and will take advantage of these and

other capabilities to take electronic books beyond the books of today” (Hill, 1999). These two styles of devices are fairly accurate representations of the market of tablet readers today with the Kindle Fire or Google Nexus representing the former and the iPad representing the latter.

Hill also discusses how books work. It is important to understand how people understand already to use books while developing E-Books because the conceptual model of how books currently operate exists and as Norman discusses, design is best when the user intuitively knows how to interact with the device. Hill views the book as “a 300 page waterslide for human attention” (Hill, 1999). This waterslide is comprised of many components. On a micro level, the fonts, letter spacing, words, and lines are all important aspects of the reading experience and it is important to maintain consistency in the publication.

Hill makes observations that readers have certain expectations when they are interacting with a book. He found that people consume books “from a top-down viewpoint” (Hill, 1990). Hill argues that the users prefer portrait orientation because it gives more lines of better length than landscape. Hill also describes visual cues which are “constants designed to help us” understand how to interact with an object (Hill, 1990). Some of these cues include that lines go from left to right, the length of the lines are standardized, a paragraph is started with an indent, and chapter beginnings have spaces at the beginning. These visual cues are a part of a cognitive model that readers have when they go to experience written content and it is important that these generally accepted traits of the book are not overlooked in E-Book design.

Digital Publishing Software

The need for well-designed digital publications is more important now than ever before. With the market of E-Readers growing, there is an increasing market of users ready to pay for downloading content from the Internet. 68% of all downloaded content put on the iPad by publishers is paid for. ~~This is a fairly ?~~

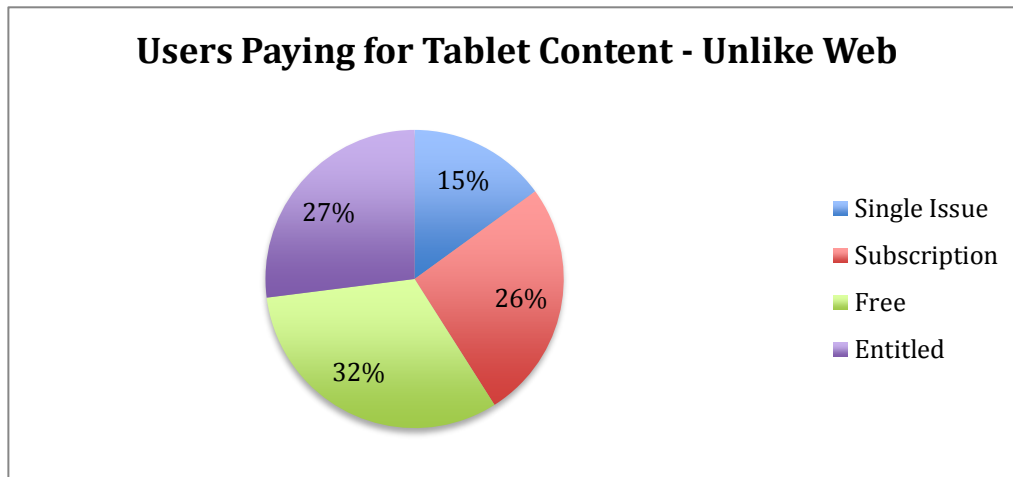


Figure 7 – Users Paying for Tablet Content (Joss, 2012)

As this market of users paying for content increases, so will demand for higher quality. In late September 2012, J.K. Rowling, author of the famous *Harry Potter* series published her latest book *The Casual Vacancy*, and released it to print and on a variety of E-Book files. The E-Book version of the book sold for £11.22 (\$17.99)(BBC, 2012). The book was highly anticipated; however upon release major problems with the E-Book version began being reported on a variety of devices. User's cited "massive frustration for the true fans" with the book and the publisher, Hachette, ultimately had to save face and fix the problem and then allow affected customers to download a new copy (BBC, 2012). Publishers must understand that readers care about the quality of the E-Books they

produce and that the medium cannot be ignored in any aspect.

Adobe is one of the most widely used tools today to meet digital publishing needs. Their app-based digital publishing package includes InDesign CS 6, which has powered more than 16 million digital publications during the last year (Joss 2012). Publications like New Yorker, Wired Magazine, or Self Magazine that use this solution are some of the most renowned interactive publications, with all of them reaching the top 10 iPad Magazines according to Business Insider (Kovach, 2011). More than half of the top 20 Newsstand Apps use Adobe publishing software as a tool to structure their content, making them clearly important software developer amongst the digital publishing industry (Joss, 2012).

Apple released iBooks Author in January of 2012. It was initially created as a tool for “educators and small publishers to create their own books” (Albanesius, 2012). Apart from the various digital textbooks that were created by Apple, some multi-touch books (as they are referred to in iTunes) currently being sold in the iBooks store created with this software include J.R.R. Tolken’s *The Hobbit*, Anna Sewell’s *Black Beauty*, and numerous different cooking, travel, and how-to books.



Figure 8 – iTunes iBooks Author Bookstore

The iBooks Author software is free for Mac OS X, which has given it quite a bit of recognition throughout the publishing industry. One foreseeable problem with the iBooks Author is that it is proprietary, meaning the file type of these books, iBooks is structure like an EPUB file, but it does not use the same standards and has undocumented extensions for CSS (Bjarnson, 2012). Furthermore, if you are creating content that is going to be looked at on an iPad, this software is a great choice. However, exporting to the other devices will mostly likely be impossible or create problems.

Human Computer Interaction

“Human-Computer Interaction (HCI) is the study and practice of usability. It is about understanding and creating software and other technology that people will want to use, will be able to use, and will find effective when they use” (Carroll, 2002). HCI is critical in the development and understanding of how humans interact with E-Books. E-Books, at their core, are simply glorified computer data files. People interacting with E-

Readers are actually interacting with a computer. Therefore, a better understanding of Human-Computer Interaction is fundamental to developing the complete picture.

Usability is a core concept of HCI and can be defined as “a measurable characteristic of a product’s user interface that is present to a greater or lesser degree” (Mayhew, 1999). User experience is a related concept to usability and impacts the way designers construct applications. If an E-Book is designed with a focus towards incorporating as much interactivity and multimedia elements as possible, the experience of the user and the usability of the device will most likely be forgotten and the result will be the user disliking the publication. User-centered design incorporates these various media elements by organizing them within a theme that emphasizes “the importance of involving the user throughout the entire process” (Rosanski & Haake, 2003). Understanding the process by which the user will interact with the content in the publication is critical to the successful design of an E-Book.

