News media design: A comparative study of digital application format

by

Lei Zhang

A thesis submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

MASTER OF FINE ARTS

Major: Graphic Design

Program of Study Committee:
Sunghyun R. Kang, Major Professor
Debra J Satterfield
Frederic C. Malven

Iowa State University

Ames, Iowa

2012

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

In this information age, newspapers are experiencing a transition from a printed format to a digital format. Using an electronic device to read news has become one of the important ways to acquire information in people's daily lives. The electronic mobile device, especially the iPad, provides a new platform for newspaper publication, which enables newspaper publishers to create unique applications for readers. However, the existing research about newspaper design for iPad devices is very limited. This study conducted an online survey to investigate users' attitudes toward digital format newspapers and printed format newspapers. Through the analysis of iPad application design and website design of the New York Times, USA Today and Huffington Post, it listed the common advantages and disadvantages of current newspaper applications. The case studies assisted to formulate the guidelines of e-newspaper iPad application design, which will contribute to improve the e-newspaper reading experiences for users.

CHAPTER 1. INTRODUCTION

1.1 The Electronic Newspaper: New Challenges of Newspaper Design in the Digital Age

When the first Kindle was announced by Amazon.com, Inc. in 2007, a revolution of book industry started. Electronic books and readers (e-books & e-readers) have transformed book content from printed text on paper to digital text on screen, which brings s new reading experience to readers. In the following years, as more and more devices (such as Apple iPad, iPhone, etc.) were introduced, the publishing industry also faced a transition from the printed age to the digital age. The revolution caused by new technologies reforms the way people acquire information in their daily lives. As an important mass communication medium, the newspaper also joined this revolution and now embraces new technology positively. However, the transition of newspaper format from printed form to digital form can be dated back as early as the birth of the first web-based newspaper in the mid-1990s when the Internet initially became popular in people's daily lives (Li, 2006, p. 13). The invention of electronic readers and mobile devices enriches news communication channels, resulting in prosperity of newspaper applications for mobile devices.

From printed format newspaper to digital format newspaper, the transition has also changed the reading habits of readers. Liu (2005) discovered several changes of reading behavior from the printed environment to the digital environment, the most significant one being the different activities involved in the reading process. He indicates that under the printed environment, the most common activity is "annotating and highlighting while reading" , but under the digital environment, reading activity is featured by browsing and scanning. Besides Furthermore, different devices also need new and different ways of interacting. Liu also mentioned the behavior of flipping paper pages has been replaced by scrolling a screen or sliding pages by finger. This result indicates that reading activity through digital medium is more complex than that of printed medium, and the role of users in a reading process is more important than ever before.

Both the format change and reading behavior change bring new challenges to newspaper design in this digital age. Compared to the traditional printed newspaper

design which mainly relies on manipulating typographic elements on pages, the digital format newspaper design requires a comprehensive understanding of multiple disciplines such as graphic design, human computer interaction, psychology, etc. to understand users' behaviors and needs. Some previous studies about e-book design and web-based newspaper design contribute to provide general guidelines for digital format newspaper design. However, as a new form of electronic newspaper, the study about newspaper iPad applications is limited. Therefore a detailed examination of newspaper iPad application is necessary to understand the current design.

1.2 Purpose of Research

The purpose of this research is to find common characteristics of current newspaper iPad applications and to make design suggestions for electronic newspaper (e-newspaper) design. This purpose can be achieved through several research objectives: (a) finding users' attitude toward digital format newspapers; (b) identifying the advantages and disadvantages of e-newspaper website design and iPad application design; (c) identifying the advantages and disadvantages of different e-newspaper iPad applications.

1.3 Thesis Procedure and Methodology

The overall research was conducted through three steps. First, the review of literature establishes a basis of newspaper typographic design and e-book interaction design. It also provides a set of criteria to evaluate the designs of current e-newspaper iPad applications. Second, an online survey was conducted to explore the general attitude of people toward digital format newspapers and printed format newspapers. Survey questions included how people use electronic devices to read news, participants' preferences of printed format newspapers and digital format newspapers, participants' evaluations about e-newspapers, and how people use an iPad to access daily news. Next, three newspaper iPad applications were selected as examples for design analysis. The website design was also compared to the design of the iPad application with the same brand. Finally, through synthesizing the findings of literature, the online survey, and a case study, the suggestions and recommendations for e-newspaper iPad application design were concluded.

CHAPTER 2. REVIEW OF LITERATURE

The first part of this thesis provides an overview of newspaper design from the printed age to digital age. It demonstrates the general design principles of newspaper layout based on its function and on the behaviors of readers. It also discusses the previous research about digital format newspaper in terms of legibility and usability. Finally, it compares the different behaviors between reading a printed medium and a digital medium. In general, this section draws a guideline of newspaper design in the digital age.

2.1 Newspaper and Newspaper Functions

When the first newspaper appeared in the United States 300 years ago, its purpose was to work as a communication medium that reported important events to ordinary people. During the mid-1940s, the newspaper industry hit a climax of development, and newspapers started to play a more and more essential role in people's daily lives (Harrower, 1995; Moen, 2000). Harold Evans (1997) defines a newspaper as "a vehicle for transmitting news and ideas ", which emphasizes the communication function of a newspaper. Therefore one of the critical functions of a newspaper is telling stories to the readers. However, the news communication process is an interactive process between the news stories and the readers. A newspaper is a bridge that connects readers to the content. Moen (2000) has described the function of newspapers in detail. He mentioned in this information age, the function of a newspaper is more than reporting new events. Since people come in contact with tremendous amounts of information everyday, the role of the newspaper is filtering useful messages from mass information, and organizing this information in an understandable and logical way for readers. Readers perceive stories from visual information including text, photos, and graphics. A successful news story has the power to invite readers to respond to the content. For instance, when a newspaper reports important meetings, readers can "write or call officials, protest, attend meetings and be heard." Some newspapers also ask for readers' opinions about some issues, which will incorporate the readers' involvement into the story. The organization of text, photos and graphics adds value and meaning to a story, through which newspapers can motivate readers to act on the information (pp.6–13).

2.2 How Readers Read a Newspaper

In the news communication process, readers are the final component of this process. The core of newspaper design understands what readers want and how to convey the information to them effectively. Before planning a design, it is necessary to examine how readers read and perceive information from a newspaper.

Whitbread (2001) explains how people perceive information during the reading process. He states the information is "a complex set of symbols made up of letters, numbers and punctuation marks", and the reading process is establishing an association between these symbols and the spoken language (p.16). Ambrose and Harris (2011) suggest the visual flow of a reading process usually starts at "an entry point", which is the most prominent visual element on a typographic surface. If the elements on a page are designed with equal visual hierarchy, people will follow the general rule where people read from the top left of the page, move to the middle part, and finally exist from the bottom right of the page (p. 60). Specifically in regards to reading a newspaper, a reader will be led unconsciously by the typographic design of the page. Some punctuated elements such as headings, subheadings, pull-quotes or images can all work as the entry point. Other elements like arrows or numbers will also push readers to follow the reading direction (Whitbread, 2001, p.15).

Due to the large quantity of information and the limited time for reading, people usually scan the content and look for the information that interests them. Moen (2000) summaries the habits of newspaper readers as following:

1. Readers look at about three-quarters of the photos and illustrations.
2. Readers look at about half of the headlines.
3. Readers look at about a third of the briefs and cutlines.
4. Readers read about a quarter of the stories.
5. Readers are more likely to read a story if it is accompanied by a photo.
6. Readers scan pages. They decide whether to start a story based on the headlines. If they start a story, about half of the readers will read at least half the story.
7. Readers spend about 25 minutes a day with the newspaper. Part of that time is spent on advertisements and comics.

8. Summaries satisfy some readers; others read them and continue to the main story (p. 28).

The summary indicates that readers read the newspaper in a rush. Therefore, a successful newspaper design should not only draw readers' attention but also arouse their interest in a very short period of time. A good typographic design will assist to communicate news story effectively. Creating clear hierarchy, visual interest and a fluent visual flow will help readers to perceive information faster.

2.3 Newspaper Typography

Typography is an effective tool to create visual order and to communicate the meaning of information. In newspaper design legibility and readability, visual hierarchy, and use of color images are especially important for conveying visual messages to readers.

Harrower analogized the page of a newspaper as a puzzle, and he suggested there were four essential pieces of the puzzle–headlines, text, photos and cutlines. Designing the page layout of a newspaper is like playing with a puzzle. The basic typographic components are like puzzle pieces that assist designers to visualize the news stories for readers (Harrower, 1995, p.22). Moen (2000) summarized eight basic components of traditional printed newspapers in detail. He suggested, in general, that a newspaper is consisted by "text type, display type, rules and borders, photographs, artwork, structures, grids and white space." According to Moen, the eight elements consist a unique newspaper design language system, through which designers will tell news stories without any verbal language (p.19). Although newspapers have changed from paper to digital and these eight elements are manipulated in new ways, the basic functions of these elements are the same as the printed newspaper. They play an essential role in drawing readers' attention, organizing visual information and communicating accurate messages to the readers.

2.3.1 Newspaper Legibility & Readability

Ambrose and Harris (2011) used two definitions to differentiate the terms "legibility " and "readability". They explained that legibility refers to "the ability to

distinguish one letterform from another through the physical characteristics inherent in a particular typeface;" whereas that readability "concerns the properties of a piece of type or design that affect the ability to make it understood (p.158)." The basic factors that determine the legibility of text include typeface, type size, line width, word spacing and letter spacing, leading, form, contrast and reproduction quality (Moen, 2000, p.109). The text type among the eight newspaper components refers to the text that is used to display the story content. It is the main factor that affects the legibility and readability of a newspaper. Therefore, choosing an appropriate text type will directly affect readers' comprehension and reading speed.

The type size, letter spacing, line width and leading work as a system that influences the overall legibility of a newspaper. Many studies have investigated newspaper legibility from different aspects. Research conducted for the American Newspaper Publishers Association proved that the serif typeface has a better legibility than the san serif typeface when reading printed content (Hvistendahl & Kahl, 1975). The research results found that the optimal type size for display copy that has the best legibility for readers is in the range of 9-point to 12-point, and that the common type size of display copy in newspapers is from 8-point to 10-point. However, the type size is not absolute because different typefaces have different x-heights that affect the optical size of a type. Therefore, referencing the x-height of a type is more accurate when consider the legibility of text (Moen, 2000, pp.110, 19). Considering the interconnection between these factors, there are several findings about the display type on a newspaper page. Moen (2000) suggested a common structure for newspaper is a "six-column format with 9-point type and a 12–14 pica column width." Tinker and Paterson (1929) found "10 to 12 words per line is the optimal number for retention in reading." In addition, Hvistendahl and Kahl (1975) indicated setting serif type in 14-pica wide columns would obtain the highest reading speed for readers. In fact, newspaper legibility research examined the common features of the factors that affect page legibility. They provided general guidelines for newspaper typographic design.

Since digital format newspapers have different a display size and technology, the legibility research results for printed newspapers are hard to apply to the digital format.

New studies about legibility issues for electronic newspapers have become a new research topic for designers.

2.3.2 Newspaper Page Layout

As Harrower (1995) compared newspaper design to playing with a puzzle, designers play with the puzzle pieces to visualize the final pattern of a newspaper. Figure 1 describes the basic structure and terminologies used for newspaper layout design.

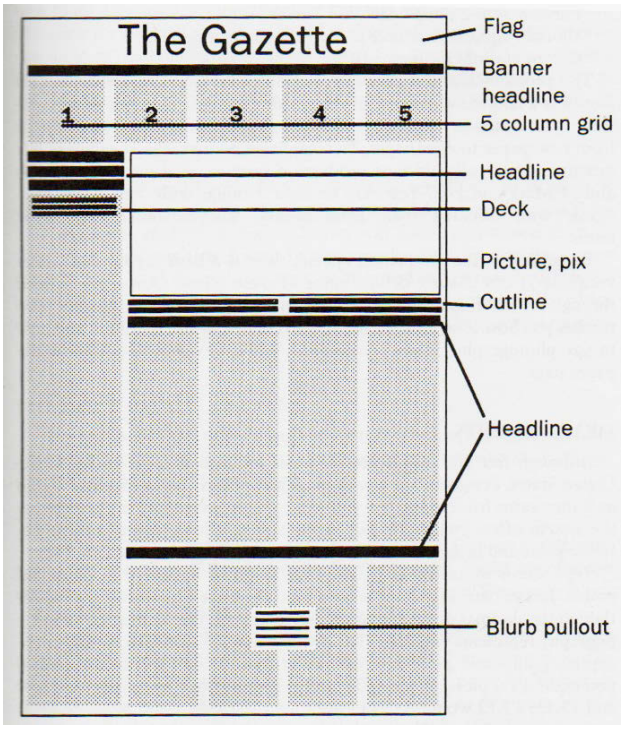


Figure 1. Conventional newspaper structure

Because most people scan the newspaper content before they read, the final puzzle pattern should achieve two functions: (a) drawing people's attention and arouse their interest before they read the content, and (b) establishing an efficient communication pattern so that scanners can get as much information as possible in a limited time. These two functions can be realized by manipulating text, photographs, graphics, structures, and white space. Typographic elements are signs that communicate ideas. On one hand, the signs are verbal cues that associate to the denotation of a language; but on the other hand, the signs are visual cues that present as a connotation to

communicate information to readers (Carter et. al, 2007, p.116). When designers plan a newspaper layout, they treat all the text and images as visual forms. Through creating contrast, balance, consistency, unity, punctuation, etc., designers organize these elements in a logical order that help readers perceive information better. Among the eight basic newspaper elements defined by Moen, the display type which refers to headline, deck, blur, pullout, etc. is one of the most significant tools to attract peoples' attention and lead their visual flow when they read.

Moen (2000) and Harrower (1995) have explored the importance of display type in a newspaper's typographic design. Moen suggested readers usually scan 70% to 80% of the headlines and decks to select which content they would like to read (Moen, p. 118). Headlines are especially critical to attract readership on a newspaper page. The functions of newspaper headlines can be summarized as following:

- Summarizes the story content and entices readers into the text.
- Creates a visual entry point and anchors story design to help organize the page.
- Prioritizes the importance of stories.
- Creates a focal point and adjusts the grayscale of the entire page.
- Communicates emotions and connotative messages.