“HCI is a multidisciplinary field, which combines the theories and practices from cognitive and behavioral psychology, ergonomics, anthropology, sociology, computer science, engineering and graphic design, among others” (Rosanski & Haake, 2003). The broadness of research within the field of HCI results in there being many different subgenres and focuses within the area. One particularly relevant HCI research experiment to this study is *Adaptive Layout Template for Effective Web Content Presentation in Large-Screen Contexts* (Nebeling, Matulic, Streit, and Norrie, 2011). This research focus was looking at the user experience towards reading online news. They measured this by asking users to sit in front of a screen and read three online articles about current news

for about 10 – 15 minutes. After they had finished reading the article, they were then asked to answer a series of questions about the material including some to their test reading comprehension and five Likert scale questions asking them to rank their reading comfort, the positioning of elements, the image alignment, the font size, and scrolling behavior. The results were then plotted and analyzed to determine what users preferred in terms of reading text-heavy documents on computer screens and what hybrid of the three articles would have been favored amongst the users.

Another HCI study relevant to my research is *How People Recall, Recognize, and Reuse Search Result* by Jaime Teevan. This research's primary focus was "on understanding how people recall, recognize, and reuse search result lists containing previously viewed Web information" (Teevan, 2008). Three separate experiments were set up to test users ability recall, recognize and reuse information that they had found in searching online. Recall and recognition are important aspects of understanding how a user engages with media elements. "Recognition data indicates how many saw (the media element). Recall Figures tell us how many of them did become sufficiently interested to actually look at it" (Stapel, 1998). In advertising, a relationship between recall and recognition has been found with average recall rate being 32% that of the recognition rate (Stapel, 1998). It will be interesting to see if media elements in a publication have a higher recall rate because it is more engaging, and as well if these rates vary amongst the different digital publishing platforms today.

To test human factors towards reading on various digital publication platforms, a benchmark of the content will also need to be developed that accurately reflects the needs of the experiment. The Human-Computer Interaction of readers with digital publications

created on a variety of digital publishing platforms will ultimately be assessed by the subjects of this research similarly to the format of the research described above in terms of reader comfort, comprehension, recall, and recognition.

Chapter 3

Research Questions

Research Questions

The Human-Computer Interaction of digital publications for tablet devices can be influenced by: 1) the platform used to display the publication and 2) the publication itself. There are many ways to create digital publications and companies are investing in software that assists in the process of transforming print ready content into digital content. The look and feel of the resulting digital publication is constrained by the capabilities of the platform to which the transformation of the print content is made.

Therefore, the question addressed by this research was:

Are there significant differences in user preferences (in terms of the value added by multimedia elements, the reader's interaction with those elements, their comprehension of the content in the publication, and their pleasure with the overall experience of the publication) for various publications produced by the following methods:

Adobe DPS, Apple's iBooks Author, and EPUB

Chapter 4

Methodology

Overview

The methodology of this research study was a human factors experiment testing for a significant difference in the reading experience of subjects exposed to one of three digital publication outputs of the same content: EPUB rendered in iBooks, and digital applications produced in iBooks Author, and Adobe InDesign. A field experiment consisting of ninety individuals assessed these publications, thirty for each of the three output formats. . Each publication was evaluated by the subjects in terms of the following criteria:

- The value added by the multimedia elements of the publication
- Their pleasure with the overall experience
- Their interaction with the multimedia elements
- Their ability to recognize information and comprehend material from the publication

Experimental Design

This methodology included the following steps:

1. Develop Article Content
2. Transform Content

3. Output Three Digital Publications
4. Assess Performance
5. Analyze Results

The independent variables of this experiment were:

- The platforms used to develop the publication (Adobe Software, Apple iBooks Author, and EPUB)
- The age of the reader
- Their education
- Experience with tablets

The dependent variables assessed were:

- The value added by the multimedia elements (responses based on a 1-5 Likert scale)
- The reader's interaction with those multimedia elements
- The pleasure with the overall experience of the publication
- The reader's recognition of the content in the publication. (Refer to appendix for full questionnaire.)

The impact that the various platforms utilization of hypermedia capabilities (various layouts, fonts, images, video, audio elements, and various added features) was assessed by measuring differences in the dependent variables by

manner of a questionnaire that the subjects took after reading the publication. An initial assessment of the various platforms hypermedia capabilities is displayed in Table 1.

Table 1 – Attributes of Publication Interactive Design Options

Attribute	Print	EPUB	iBooks	Adobe
Layout	●	◐	◑	●
Font	●	◐	◑	●
Hyperlinks	◐	◑	●	●
Images	◐	◑	●	●
Audio	◐	◑	●	●
Video	◐	◑	●	●
Added Features	◐	◑	●	●

LEGEND: ● Full Control, ◑ Lots of Control, ◐ Some Control, ◒ Little Control

Step 1. Develop Article Content

The content used in the article was very important to the ultimate success of this experiment. Although the experiment did not look at the subject’s interest in the genre of the content, the goal was to use a topic for the article that would be universally likeable, not very well known, and would be able to lend itself to a great amount of multimedia interactivity. In order to gain a better idea about what topic the majority of people would be interested in, online survey of 50 people from the Rochester and RIT community was conducted that asked respondents to rank their top three choices in terms of publications they would be interested in reading an article out of. These results are displayed below in Table 2.

Table 2 – Publications Rankings (50 Subjects)

Publication	1st Choice	2nd Choice	3rd Choice
Time	6	15	6
National Geographic	20	6	6
Reader's Digest	0	2	8
Better Homes and Gardens	0	1	2
Entertainment Weekly	5	5	4
New York Times	13	8	12
Wall Street Journal	0	5	4
The American Legion	0	2	0
People	5	2	8
Newsweek	1	4	0

National Geographic appeared to be the most interesting publication for the subjects of this initial survey out of the choices provided. Several topics covered by National Geographic were then considered and ultimately, it was decided to use the lynx, the genus of medium-sized wild cats, as the topic of the article. Aside from being a topic that would be of interest, several resources including images, audio, video, and interactive images would have to be used to enhance the publication. Collection of information online about the lynx began and continued until there was enough content to fill 5 – 10 pages of digital content. The text that ended up selecting to be the centerpiece of the content had a FRES score of 55, indicating it would be at a level that most people could read comfortably but still have information they likely did not know already. The final combination of images and text can be found in Appendix A.