Except for headlines, other elements such as sub headlines, decks, pull quotes, etc. also play a similar role as the role of headlines in newspaper design. All of these elements interact with each other to provide scanners with the outline of a story, which have the power to lead people from scanning information to reading the content.

For traditional printed newspaper design, some typographic rules can be followed when choosing appropriate display types. Harrower suggested the more important the story is; the larger type would be used to display headlines. In general, "small headlines range from 12-to 24-point; midsize headlines range from 24-to 48-point; large headlines range upwards from 48-point (Harrower, p. 25)." "The type size for deck is usually half the size of the main head, and the summary deck is usually written in the range from 14-to 18-point. A pull quote is usually set in 14-to 18-point (Moen, p. 21). "

Digital format newspapers can also follow the display type hierarchy order used in printed newspapers, but specific type sizes should be adjusted based on the screen size and other ergonomic conditions.

2.3.3 Telling Stories with Typography

The purpose of newspaper design is not only communicating information, but also telling stories and evoking the emotional responses of readers. This purpose can be achieved by manipulating the form of display type and displaying photos, as well as graphics. Moen (2000) and Harrower (1995) also investigated the function of communicating the emotions of newspaper typography. As mentioned in the previous section, type styles are visual signs that are able to express connotative meaning to readers. By varying the typeface, type size, type weight and form, designers will convey emotion to readers through the appearance of newspaper typography (Moen, p.124).

In newspaper design, photography is another powerful tool to attract scanners' attention. Harrower emphasized the importance of a photo as "there is nothing like photography to give a page motion and emotion." A photograph will assist to tell a story by the image content and the cutlines that accompany the photo. Previous research suggested cutlines were able to provide messages behind a picture, and readers usually look for quick hits of information from the cutlines (Harrower, pp. 28–31).

Editing photos for a newspaper is as important as editing the text content. The general guidelines are (a) choose the photo that enhances the main idea of the content; (b) when displaying several photos, establish a clear hierarchy; and (c) keep all of the photos consistent (Moen, p.59). In the digital age, video has become a new element that contributes to the communication of news information. As it has similar function as photographs, some of the guidelines can also be applied to organize the multi-media element in digital format newspaper.

2.4 Newspaper in the Digital Age

With the widespread use of the personal computer and the development of the World Wide Web, traditional newspaper is no longer the dominant medium to communicate news information in people's daily lives. After the first electronic news appeared in the mid-1990s, newspapers started to experience a transition from a printed format to a digital format. The prosperousness of web-based publications enables web users to get more news information online; while the popularity of smart phones and electronic book devices "feed" news to readers at anytime and any place. Technology not

only forces the evolution of newspapers, but also reforms the newspaper reading habits of readers. The newspaper form change brings new experiences to readers; therefore, newspaper design is facing new challenges to meet the needs of readers.

2.4.1 Differences Between Printed Newspapers and Electronic Newspapers

Different medium platforms define different features of newspapers. From printed format to digital format, newspapers change how people read, comprehend and interact with the information. Through comparing traditional printed newspapers and web-based newspapers, Barrie Gunter summarized the key differences between printed newspapers and digital newspapers in seven categories: (a) amount of content; (b) format and design; (c) access and customization; (d) immediacy; (e) hyperlinking; (f) interactivity; (g) cost (Table 1) (Gunter, 2003, pp.65–72). On one hand, these differences improve the news communicating process, which facilitate readers to get information better. On the other hand, these changes force readers to perform differently when interacting with traditional newspapers and electronic newspapers, which challenge their newspaper reading habits that formed over a long period of time.

Table 1. Differences between printed and digital newspapers

Features	*Printed Newspaper*	*Digital Newspaper*
Amount of content	1. Only report a specific event; 2. Content is limited by page space;	1. Report a specific event, provide background information and related stories; 2. No limitation of page space;
Format & design	3. Vertical reading format; 4. Measured by inch and pica; 5. Content is presented by text, photos and graphics.	3. Horizontal reading format; 4. Measured by pixel; 5. Content is presented by text, images and multimedia elements (audio & video).
Access	6. Information is accessible at circulation time and place; 7. Readers do not need an extra device for reading.	6. Information is accessible any time, anywhere; 7. Readers need an extra device for reading.

Customization	8. Readers cannot choose the news content.	8. Readers have the flexibility to receive news of a certain section and store useful news.
Immediacy	9. Content can only be updated when a new edition is available. Information delivery is limited by print and distribution process.	9. Content can be updated online continuously. There is no extra time spent on printing and product distribution.
Hyperlinking	10. There is no interconnection between newspaper content or one newspaper to another.	10. Newspaper content and different newspapers are connected by hyper links.
Interactivity	11. Print medium is a "one-way" communication medium, which makes hard-copy newspapers hard to interact with.	11. Electronic medium is a "two-way" communication medium, which enables users to interact with either newspaper content or other users.
Cost	12. The cost of printed newspapers comes mainly from the expense of paper and ink.	12. The cost of digital newspapers comes mainly from the expense of the reading device.

2.4.2 Electronic Newspapers Features

As the basic function of newspapers is communicating news stories to readers, both printed newspapers and electronic newspapers need to maximize the efficiency of information presentation, which will assist readers to acquire a pleasant reading experience. However, due to the different characteristics of the printed medium and digital medium, traditional hard-copy newspapers and electronic newspapers have different approaches to achieve this purpose.

When Li (1998) studied the features of electronic newspapers, he discussed three models in the presentation of news information: (a) the interactivity model, (b) the hybrid model, and (c) the media transition model. Based on these three models, Gunter (2003) examined how electronic newspapers convey information to the users.

The Interactivity Model

The most significant feature of electronic newspapers is the ability for interaction. As Rogers noted, "the most essential capacity of electronic media is that of interactivity," electronic newspapers provide readers with interaction on various dimensions and levels. Cho and Leckenby categorized interactivity as "interaction between users and messages,

human beings and machines, and senders and receivers" (Gunter, 2003, pp.60–63). Their research indicated that compared to traditional printed newspaper, the role of readers in electronic newspaper is more active. For the traditional hard-copy newspapers, the information delivery process and reading process are separated. On one hand, readers can only read the content that is presented on the page; but on the other hand, it is hard for newspaper editors to evaluate the effectiveness of news communication. The power of message delivery belongs to newspaper publishers, while readers are passive message receivers. However, for the electronic newspapers, the communication power has shifted to readers (Li, 2006, pp.33–37).

Li and Zeng divided the interactivity of the Internet newspaper into two dimensions– the "content interactivity" and the "interpersonal interactivity" (Li, 2006, p.141). The content interactivity refers to the flexibility to select new and customized personal newspapers. Without the constraint of page space, the quantity of news is increased dramatically by electronic medium. But at the same time, the digital format newspaper also provides readers with the freedom to choose news that they are interested in. Interpersonal interactivity indicates the "communication between human beings." Elements such as e-mail links, discussion forums and the comment messages of electronic newspapers all contribute to the communication process. Through these discussion platforms, readers are able to exchange messages and ideas with other readers or editors (Li, 2006, pp.139–158).

According to Li and Zeng's study, electronic newspapers establish networking that links content with content, as well as readers to readers. Through connecting background information and related stories by hyper links, the content networking increases the depth of a report, which provides readers with an overall examination of a specific event. Therefore, how to manage the content networking is especially important for digital newspaper design. Previous studies found "newspapers… are helpful in providing information about and building confidence in society, in overcoming loneliness, and in strengthening social stability". Some researches also revealed that one of the significant motivations of using the Internet is "using the Internet for social contact" and "seeking socially oriented gratification" (Gunter, 2003, pp.150–155). In this way, the interpersonal interactivity is a unique feature of electronic newspapers that can

fulfill the demand of social communication. How to build interpersonal communication networking through newspapers will become a new topic for electronic newspaper design.

The Hybrid Model

Applying multimedia functions in a news communication process is another essential feature of electronic newspapers. Computer technology enriches the way of telling news stories, which improves the electronic newspaper as a new hybrid news medium that mixes literacy-print content with multimedia content (Li, 2006, p.36). However, study regarding the effects of using multimedia in news information communication is limited. From a cognitive psychology perspective, the *cue summation theory* indicates "when textual information is presented along with images, it provides additional learning cues, particularly at the time of retrieval from memory" (Severin, 1967). However, Lang (2000) and Leigh (1991) argued "media messages delivered simultaneously in a number of modalities are cognitively complex and serve to overload the processing system." Sundar (2000) investigated the impact of news website multimedia on user's memory. Through comparing (a) text-only news site, (b) text and picture based news site, (c) text and audio based news site, (d) text, picture and audio mixed news site, and (e) text, picture and video mixed news site, he drew the following conclusions:

- The text-only and text-with-picture format news sites are preferred by users.
- Compared to presenting information by pictures, audio has a strong negative effect on the memory for news content.
- Adding multimedia could hinder the user's memory of news (Gunter, 2003, pp.162–163).

Although multimedia technology including audio, video and animation make newspapers more vivid and appealing, the effect of multiple channel communication on cognitive ability should also be considered in electronic newspaper design. How to integrate new technology into conventional news communication needs to be further investigated.

The Media Transition Model

Bordewijk and van Kaam (1986) illustrated four patterns for communication, among which the two patterns "allocation" and "conversation" can demonstrate the different processes of information transmitted for conventional newspapers and electronic newspapers. They also concluded that as the mass communication medias were reformed by new technologies, the communication pattern was "shifting from allocatory to conversational." According to their research, *the allocation pattern* refers to "information sent from the center simultaneously to peripheral receivers". This pattern describes how printed newspapers convey the information to the final audience. By contrast, *the conversation pattern* means "individuals interact directly with each other, by passing a center or intermediary and choosing their own partners as well as the time". The conversation pattern reveals the feature of information distribution of electronic newspapers (Li, 2006, pp.36–37).

2.4.3 Reading Experience in Digital Age

The transition from a printed medium to a digital medium also changes the way that people read. The features of electronic newspapers are subverting to conventional newspaper reading habits. With display technologies, reading devices as well as the design of electronic newspapers all contribute to creating new reading experiences for readers.

2.4.3.1 Reading from Paper vs. Reading from Screen

The electronic newspaper is characterized by displaying information with digital text on a screen. Reading from printed text on paper to digital text on screen is the most significant change of the newspaper reading experience. As early as 1980, researchers started to study reading differences between these two types of mediums. Dillon et al. (1988) reported an overall summary about reading from paper and reading from screen. Through reviewing previous research studies, the research team reported that the reading speed on screen is slower than on paper, and that tasks with more cognitive demand were less accurate on screen than on paper. However, they suggested that these differences were not caused by the medium itself, but by the intervening of various variables such as

type size, line length, and color contrast, etc. They concluded that the key factor influencing reading behavior was the visual display quality. Therefore, the resolution of screen is especially important for a pleasant reading experience.

As more and more display technologies were invented, the quality of digital display was also improved. The paper-like e-ink display and high-resolution LCD display make up the previous screen display deficiencies, which brings a more comfortable reading experience to users. In the study of Siegenthaler et al. (2011), they explored the reading differences between printed book and e-book by analyzing two types of eye movement: "fixations (eye fixation times and duration)" and "saccades (progressive, regressive and line sweeps)". In their study, results revealed there was no obvious difference of saccades when reading these two types of book, however, the fixation duration on a printed book was significantly longer than on an e-book. As visual fixation is a factor in evaluation of legibility, researchers concluded, "In some situations, e-readers have better legibility than a printed book". They ascribed the reason to a feature of e-books that enables users to adjust the optimal font size according to their personal needs.

Although the existing research did not compare the visual display of printed newspaper and electronic newspaper directly, the studies about reading experiences on conventional printed mediums and digital mediums convey a general result of the problem. It suggests with the development of display technology, the deficiencies caused by digital displays have been reduced. The display medium is not the main factor that affects the reading experience.

2.4.3.2 Interaction with Electronic Newspapers

The three information-presenting models illustrated by Li (1998) not only explain the features of electronic newspapers, but also influence how people perform when reading electronic newspapers.

As a communication medium, the Internet is described as "nonlinear"– users are able to read content without following a certain sequence, and they can also access other related information through hyperlinks (Friedland & Webb, 1996; Paul, 1995). This nonlinear feature can be applied to any digital format newspaper today; there is no

difference if it is presented in the form of a website or mobile device application. Gunter believes the nonlinear feature has the potential to result in nonlinear reading, which is different from the linear reading of traditional newspapers:

> "With a hard-copy newspaper, finite information is prepared that a reader consumes by starting at the top of the page and reading down. With an electronic newspaper, the reader may be able to switch from the story halfway through to pursue more detailed information on a point that is archived elsewhere." (Gunter, 2003, p.145)

In response to the key feature "interactivity" of electronic newspapers, researchers also examine how readers interact with news content during the reading process. Similar to reading a printed newspaper, readers usually scan the information before deciding to explore a specific content. However, researchers define the major interactivity of reading electronic newspapers as "browsing". Fredin and David (1998) established a "Hypermedia Interactivity Cycle (HIC)" model to examine the "browsing" behavior in detail. The HIC model can assist people to understand how readers perceive and select information under the digital reading environment.

According to Fredin and David, the HIC model divides browsing into three stages: preparation, exploration, and consolidation. The preparation stage is the beginning of this cycle. During this stage, users are exposed to various menus and options. They need to make the best choice from the options based on their guess and estimation. The preparation stage can help users to filter out the information that does not interest them, so that they will face a moderate amount of information in the exploration stage. After making the choice from a menu, users come to the exploration phase where they need to explore the information that relates to their choice. In this phase, the integrated text, graphics, audio, and video information plus various menu items and buttons bring users to a more complex interaction system. Users need to interact with this system before focusing on their final choice. The HIC cycle will end with the consolidation stage, where users either find the information they are interested in or fail to find the information and start a new exploration phase to keep searching. Fredin and David suggested that the behavior of the HIC model was controlled by motivational components, which are

consisted of “goals” and “self-efficacy”. Motivational components show the relationship between users’ expectations and action outcomes; users usually make decisions based on this relationship (Gunter, 2003, pp.146–149).