Step 2. Transform Content

Once the article content had been prepared, conversion of the digital publications began. The researcher worked with one publishing tool at a time to allow them to be immersed with all the features of that tool. This, along with following the book and web design principles mentioned in the literature review ultimately allowed generation of the most appealing publication.

Multimedia elements were added to each of these digital publications with the goal being to optimize its use while maintaining as much consistency as possible within each rendition of the article. Although the features available on each platform differed, the content itself stayed the same throughout each publication. An example of this is seen with the images. In the Adobe and iBooks Author version of the article, slideshows are used and contain three images each. In the EPUB version, slideshows were not used and instead images were just placed inline with the text.

Another important difference found between the interactions in these three articles was in the use of two maps that showed the differences between the range of the Spanish lynx from 1980 – 2003. In the EPUB version, the two lynx-range maps were displayed in-line next to each other. In the iBooks Author version, a slideshow was used so the user could swipe the 1980 range-map reveal the 2003 range-map. The Adobe DPS version had the greatest interactive design, where the map had a scanner bar that as the user's finger swiped across changed accordingly the map from 1980 – 2003. Screen shots of the three complete publications can be found in Appendix B.

Step 3. Output Three Digital Publications

Once each publication's design was finalized, the results were output to their respective devices. Each output required its own separate devices so that while the experiment is being performed, the user had access to only one of the three publications.

During the output process, preliminary testing of the content was done for a variety of reasons. Assessing reader fatigue to ensure that the publications was not overbearing on my subjects in terms of their time and effort was important. As well, it was necessary to ensure that the design of the publication allowed, to the greatest extent possible, for the users to intuitively understand how to interact with the publication.

After the preliminary testing had been completed, some confusion with the controls of the publication had been observed with the unfamiliar tablet users. To help with this, a page to the beginning of the article was added in which the interactions that were found in the publication were explained and various sample media elements were provided so users had a "practice" before going live to the publication itself.

Step 4. Conduct Experiment

Each of the three publications was tested by a total of thirty different subjects, making the overall sample group for this experiment ninety individuals. These subjects came from a variety of backgrounds and were all fluent English speakers and readers.

Subjects usually signed up for the experiment online through a Google Form online. This form asked subjects to provide a bit of background information including whether they owned a tablet device, education, age and their ranking of their tablet use abilities from 1 – 5. Subjects that did not sign up online were asked these questions before the experiment process began. Assessing subjects tablet abilities was important in ensuring that each publication had an equal representation of both experienced and non-experienced tablet users. As well, education and age were important to keep track to ensure each group was an accurate representation of the whole population. The differences between these groups to navigate and interact with the media elements of the article would likely be important enough to take into consideration.

Subjects were asked to come to a quiet and secluded location to participate in the study. Some of these included study rooms in the Wallace Center as well as the Gravure Research Lab in the School of Media Sciences. These locations were ideal for their isolation, comfort, and accessibility. Since this experiment was not an exact replica of their home reading conditions, my goal was to make the setting as inviting as possible to the users while also ensuring no distractions would be able to take place.



Figure 9 – Sample Experiment Location

Assessments were done individually with a maximum of three participants taking the experiment at a time. When multiple experiments were running, the tests were set up so as the subjects were not distracted by one another or felt rushed to finish.

Upon arrival, subjects were first asked to sign a consent form in which they agreed to participate in the experiment. Once this had been completed, the researcher then provided subjects with the essential information on the experiment. Once the subjects began the experiment, the researcher stepped out of the room and started the timer to keep track of how long they spent reading. Once they had completed the article, the researcher then stopped the timer, reentered the room, took the iPad away from them,

and then explained to them the next step was a 15 question questionnaire that asked questions about the information that they had just interacted with. These materials can be found in Appendix B.

The subjects were then provided with the questionnaire form, found in Appendix C, which they then completed and returned to me. Upon completion of the questionnaire, subjects had finished the experiment and were asked to provide their name and contact information to register them for the drawing of \$100 gift card. Subjects were finally thanked for their participation and dismissed.

Step 5. Analyze Results

After all the data had been collected, inferential statistics was used to analyze the data. An Analysis of Variance test, or ANOVA test, was used to measure variation between the users of each publications time spent reading, image recognition score, overall score, and revised test score. Using an F-Test, the variance within all of the variables could be assessed to determine if there was a significant difference in the responses. By testing the null hypothesis, which is that each output will have the same score, a conclusion to whether a significant difference between the publications read by the subjects existed within each of the variables could be made. As well, a Chi-Square test was used to analyze the attitude-based questions by each publication group. Some of these results proved to be significant and revealed interesting differences in the experiences and comprehension of the readers of the three publications.

Chapter 5

Results

The data collection was completed over the course of a three-week period from late March - April 2013. The samples of each group were comparable in mean ages, tablet experiences (least experienced 1 – 5 most experienced), and education (no high school 1 – 6 graduate degree) as seen in Table 3. This was indicated by an analysis of variance that showed no significant difference between the three groups and these controlled variables.

Table 3 – Demographics of each Publication's Sample

	F Score / p-value	Adobe DPS	iBooks Author	EPUB	Mean
Age	0.271 / 0.764	35.7	32.27	34.83	34.16
Tablet Experience (1-5)	0.981 / 0.379	3.47	3.33	3.47	3.42
Education (1-6)	0.881 / 0.127	4.53	4.17	4.57	4.42

Multimedia Value Added and Pleasure with Overall Experience

The mean “value added of the multimedia elements (based on a 1-5 scale Likert scale) was found to be marginally significant ($F = 2.493$, $p = 0.089$) with a 3.97 and 4.27 average score for readers of the EPUB and DPS version of the publication respectively vs. 4.47 for the iBooks Author version. The pleasure with the overall experience, however, showed no significant difference ($F = 0.176$, $p = 0.839$) as seen in Table 4.