The digital communication medium has shifted the power from information senders to information receivers; therefore, a user-centered design strategy is extremely important for electronic newspaper design. The research about reading behavior and experience under a digital environment provide designers with a general understanding of how users act under the digital reading environment. In order to facilitate linear reading, the design of traditional printed newspaper focuses on organizing separate news stories to establish a clear visual structure and lead a fluent visual flow. Although a structured visual layout is important for electronic newspaper design, since users usually perform nonlinear reading when reading digitally, it is also critical to build a reasonable information network to support the nonlinear reading behavior of users. In this way, the information architecture and page navigation will play essential roles in electronic newspaper design.

2.5 Electronic Newspapers

The electronic newspaper (e-newspaper) is a digital-format newspaper that communicates information through a certain electronic device. An early format of e-newspaper is the web-based newspaper that is displayed on a computer screen. However, as more and more mobile devices such as e-readers, Smartphones and tablet PCs enter the market, the formats of e-newspapers are expanding beyond the web page of a computer. The invention of e-book readers and tablet PCs (such as the Amazon’s Kindle and Apple’s iPad) revolutionized the publishing industry. Online bookstores and mobile applications enrich the publishing platforms. However, the development of technology is at a faster pace than users’ acceptance and comfort-level of technology. New technologies constantly challenge the reading habits of users’ that formed years earlier. In this case, there is a gap between what technology can offer to users and how users will use technology. More research is needed to investigate this issue and close in on the gap between technology and users. Research focused on e-newspaper design is especially

limited. The existing studies that have explored the issues regarding reading in the digital environment and e-book design will help to establish a base for e-newspaper design.

2.5.1 Electronic Reading Devices

The electronic reading devices in the current market can be divided into two major categories: e-book readers (eReaders) and tablet PCs (tablets). Among the various brands, the Amazon Kindle and Apple iPad are the most popular brand in each category. Research has examined the differences between these two types of devices from different perspectives.

2.5.1.1 Display Technologies of eReaders and Tablets

One of the most significant differences between eReaders and tablet PCs is the various screen display technologies. The eReaders device usually works with electronic ink (e-ink) on electronic paper, which relies on ambient lighting resources for display; whereas, the tablets adopt the LED (light-emitting diode)-lit LCD (liquid crystal display) displays, which needs background lighting to display in a dark environment (Lee et al., 2011, Lin et al., 2008, & Ballhaus et al., 2010). The two different display technologies have both advantages and disadvantages to present digital format content.

The main advantage of e-ink display is that it provides readers with a paper-like reading experience. Lee et al. (2011) described how E-ink technology works to display information on a device:

> "… E-ink comprises millions of tiny microcapsules where a mixture of positively charged white particles and negatively charged black particles are suspended in fluid. The black and white image is shown by applying an external electric field to attract the charged particles on the surface according to the polarity."

Research has proved that the e-ink display technology has fewer glares on the screen. This feature will help to reduce visual fatigue when reading on an electronic device (Lin et al., 2008). However, the limitation of e-ink display technology is that it can only present black and white content with gray scales. Therefore it confines the display of graphics and videos for digital format content. Moreover, e-ink technology has a delay of

transition from one screen to another, which also interferes with the reading experience of users (PrincewaterhouseCoopers, 2010, pp. 4–5).

By contrast, tablets that use LED display technology present content on a liquid crystal display (LCD) screen, which often causes a glare from a direct light source. In previous studies, users also mentioned they felt uncomfortable when reading in direct sunlight with an iPad. This problem makes it is hard to predict in what condition readers can get the best legibility of the text with tablets. Compared to the e-ink display, the LED technology is able to present high-resolution photos and multimedia content. It also has the advantage of turning pages and following hyperlinks without delay, so it is especially suitable for newspapers and magazines (PrincewaterhouseCoopers, 2010, pp. 6–7).

2.5.1.2 Target Users of eReaders and Tablets

The research conducted by PrincewaterhouseCoopers (PwC) illustrated an overall comparison of functions, physical appearances (screen size, weight, etc.), battery life and available book resources between eReaders and tablet PCs. Based on the comparison analysis, it concluded the target users of these two types of device had various reading purposes.

According to the PwC report, an eReader is a single function device that has advantages in terms of legibility, battery operating time and weight compared to tablet PCs. Therefore, they enable users to read lengthy content without being disturbed by other tasks and visual fatigue. In comparison, the table PC is a multi-functional device, which not only supports reading e-books, but also provides users with functions such as accessing the Internet, checking e-mail, playing games, and so on. In response to the different functional features, the research implies eReaders and tablets attract users with different reading purposes. An eReader is usually accompanied with an e-bookstore from the same brand. The online e-bookstore provides sufficient e-book resources to readers. Therefore, the eReader is ideal for mass-market books. It targets readers who are interested in the content rather than the format of a book. Due to the advantages of LED display technology, the tablet performs better when displaying color and multimedia content, which makes it is particularly suitable to display the content of newspapers or

magazines. In addition, a tablet is good for readers who occasionally read or those who look for special interest literature.

Research also compared the characteristics of eReader users and tablets users. The target users of an eReader device are described as “avid readers”, traditionally are “women between 30 and 60 years of age, who read several times a week and purchase many books each year.” The major target users of a tablet usually include younger users, “technophile consumers”, as well as people who are concerned with up-to-date information everyday (PrincewaterhouseCoopers, 2010, pp. 8–15).

2.5.1.3 The Influence of Electronic Reading Device on Newspaper Industry

Research found that the electronic reading device was changing the way people acquire daily news. Previous studies have proved that tablets have the advantage of displaying newspapers and magazines to readers, which provide a new platform for newspaper publishers. The unique iPad application store developed by the Apple company brings more opportunities to e-newspapers. As the Internet has become the dominant channel for people to acquire information in their daily lives, the publishing industry has shifted from the printed age to the digital age. This change resulted in an increased production of digital format products for newspaper and periodical publishers. The PwC consumer survey indicated that “36% to 49% of periodical subscribers and 30% to 48% of newspaper subscribers would use the iPad for reading electronic newspapers and periodicals.” In the survey of consumers’ attitudes toward digital publishing products, “16% of American users say that they might subscribe to digital newspapers and periodicals, and two thirds of all people covered by the survey believe that digitally distributed newspapers will at least partially replace the printed editions.” The statistics reveal reading newspaper via an iPad device will become a new way to acquire news in consumers’ daily lives (PrincewaterhouseCoopers, 2010, p. 17).

2.5.2 Related Design Researches

Compared to traditional printed newspapers, the digital format newspaper brings a different reading experience to users. One of the most significant changes is it involves more interaction during the news reading process. Unlike conventional newspaper design,

e-newspaper design research focuses on the typographic issues of newspaper page layout that requires an overall examination of both the typographic perspective and the human computer interaction perspective. The role of users needs to be fully considered in the research. Existing research especially targeted on e-newspaper design is limited. However, related research about e-book design and web-based newspaper design will contribute to future study about the design of electronic newspapers.

2.5.2.1 E-book Legibility

The change from reading through a printed medium to a digital medium brings different visual experiences to readers. Legibility issues regarding text size, fonts, leading, etc. in printed mediums still play an essential role in digital typographic design. As the e-book and e-newspaper share the same reading devices, some study results concerning the legibility of e-books will benefit the exploration of e-newspaper legibility.