Table 4– Media Value Added and Overall Pleasure with Publication vs. Publication

	F-Score / p-value	Adobe DPS	iBooks Author	EPUB	Mean
Media Value Added	2.493 / 0.089	4.27	4.47	3.97	4.23
Overall Pleasure with Publication	0.167 / 0.839	4.06	3.93	4	4

Video and Audio Question Recall

As for the readers' interaction with the media elements of the article, the analysis of variance indicated that no significant difference was observed in users' choice to interact with the video and audio media elements of each publication for the video elements ($F=0.109$, $p=0.894$) and for the audio elements ($F=1.481$, $p=0.227$). When asked a question about the media elements they interacted with, specifically the audio elements, a minor difference was found ($F=2.146$, $p=0.121$) but not statistically significant. The Adobe DPS users answered right more frequently than the others. Specifically, 17/30 and 18/30 readers of the EPUB and iBooks Author version of the publication respectively selected the correct answer vs. 24/30 of the Adobe DPS readers. As well, the percentage of people who got the video and audio questions wrong (not including those that didn't watch/listen at all) was far less for the Adobe DPS than the iBooks Author or EPUB version. These results have been displayed in Table 5.

Table 5 – Video and Audio Variables vs. Publication

	F Score / p-value	Adobe DPS	iBooks Author	EPUB	Mean
# Saw Video	0.109 / 0.894	26	27	27	26.67
Video Question Right	0.801 / 0.443	23	19	19	20.33
Video Question Wrong	-	3	8	8	6.34
# Heard Audio	1.481 / 0.227	27	29	25	27
Audio Question Right	2.146 / 0.121	24	18	17	19.67
Audio Question Wrong	-	3	9	8	7.33

Layout and Information Application

Two questions were aimed at measuring the impact that the layout of the publication had on the users' ability to recall information, and the interaction in the publication had on the users' ability to apply the information to new content. The analysis of variance indicated

that no significant difference was observed for the questions on the weight of the lynx question ($F = 0.580$, $p = 0.562$) and applying the information to new material ($F = 0.993$, $p = 0.374$). These results have been displayed in Table 6.

Table 6 – Layout Recognition & Information Application vs. Publication

	F Score / p-value	Adobe DPS	iBooks Author	EPUB	Mean
Layout Recognition Right	0.580 / 0.562	27	25	24	26.67
Apply New Information Right	0.993 / 0.374	22	18	17	20.33

Time Spent

In terms of time spent reading each publication, the analysis of variance indicated no significant differences were observed ($F = 2.158$, $p = 0.122$). Even though it was not significant, it appears that readers of the EPUB publication tended to spend the most time on average than the Adobe DPS readers and iBooks Readers. These results are displayed in Figure 10.

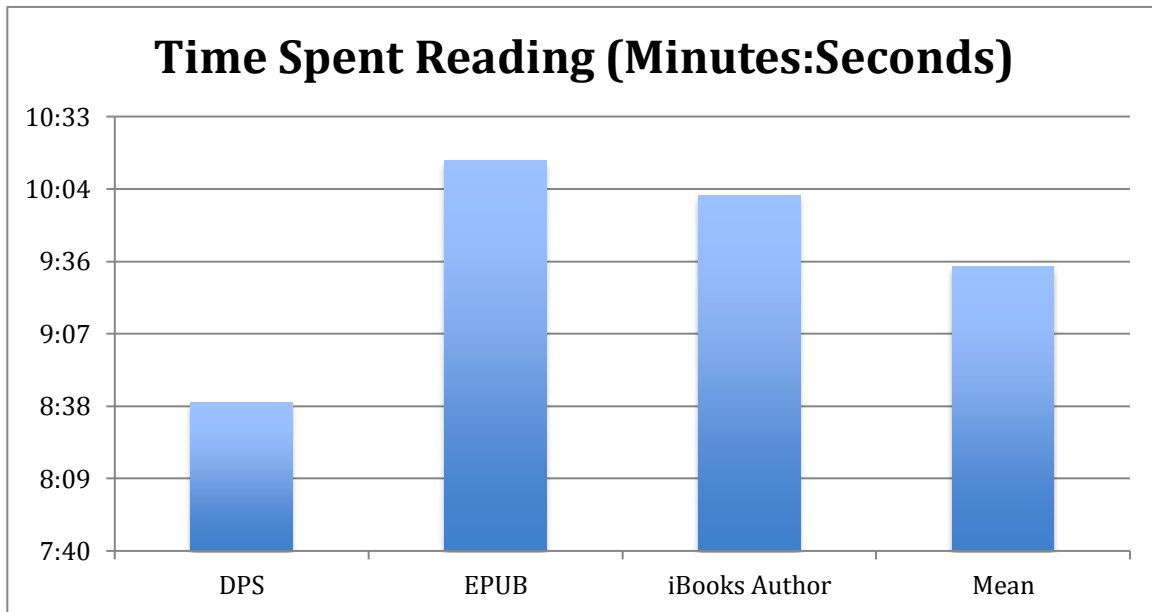


Figure 10 –Time Spent vs. Publication ($F = 2.158$, Sig. 0.122)

Image Recognition

The analysis of variance indicated that the readers' ability to recognize the images they had seen in the publication was not significant ($F = 0.181$, $p = 0.835$). However, when each image was analyzed individually, some marginally significant results were found. Image 2 was correctly recognized the most by Adobe readers ($F = 2.786$, $p = 0.067$), while Image 3 was correctly recognized the most by EPUB readers ($F = 2.812$, $p = 0.066$). These results have been displayed in Table 7.

Table 7 –Recognition Score and Images vs. Publication (Sig. 0.122)

	F Score / p-value	Adobe DPS	iBooks Author	EPUB	Mean
Recognition Score (/6)	0.181 / 0.835	3.63	3.6	3.43	3.56
Image 1 Right	1.937 / 0.147	6	9	13	9.33
Image 2 Right	2.786 / 0.067	27	25	20	24
Image 3 Right	2.812 / 0.066	14	9	18	13.67
Image 4 Right	0.000 / 1.00	20	20	20	20
Image 5 Right	1.318 / 0.266	22	16	18	18.67
Image 6 Right	0.661 / 0.510	20	23	19	20.67

Interactive Map

One question assessed user's ability to remember the range of the Spanish Lynx according to a map displayed in the publication. After seeing two maps that compared the lynx range in 1980 and 2003, users were asked to select the map that accurately reflected the lynx range in 2003 from four choices. This question monitored the impact that the type of publication, and ultimately the interactivity that was available for that map in the publication, had on their memory. A significant difference ($F = 6.824$, $p = 0.002$) was observed, which showed a strong tendency that greater interactivity increased the user's comprehension of the information. Specifically, 15/30 and 17/30 readers of the EPUB and iBooks Author version

of the publication respectively selected the correct answer vs. 27/30 of the Adobe DPS readers.

Overall and Revised Score

Finally, users' comprehension of the media elements of the article were tested by using the raw overall score as well as a revised scoring metric in which the total of the 6 image recognition questions are divided by 2 (to make a more proportional representation of the questionnaire). An analysis of variance determined a marginally significant result for the overall score ($F = 2.785$, $p = 0.067$) as well as a significant difference ($F = 4.253$, $p = 0.017$) when using the revised scoring metric. Readers of the Adobe DPS version of the article had higher test scores for both the overall (8.73 vs. 8.01 mean) and revised (6.92 vs mean of 6.23) scores than those who read either the iBooks Author or EPUB versions. These results are displayed in Table 8.

Table 8 –Overall Score & Revised Score vs. Publication

	F Score / p-value	Adobe DPS	iBooks Author	EPUB	Mean
Overall Score (/12)	2.785 / 0.067	8.73	7.56	7.73	8.01
Revised Score (/9)	4.253 / 0.017	6.92	6.12	5.93	6.23

Chapter 6

Summary and Conclusions

Summary of Results

The key results of this experiment determined that:

- No significant differences among the publications were found for:
 - Overall pleasure with the publication
 - Saw the video & answered the recognition question correctly
 - Saw the audio & answered the audio recognition question correctly
 - Layout impact on information recognition
 - Interactivity impact on applying knowledge to new information
 - Time spent with the publication
 - Recognition of images
- Marginally significant differences among the publications were found for:
 - Media value added
 - Image 2 & 3 of the image recognition questions
- Significant differences among the publications were found for:
 - Interactive map question (recognition)
 - Overall & revised complete recognition score

The overall pleasure with reading the publication was a variable the researcher felt would have shown a preference towards the more interactive publication. However, it revealed no significant differences among the three publications in the experiment. This result may have been impacted by a few possible factors. First, some of the readers in my experiment had never used a tablet device before. When these individuals were presented with any type of digital publication, they were often simply impressed by the device itself and were inclined to give the publication a perfect score not knowing that there was the possibility for more interactive publications out there. Second the reader's interpretation of the question could have impacted the way they answered. Some readers wrote in comments how they loved the article because of their interest in Lynx specifically, not necessarily the publication design and interactivity itself.

The multimedia value added proved to have marginally significant results among the publications, with the readers of the iBooks Author and DPS versions getting higher scores than those who read the EPUB version. This result was not too surprising, as the two versions of the publication that had greater amounts multimedia interactivity built in scored higher on the multimedia value added. It was a bit unexpected, however, that between the DPS and iBooks Author versions of the publication, the iBooks Author version had higher scores. This could be a result of the fact that because the iBooks Author environment restricts the amount of layout freedom you have, forcing the designer to use premade templates to include the interactive elements. Perhaps the DPS version of the article did a better job of integrating these media elements in and therefore instead of being a highlight was more of an "accent" to the publication.

The user's interaction with the publication was measured with several variables, some proving to be significantly different. The amount of time subjects of each group spent reading the publication did not show a significant difference. However, the results did reveal that the readers of the DPS and iBooks Author version spent less amount of time with the publication than readers of the EPUB version. While the difference was not large enough to be considered significant, this difference is still interesting to examine and could be due to many things. Perhaps the readers of the DPS and iBooks Author version were able to understand the publication with greater ease as a result of the multimedia elements and therefore spent less time reading. This would be supported by the fact that there was a marginally significant difference observed in the "value added" of the multimedia elements of the publication.

Interaction with the video and audio elements of this publication revealed interesting results. While there was not a significant difference in the number of people who saw/heard the video/audio elements or the number who got the video recognition question right, a marginally significant difference in the number who got the audio recognition question right was observed, with the 24/30 Adobe DPS readers getting the question right and only 18/30 and 17/30 of the iBooks Author and the EPUB readers respectively. Also noteworthy is the difference in the number that got the video recognition or audio recognition question wrong after interacting with the media elements. 8/30 readers got the video recognition question wrong for both the iBooks Author and EPUB sample groups, while only 3/30 got it wrong with the Adobe DPS version. As well, 9/30 readers of the iBooks Author and 8/30 of the EPUB sample groups got the audio recognition question wrong while only 3/30 got it wrong with the Adobe DPS version. These data shows that although readers of the more interactive version did not interact more than readers of the less interactive versions, they were more engaged with the media elements and did do better remembering and applying the

information they saw. Perhaps it was the layout freedom of the Adobe DPS version (for example, greater freedom selecting the audio button image or the automatic video full screen) that enhanced the media elements attractiveness to the reader and increased their ability to get the question right.

One recognition question was designed to determine if having “information boxes” integrated into the layout of the publication at the bottom corners of pages reinforced the readers’ ability to retain the information better than placing the text in line. Given that the DPS and iBooks Author publications had the corner information boxes integrated and not the EPUB, it seemed as though the EPUB readers may be more likely to get the recognition question wrong. This was not the case, with the results showing no significant differences between the publications. In fact, the EPUB readers ultimately got the recognition question right more frequently than the iBooks Author readers, further disproving that the corner information boxes would reinforce that information.

Another recognition question examined the impact that the interaction in the publication had on subjects’ ability to apply the information they had learned to new information. The question showed a picture of a Lynx that was NOT displayed in the publication. The user then had to identify the species of the lynx based on the images they had seen and the descriptions they had read. This returned no significant results as well, with DPS readers getting the answer right only slightly more than those of EPUB or iBooks author.

Subjects’ ability to correctly recognize from a series of images whether or not they had seen them in their publication proved to not have a significant difference. This

was another surprising insignificant variable, as it was expected that readers of the more interactive versions of the publication would fare better at recognizing the images. Images 2 and 3 from the questionnaire (Appendix A) had marginally significant differences. Image 2, depicting a lynx kitten with its mother that was not in the publication, had the highest correct responses from the DPS readers, with 27 of them getting the question right. This is compared to 25 iBooks Author readers and only 20 EPUB readers getting them right. This could be related to the fact that the more interactive publications contained slideshows of images that readers could physically engage with. This may have increased the reader's ability to spot out the false image because of their higher level of engagement.