Illumination Condition & Legibility

The display of digital contents usually relies on an electronic device; therefore, the interaction between display technology and the reading environment has become a new factor that affects users' reading experiences. Previous research has proved that illumination is one of the important factors that affect visual performance (Lin et al., 2008). Several studies have contributed to the investigation of the relationship between ambient illumination conditions and the legibility of an e-book. The study found that the legibility of electronic paper increased as the illumination level increased in a certain range. The minimum illumination requirement for electronic paper is 62 lux, and legibility will increase with the illumination level until 1500 lux. However, if the illumination level is beyond 1500 lux, it will cause a decrease in legibility. A possible reason for the decrease in legibility is the reflected glare caused by higher illumination. The study concluded that the ambient illumination at 700 lux and greater, such as 1500 lux were better for electronic paper display (Lee et al., 2008, & Lin et al., 2011).

Typography & Legibility

Some research also discussed how the basic typographic elements affected the legibility of e-ink display on electronic papers. The research team of Lee et al. used a letter-search task to evaluate the effect of character size, font style and interline spacing on visual performance and visual fatigue. Based on their study results, search time decreased and accuracy increased along with the increase of character size and interline spacing. They also suggested that E-paper displays might need greater character size such as 3.3 mm or 22 mm of visual angle, and leading set to about 66% of character size. The research team also studied how font style affected the readability of electronic paper. They concluded, "thicker stroke is more readable for real paper or under higher contrast, but e-paper was contrary (Shen et al., 2009)."

Legibility research of e-Ink display was based on the Chinese language, which usually has different font structures and size measurements compared to English. The participants of the study were Chinese; who have different reading habits compared to English readers, which means the existing research may have limitations to the eReaders in the US.

2.5.2.2 E-book Usability

From paper to screen, the evolution of the book has challenged the reading experiences of readers. With the exception of reading and comprehending static texts and images, reading experiences also involve the interaction with the devices. Therefore, the usability of the e-book has become a new topic for researchers. Siegenthaler et al. (2010) summarized two criteria to evaluate an e-book design: adequate legibility and good usability. They also suggested that these two criteria of e-book design would affect each other as they influence readers' reading experiences.

Kang et al. (2009) evaluated the usability of e-books through comparing the reading performance of a conventional book to an e-book. The comparison was examined from two perspectives: (a) reading performance, which included reading speed and reading accuracy; and (b) eye fatigue. In this study, researchers found the reading speed of an e-book was slower than the conventional paper book. However, the reading accuracy was similar for the two book formats. The study also proved that the e-book will

cause more visual fatigue than the conventional book, but because the participants were Chinese speakers, and the book content is displayed in Chinese, and the result might be different for English speakers.

Jakob Nielsen investigated the usability of the Kindle and the iPad in his self-experiment. In the usability study of Kindle 2, Nielsen read half of a book with the Kindle 2 and the other half with the conventional paper book. He concluded the advantage of the Kindle 2 was it provided readers with an equal-to-print legibility. The content layout design and interface design made the device suited for reading linear text (e.g. text in a novel) rather than non-linear text (e.g. text in a newspaper) (Nielsen, 2009). For Amazon's new eReader product, Kindle Fire, Nielsen criticized the display dimensions of the device as "too small to display the content that is suitable for 10-inch tablets (e.g. the iPad), and too "luxurious" for a mobile site that is designed for 3.5-inch mobile screen." According to Nielsen, the Kindle Fire has poor usability because the limited screen size usually causes tap errors and accidental activation, but the color display feature makes up the disadvantage of displaying magazines and color content in previous Kindle generations (Nielsen, 2011).

2.5.3 Electronic Newspaper Design

As a new format of newspaper, the newspaper iPad applications share similar interactive features with Internet newspapers. Previous research about website usability design demonstrated how a website facilitated the interaction of users with a website, and web-based newspaper design research illustrated how e-newspaper design affects the way readers acquire information during the reading process. The results of the research provided general guidelines for e-newspaper design.

Krug (2006) had an overall examination of website design usability, and he suggested that the fundamental principle was "don't make users think." He implied when users search a website to get information, they usually scan the page, make a quick reasonable choice rather than the best choice, and "muddle through" the process without understanding how things work (pp. 21–29). Therefore users get information from a website in a hurry, and the website design should reduce the cognitive load of users. Krug

proposed a set of design principles for creating good web usability, and some of them will benefit e-newspaper design:

- Make buttons and link labels clear, to let users know they are clickable.
- Reduce unnecessary selections for users, and provide limited selections.
- Design familiarity for users.
- Provide search functions for "search-dominant" users.
- Create an effective navigation system through clear hierarchy and visual signs.

Li (2006) identified an essential function of newspaper design as facilitating users to retrieve news information. Therefore he examined the relationship between general website design and information retrieval efficiency. According to Li's analysis, web page design contains two dimensions–presentation and navigation. Presentation means how information is presented on the web page, and navigation means how a website directs users to access information. The two dimensions of design interact together to build the basic structure of a web page. This structure will determine the information retrieval efficiency of users. Li implied a successful Internet newspaper design should achieved three objectives: (a) designing a shallow structure that offers news on the first available screen; (b) providing an immediate access to information that limits the steps to access final news stories; and (c) creating a fluent news flow that enables readers to access desired information without any obstacles. Based on Li's analysis, the factors that influence the information retrieval efficiency can be summarized to evaluate the design of e-newspapers (Table 2) (pp. 65–80).

Table 2. Factors affect e-newspaper information retrieval efficiency

Objective	Factor
Shallow information structure	News items displayed on the homepage
Immediate access to news information	Steps to access news story content
Smooth news flow	Fluent navigation/ Information loading time

According to Li's research, the newspaper visual presentation style and visual appeal will also affect news retrieval efficiency. As the visual presentation style refers to the balance between graphics and text, the styles can be categorized as text-dominant presentation, balanced presentation, and graphic-dominant presentation. The research

suggested the retrieval efficiency of a graphic-dominant style and a balanced style were similar to each other, yet were significantly different from the text-dominant style. The visual appeal can be evaluated by the typographic design of a page. Li implies a page with high visual appeal will assist readers to process and access news information through the coherent organization of visual elements, and the high visual appeal will result in high retrieval efficiency of an e-newspaper (pp. 81–98).

2.5.4 Usability of iPad Applications and Websites

As the iPad application stores become more and more popular, many newspaper publishers embrace the marketing opportunity to create their own unique applications to meet readers' needs. It is hard for many consumers to evaluate the newspaper application design. Budiu and Nielsen (2011) compared the usability of websites and applications on the iPad. The report analyzed iPad usability in detail. It also studied magazine design on an iPad, which concluded several design suggestions for magazine applications.

2.5.4.1 Comparison of iPad Applications and Websites

In the comparison study of iPad applications and websites, researchers found that applications usually attract users who are already engaged with a certain brand and use it on a regular basis. Through comparing the information provided by the application and website with the same brand, researchers discovered the applications contained less information than the websites, and the app design usually required users to work more to finish the same task on the website. Based on this observation, they suggested iPad application design should have distinct advantages compared to the website with the same brand, and the overall application design should not make users work more than on the website (pp. 12–24).