This idea was debunked by the fact that 4 out the remaining 5 images, along with the overall recognition score, showed no significant difference. The only other marginally significant result was Image 3, an image that was in the publication that showed a couple of lynx kittens at play. For this image, the readers' of the EPUB version were the ones who fared best with 20 of them getting the question right versus 14 for DPS and 9 for iBooks Author. Overall, it appears that readers' ability to recognize images they saw in a digital publication is unchanged between those reading publications that display images in-line or in slideshows.

Another interesting observation was that the number of people who could answer a recognition question about two maps presented to them in the publication. The maps were displayed differently in each publication and ultimately had a different level of interaction. The EPUB displayed the two maps side by side with the only interaction

being the ability to view the image full screen. The iBooks Author version displayed the two maps in a slideshow, similarly to how all the images in the publication had been displayed. DPS had the most interactivity with subjects swiping across one map to reveal the second map below. In terms of how well each group did answering the recognition question, readers of the more interactive publication fared far better, with 27/30 of them getting the question right while only 17/30 and 15/30 of the iBooks and the EPUB respectively got it correct. This may have been because more DPS readers interacted with the map and were better able to remember the information they saw. This is critical in showing that appropriate use of interactive features can be utilized on tablet devices to engage users' and increase their abilities of retaining that information.

Finally, readers' overall recognition scores showed significant differences between the three publications in this experiment, with the subjects exposed to the Adobe DPS version faring better on the revised score than either the iBooks Author or EPUB groups. This better result could be the result of several different factors. The layout freedom of the Adobe DPS platform could have affected the readers' ability to comprehend, with the neater layout better displaying the information. However, this is likely not the most important factor because the iBooks Author scores were much lower than the DPS even though it also provided a high level of layout freedom. A more likely cause for the better scores by DPS readers could be that the greater interactivity of that publication increased their interest in the content they were reading, resulting in more careful, enthusiastic reading. If the higher level of interactivity in the DPS publication is what resulted in the better scores on the questionnaires, the implications could mean that for digital content intended for the most knowledge retention by the user, selecting a

solution with a higher level of interactivity could be most suitable. This coupled with the results from the interactive map question discussed previously strengthen this notion of the value that the interactivity of a digital publication adds to readers' recollection of the information afterward.

Special Cases

All of the subjects that took part in this experiment were unique, and therefore had different criteria for what would have made the publication “optimal” to them. This was apparent from the comments that were left at the end of the questionnaire. Some subjects really enjoyed the images, while others preferred watching the video. There were those who would have preferred just text, and some that noticed mostly the layout and design. These preferences in “taste” and different ways of viewing the same content show an interesting array of people's personalities. However, there were some subjects who represented demographics of particular interest in regards to the unique needs in order to consume digital content.

Hearing Impaired

One of the participants was deaf. Right away it was clear that the audio elements of the publication could pose a potential problem. However, a solution was developed to this problem by rephrasing one of the questions to be more inclusive of his needs. The question originally was stated as “did you listen to all three audio elements?”. This was changed to “did you interact with all three audio elements?”. He clearly could not listen to

the sounds, however he could potentially press the buttons and read the labels, constituting “interacting”. Ultimately, the audio comprehension question did not need to be changed because it could be answered by reading the labels next to each audio element.

The video element proved to be the more a challenging problem, and ultimately resulted in his data being unusable. The video used in this publication had been pulled from YouTube. A work around was to use the automatic closed captioning automatically provided by YouTube provides. This ended up not being suitable, however, because the closed captioning ended up displaying text that was not even remotely close to the words spoken in the video. One example of this inaccurate translating was when the video stated: “A large mouflan can feed a family for several day” was translated to “allowed to move towards a reference”.

This subjects experience participating in this experiment raised my awareness towards the special attention that needs to be paid to people with limitations. Customization of publications to meet the needs of these individual should be a focus going forward so people like this subject or others with similar special criteria can be included.

Participants 75+

I was fortunate to have the opportunity to go to a local retirement home and obtain a small four person sample group. All four people were women over the age of 75,

with the oldest being 95. Three of the four participants had never used a tablet device before and the one who did claimed to almost exclusively use it for playing games. All four of the participants were able to read through the publication on their own, and fared relatively well on the questionnaire at the end. It was interesting to observe the experience that these women had with the publication, as their experiences should be representative of the 75+ population as a whole.

The reader of the EPUB really liked that the text size was adjustable. Oppositely, readers of the DPS and iBooks Author publications thought the text was too small and wanted to be able to zoom in or increase the text size. This raises interesting design questions for creating digital publications. While making a visually pleasing portrayal of the information on the screen is still critical, for this demographic, it is also important to consider readability. This may change which platform a designer chooses to produce the content on depending on the demographic, with EPUBs allowing greater freedom for the reader to change the font size, or make the font sizes larger in DPS and iBooks Author.

The images were, in general, were a hit amongst this group with lots of positive feedback on the value added by being able to see what was being discussed. As for the video and audio elements, two of the four were unable to use the audio buttons to access the sounds in the publication while one was unable to interact with the video. Perhaps more clear affordances, even at the cost of esthetic appeal, needs to be added for older target populations to ensure that the media elements are not being overlooked and used appropriately.

Children

There were numerous requests from families with children of various ages interested in participating in the experiment. While this seemed like it could be interesting in including these young participants in the study, the demographic was set for people ages 18 or up. Going forward, it would be very interesting and rewarding to expand this research to include children, or exclusively look at children's reception of interactive digital publications. With younger audiences often times being visual learners and more "experimental" in their approach to these types of interactions, the results would likely show an even greater trend than is seen in this study towards the interactive layout resulting in higher scores (and possibly more pleasing experiences).

Limitations

A limitation of this research was the device chosen for the publication. This was limited due to financial and time limitations. The sizes and resolution of the tablets vary by device, so it was a limitation to represent by only one device. As well, other operating systems other than Apple iOS like Android are widely used in tablet devices on the market and were not considered in this study.

Viewing conditions were consistent throughout this research experiment, ensuring that each subject had a quiet, secluded environment to read the article and answer the questions. However it was not necessarily the most accurate representation of where and when the user would most likely want to do this type of reading. Different

distractions and perhaps more natural reading positions in a variety of locations could be important variables that are being overlooked by only using select locations.

The genre that was picked, while attempting to represent the most appealing type of publication to the greatest range of audience, is a limitation to this research. As discussed before, subjects' responses to how pleasing the article was, intentionally or not, often times were influenced by the genre of the content. Had the genre been a more appealing topic to some of my subjects, the results could have been different. As well, the genre is a limitation in that it dictates what the content will be about and thus dictates what is relevant to include. Fortunately, the genre in this study (the lynx) served itself well to images, audio, video, and added interactive features. Other genres may not serve multi-media elements as well and therefore the results in this study may not be applicable.

Future Research

Aside from looking at the reading experience of certain demographics like children, there are various other ways by which this research can be expanded upon. Looking at multiple different tablet devices would be an interesting way to continue this research study. Perhaps user comprehension and/or experience will be different depending on the device's size, resolution, or operating system. As new devices are continuously being released in the market, perhaps a new technology will expand the capabilities of digital publishing even further and introduce a new dimensions that can be tested to see the impact it has on comprehension and overall reading experience.

It would also be interesting to conduct this same test, but instead of having subjects take the questionnaire immediately after finishing reading, wait a day and then take the questionnaire. This would be interesting to see what the long-term retention of the information is and whether there would be any impact from the amount of interactivity in the publication. This style of testing, however, would most likely be difficult to complete because of the amount of time you must request from your subjects.

As well, it would be interesting to assess the impact that the genre/subject matter has on user interaction, information retention, overall pleasure, and media value added. This variable was controlled in this study by means of picking a topic that garnered universal interest and served itself well to inclusion of multimedia. However, with a different subject matter the results of this study most likely would not have been the same. A similar research study could be conducted that aims to measure various content output methods over a variety of genres and topics to determine trends in genre and interactive multimedia adoption.

Another interesting way to expand this research would be to use embedded analytics within the digital publications to observe the subjects' behavior in the background, rather than using the questionnaire method from this study. Using embedded analytics would greatly reduce the potential disparity between the subjects' responses to questions regarding their interactions with the publication and their actual interactions. As well, the ability to monitor user experience in the background without disturbing the subjects' reading environment or having a "quiz" to prepare for as a distraction would more closely replicate their natural reading environment and provide more meaningful,

accurate data. Adobe DPS provides embedded analytics as part of their digital publishing packages where content creators can view data regarding their user behavior, devices they are using, and miscellaneous other information. In the publishing industry, these analytics are extremely valuable as they provide publishers a more complete picture of who their user base is and provide them with the ability to tailor their content to their readers. A research study that monitors reader behavior via analytics embedded into the device would provide extremely valuable feedback on user behavior that would be, otherwise, impossible to get.

Finally, it would be fascinating to see the financial value added by including interactivity into a digital publication. In order to examine this, it would be interesting to see a publisher who produces digital publications already without interactivity and then recreate that content using a different platforms and see if the demand for the publication varies based on the interactivity. Along with this, it would be interesting to see a case study that examines one of these publishers who has gone from static to interactive content and see the impact that this has had on the workflow. Observing how new problems are being addressed by these publishers could indicate a model for others. For example, where does the inspiration for interactivity come from: the designer, the author, or the digital content producer? Observing a real life workflow to break down the keys to the decisions being made by digital publishers could provide a lot of needed guidelines for what constitutes a successful publishing workflow.

Bibliography

- Albanesius, Chloe (2012). *Apple Targets Educators via iBooks 2, iBooks Author, iTunes U App*. [PCMag.com](http://www.pcmag.com). Retrieved from:
<http://www.pcmag.com/article2/0,2817,2399075,00.asp>
- BBC (Sept. 28, 2012). *JK Rowling's The Casual Vacancy ebook suffers glitches*. Retrieved from: <http://www.bbc.com/news/technology-19759117>
- Blodget, Henry. (2011) "A Print Reader is Worth 228-Times as Much as a Online Reader – And Other Fun Facts About The New York Times." *Business Insider*. 20 Feb. 2012. http://article.businessinsider.com/2011-05-24/news/29979759_1_print-edition-new-york-times-digital-business .
- Carroll, J., Ed. (2002) *Human-Computer Interaction in the New Millennium*. ACM Press.
- Chillemi, Stacey. (2007). *How to Become Wealthy Selling Ebooks on the Internet* (2nd ed., pp. 12 - 13). Morrisville: lulu.com. Retrieved from
<http://books.google.com/books?id=cbYeqgohb30C&pg=PA12&dq=%22what+is+an+ebook%22&hl=en&sa=X&ei=dc2rT6e2HoSZ6QGJ1LzFAQ&ved=0CFgQ6AEwAQ#v=onepage&q=%22what+is+an+ebook%22&f=false>
- Dauphin-Tinturier, Anne-Marie. (2007). Publishing and Hypermedia. *Research in African Literatures*, 38(3), 162 - 169.
- DeRose, Steven. (1997). *The Sgml Faq Book: Understanding the Foundation of Html and Xml* (pp. 194 - 201). Norwell: Kluwer Academic Publishers.
- Edgar, D., and Chall., J. S. (1949). *The concept of readability*. Elementary English, 26, 23.
- Flesch, R. (1948). A New Readability Yardstick. *Journal of Applied Psychology*. 32(3). 221-233 doi: 10.1037/h0057532

Garrish, Matt. (2012). *What Is EPUB 3?* (pp. 1 - 12). O'Reilly Media Inc. Retrieved from <http://books.google.com/books?id=yM6SYIRnFpMC&printsec=frontcover&dq=what+is+epub3&hl=en&sa=X&ei=L92vT8jgKomJ6gHs7-y8CQ&ved=0CEwQ6AEwAA#v=onepage&q=what%20is%20epub3&f=false>

Guiard, Yves. Beaudouin-Lafon, Michel. Du, Yangzhou. Appert, Caroline Fekete, Jean-Daniel. and Chapuis, Olivier. (2006). *Shakespeare's complete works as a benchmark for evaluating multiscale document navigation techniques*. In *Proceedings of the 2006 AVI workshop on BEyond time and errors: novel evaluation methods for information visualization* (BELIV '06). ACM, New York, NY, USA, 1-6. DOI=10.1145/1168149.1168165
<http://doi.acm.org/10.1145/1168149.1168165>

Graham, Lisa. (2008). *Gestalt Theory in Interactive Media Design*. Journal of Humanities & Social Sciences. Volume 2. Issue 1. Retrieved from:
<http://www.scientificjournals.org/journals2008/articles/1288.pdf>

Graziano, Dan. (2012). *Tablet sales expected to reach 248.6 million units by 2015, smartphones sales to hit 1 billion*. BGR. Retrieved from
<http://www.bgr.com/2012/02/10/tablet-sales-expected-to-reach-248-6-million-units-by-2015-smartphones-sales-to-hit-1-billion/>

Hill, B. (1999). *The Magic of Reading*. Redmond, WA: Microsoft.