2.5.4.2 Magazine Design on iPad

Budiu and Nielsen (2011) conducted a case study about magazine design on an iPad. Through comparing various electronic magazines, they described the common characteristics of iPad magazine design and gave several design recommendations:

a. ***Navigation:*** Keep the navigation bar always visible.

b. ***Table of contents:*** First, the page should always contain a table of contents link, and the link should take the users to the table-of-contents page in the magazine. Second, the information in the table of contents should be understandable and clearly formatted.

c. ***Slider & Page Viewer:*** A page viewer that displays page (or article) thumbnails will assist users to navigate a specific article without go back to the table of contents (Figure 2). The page viewer navigation is especially helpful to look for an article that users have read before. Some magazines also provide a page slider for a quick navigation of the magazine, but the results revealed it usually turns out to be useless for readers (Figure 3).

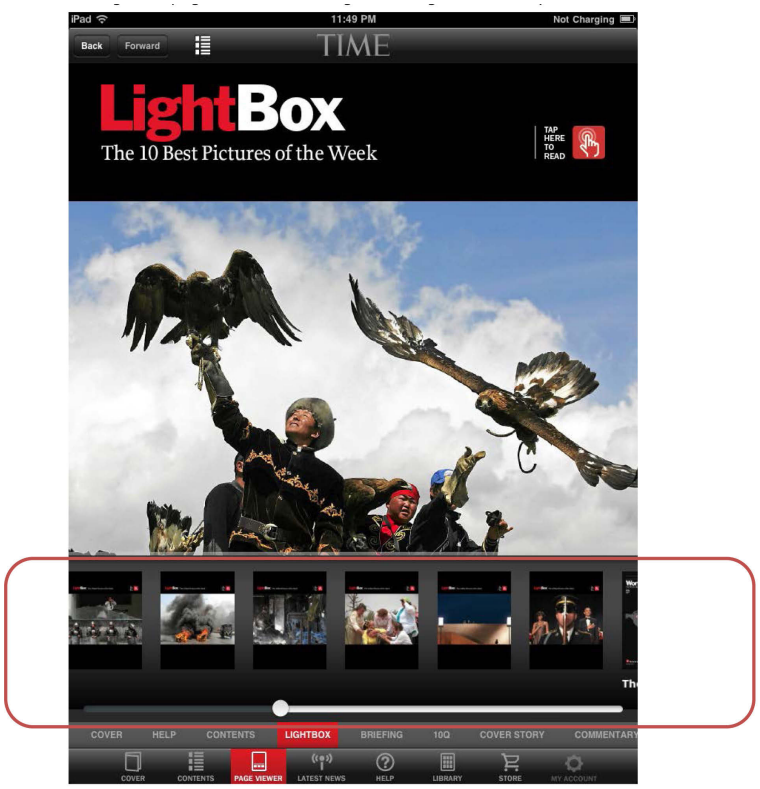


Figure 2. iPad magazine page viewer

Figure 3. iPad magazine page slider

d. ***Search Function:*** None of the magazine applications in the research provided a search function, but users mentioned the search function was critical when reading digital format magazines.

e. ***Multiple Navigation Schemes:*** Most magazine apps today apply a dual model for navigation– swipe to go to the previous or next pages, and scroll vertically to read the article. Researchers suggest not using multiple navigation schemes in the same app, and not using horizontal navigation for a slideshow if the app supports a two-dimensional navigation scheme.

f. ***Splash Article Pages:*** It is important for readers to scan the information on the first page of a magazine to make a decision about whether or not to read further. Therefore, conveying the right information about the article is especially critical for a page design. Typically it uses a picture, as well as a paragraph giving users enough detail about the article content to draw readers' attention.

CHAPTER 3. ONLINE SURVEY & RESULT ANALYSIS

3.1 Overview

At the beginning of this study, an online survey was conducted to investigate readers' reading experience and preference with printed newspaper and digital format newspaper. An online survey questionnaire with 27 questions about reading printed newspaper and digital format newspaper was posed on the online survey website "SurveyMonkey"(Appendix A). Participants were recruited by word of mouth, social networking, and mass email. The demographic information including age, gender, native language, education, profession, income, and familiarity with technology are collected to examine how they associate with the final results. Two main questions were investigated in the survey:

- Which format do readers prefer to use to access daily news?
- What are the advantages and disadvantages of digital format newspaper?

In addition, the survey also studies the use of an iPad for reading digital format newspapers.

3.2 Participants' Demographic Information

After obtaining IRB approval (Appendix B), 162 subjects age eighteen and over participated in the online survey, among which, one hundred and forty-five subjects completed the questionnaire of the survey. The valid data was collected from the 145 subjects who completed the survey.

3.2.1 Age

Among the 145 participants who completed the survey, 143 participants indicated their ages, ranging from 19 to 74 years old. In order to explore the correlation between age and preference of newspaper format, the participants were divided into seven groups. The groups with age ranges 18~24 years and 25~31 years represent the most participants, covering 44.8% participants total. The other age groups have a similar number of subjects (Figure 4). Here initial concepts and conditions are explained and several hypotheses are mentioned in brief.

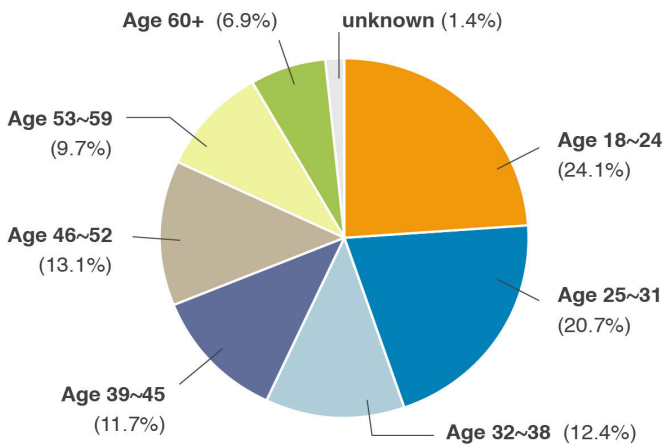


Figure 4. Age distribution of participants

3.2.2 Gender

Of the 145 participants who completed the survey, 143 participants reported their gender in the survey, totaling 54 male subjects and 89 female subjects. The gender ratio between the male and female participants is approximately 3:5 (Figure 5).

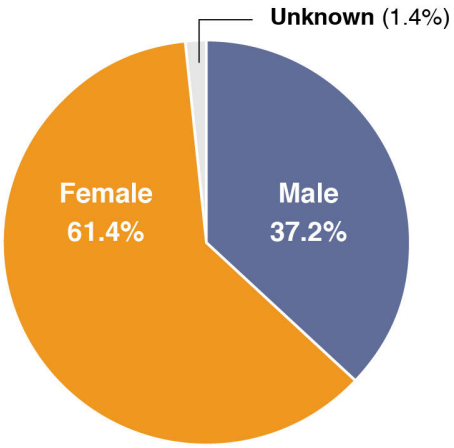


Figure 5. Gender information of participants

3.2.3 Native Language

A total of 142 subjects provided their native language information, consisting of 96 English speakers (66.2%), 26 Chinese speakers (17.9%) and 20 international

participants (13.8%). The international group includes 4 Korean participants, 4 Japanese participants, 4 Indian participants, and 8 European participants.