Hunter, David. Rafter, Jeff. Fawcett, Joe. Van Der Vlist, Eric. Ayers, Danny. Duckett, Jon. Watt, Andrew. (2004). *Beginning XML* (3rd ed.). Wrox Publishing. Retrieved from
<http://books.google.com/books?id=x8cFTi8vF70C&pg=PT632&dq=docbook+hunter&hl=en&sa=X&ei=8d-vT9yBKaji0QGhramwDQ&ved=0CDsQ6AEwAA#v=onepage&q&f=false>

Joss, Molly. (2012). *A view of iPad Readership Through Adobe's Lens*. The Sybold Report. Volume 12, number 4.

Kleinfeld, Sanders. (2012). *HTML5 for Publishers*(pp. 27 - 43). O'Reilly Media Inc. Retrieved from
<http://books.google.com/books?id=EMJPFrWEnAQC&printsec=frontcover&dq=html5+for+publishers&hl=en&sa=X&ei=E92vT8eJKqXz0gHfs9WADA&ved=0CEoQ6AEwAA#v=onepage&q=html5%20for%20publishers&f=false>

- Lowe, David. Hall, Wendy. (1998). *Hypermedia & the Web: An Engineering Approach*. Retrieved From: <http://users.ecs.soton.ac.uk/lac/LoweNHall/extracts/Hypermedia.html>
- Mayhew, D. (1999) *The Usability Engineering Lifecycle – a Practitioner’s Handbook for User Interface Design*. Morgan Kaufmann.
- Mercer, David. (2003). *Schaum’s Easy Outline of HTML* (pp. 2 - 25). New York: McGraw Hills Companies. Retrieved from http://books.google.com/books?id=r5COLeDFYNAC&printsec=frontcover&dq=Mercer,+Dave+html&hl=en&sa=X&ei=kNevT57hG_CA6QHE6aW-CQ&ved=0CDcQ6AEwAA#v=onepage&q=Mercer%2C_Dave_html&f=false
- Nebeling, Michael, Fabrice Matulic, Lucas Streit, and Moira C. Norrie. “Adaptive Layout Template for Effective Web Content Presentation in Large-screen Contexts.” In Proceedings of the 11th ACM Symposium on Document Engineering, 219–228. Mountain View, California, USA: ACM, 2011.
- Norman, Donald. (1990) *The Design of Everyday Things*. NY: Currency and Doubleday. ISBN 0-385-26774-6
- Norman, Donald (2008) *Signifiers, not affordances*. ACM Interactions. Vol 15, issue 6. Retrieved from: http://www.jnd.org/dn.mss/signifiers_not_affo.html
- Polanka, Sue. (2011). *No Shelf Required: E-Books in Libraries* (pp. 1 - 12). American Library Association. Retrieved from http://books.google.com/books?id=FZ8QJwD1Nm8C&pg=PA88&dq=electronic+reading&hl=en&sa=X&ei=4AGtT9H2A6KD6AGjr7DxDA&ved=0CG0Q6AEwBQ#v=onepage&q=electronic_reading&f=false
- Pilgrim, Mark. (2010). *HTML5: Up and Running* (pp. 9 - 14). Sebastopol: O’Reilly Media. Retrieved from http://books.google.com/books?id=Mk3sW0on7OAC&pg=PA10&dq=everything+you+know+about+xhtml+is+wrong&hl=en&sa=X&ei=QcuvT5uECOex6AGUhsieCQ&ved=0CDkQ6AEwAA#v=onepage&q=everything_you_know_about_xhtml_is_wrong&f=false
- Project Gutenberg. (2012). Retrieved May 4, 2012, from <http://www.gutenberg.org/>

- Rainie, Lee (2012). *Tablet and E-Book reader Ownership Nearly Double Over the Holiday Gift Giving Period*. Pew Internet. Retrieved from: <http://libraries.pewinternet.org/2012/01/23/tablet-and-e-book-reader-ownership-nearly-double-over-the-holiday-gift-giving-period/>
- Stapel, Jan. "Recall and Recognition: A very Close Relationship." *Journal of Advertising Research* 38.4 (1998): 41-5. ABI/INFORM Complete; ProQuest Psychology Journals; ProQuest Research Library. Web. 8 Feb. 2012.
- van Kesteren, Anne & Pieters, Simon . (2012). HTML5 differences from HTML4. W3C. Retrieved May 4, 2012, from <http://dev.w3.org/html5/html4-differences/#apis>
- Walsh, Norman & Mueller, Leonard. (1999) *DocBook: The Definitive Guide*, O'Reilly & Associates, Inc., 1st Edition, <http://www.docbook.org/tdg>
- Walsh, Norman & Hamilton, Richard. (2010). *DocBook 5: The Definitive Guide* (pp. 1 - 14, 24 - 41). O'Reilly Media Inc. Retrieved from <http://books.google.com/books?id=nbiRSagoci8C&printsec=frontcover&dq=docbook+walsh+and+hamilton&hl=en&sa=X&ei=ut2vT8zuCofv6AHQvbmJCQ&ved=0CD4Q6AEwAA#v=onepage&q=docbook>
- Wooyong Yi, Eunil Park, and Kwangsu Cho. (2011). *e-book readability, comprehensibility and satisfaction*. In Proceedings of the 5th International Conference on Ubiquitous Information Management and Communication (ICUIMC '11). ACM, New York, NY, USA, , Article 38 , 7 pages. DOI=10.1145/1968613.1968660 <http://doi.acm.org/10.1145/1968613.1968660>
- Zickuhr, Kathryn. (2013). *Tablet Ownership 2013*. Pew Internet & American Life Project. <http://www.pewinternet.org/Reports/2013/Tablet-Ownership-2013/Findings.aspx>