3.2.4 Education

The participants' education background was measured by the highest degree earned. A certain degree includes subjects who are currently pursuing it and who have already acquired it. For example, the bachelor's degree group includes both college students and people who have earned a bachelor's degree but did not enter graduate school.

A total of 139 participants responded to the question that asks about their education. Their education backgrounds are as follows:

- 53 subjects are at the bachelor's degree level, including 20 college students and 33 participants who have graduated. This totals 36.6% of all the participants;
- 45 subjects have a master's degree, equaling 31% of the total participants;
- 33 subjects have a Ph.D degree, equaling 22.8% of the total;
- 8 subjects indicate they are graduate students but did not specify which degree they have.

3.2.5 Profession

The number of participants who reported their profession information is 143, 98.6% of the total participants. Since this survey was conducted in a college town, the main participants are university students, 33.1% of the total participants, and university staff and professors, 29% of the total participants. Other professions include 8.3% designers, 9.7% marketing related careers, 4.8% IT related careers, and 13.8% miscellaneous careers.

3.2.6 Monthly Income

A total of 116 participants reported their monthly income, making up 80% of the total. The subjects were divided into seven groups based on their monthly income (Table 3). The top two groups with the most subjects are the group with monthly income under

$2000 (24.8%), and the group with monthly income between $2000 and $4000 (17.9%). The group with subjects who have less than $2000 every month is considered a student group. It is congruous with the result of profession information. However, some of the subjects who indicate their income over $8000 per month did not mention the currency type, so the data related to monthly income in this group is not clear.

Table 3. Subjects' monthly income information

Monthly	Number	Percentage
Less than	36	24.8
2100~4000	26	17.9
4100~ 6000	13	9
6100~ 8000	14	9.7
More than	14	9.7
Total	116	80

3.3 Analysis

The questions of the survey can be categorized into four sections: (1) familiarity with electronic devices; (2) reading habits of daily news; (3) evaluation about electronic newspapers; (4) the usage of an iPad for reading daily news.

In the first three sections, users' demographic information was examined to investigate the correlations between their background and responses to the questionnaires. The first and second sections provide participants with several multiple choice questions about what devices they have (Question 8–9), what devices they usually use to read daily news (Question 11), and their habits of reading news (Question 13–14). In these two sections, participants were also asked to indicate the frequency of using their devices (Question 10 & 12). In the third section, participants were required to compare printed newspapers and electronic newspapers and show their preference of the two media. Subjects' preferences were measured by their attitudes toward eight questions (Question 15–22), each on a 1–5-point scale, ranging from "disagree" to "agree". In addition, two multiple-choice questions about advantages and disadvantages of electronic newspaper were also asked in this section (Question 23–24). The forth section

investigates users' characteristics and their method of using an iPad to access daily news (Question 25–28). The usage of an iPad for reading newspaper was examined from two directions: in what situation participants use an iPad to read news and which websites or applications are popular for readers.

3.4 Results

3.4.1 Familiarity with Electronic Device

Participants' familiarity with electronic devices was evaluated by two criteria: the digital devices they possessed and the frequency of using their devices. In this survey, subjects selected the devices they owned from the following: desktop computers, laptop computers, tablet PCs, smartphones, regular cell phones, e-book readers, and iPod touch. They also indicated how often they use these devices.

3.4.1.1 What Devices Do Users Have?

The data collected from the 145 subjects illustrates the popularity of various devices for people's daily use (Figure 6).

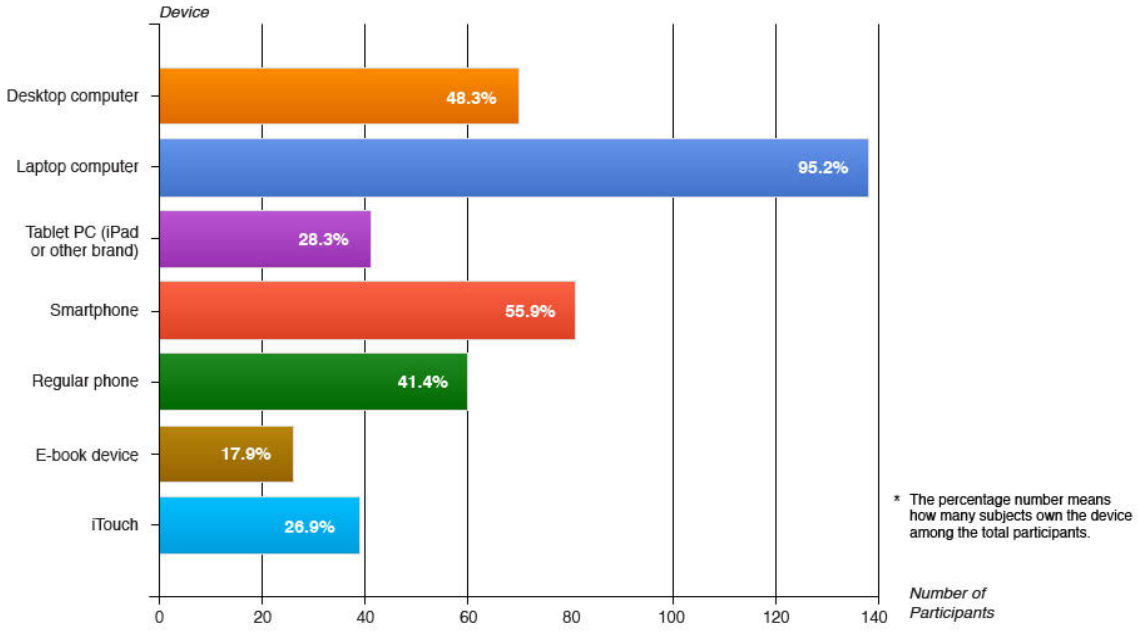


Figure 6. Participants' possession of different device

The survey results show the two devices that most subjects claim to have are laptop computers and smartphones. However, the statistics indicate the number of subjects who own a laptop computer is 95.2% among the total, which is 1.7 times larger than the subjects who have smartphones (55.9%). This result proves the laptop computer has become the most common device for daily use. When comparing the two types of electronic reading devices, the results show more participants possess a tablet PC (28.3%) than an e-reader (17.9%), which means the mono-functional reading device is not as popular as the multifunctional tablet. Since no subject mentions he or she has a brand of tablet other than the Apple iPad, the tablet PC in this study can be specified as iPad.

Participants' demographic information was also studied to examine how an individual embraces technology. Some devices can be interpreted to present old technology and new technology based on technology development trends. From this perspective, the comparisons between desktop computers and laptop computers, and regular phones and smartphones were analyzed. By examining the age differences, the results reveal the younger generation and elder generation tend to adopt technology through different approaches (Table 4). The difference is especially obvious between Group 1 and Group 7.

Table 4. Technology adoption of different age groups

Group	Age	Laptop (%)	Desktop (%)	Smartphone (%)	Regular phone(%)
1	18~24	100	11.8	50	38.2
2	25~31	86.7	43.3	60	23.3
3	32~38	94.4	77.8	44.4	38.9
4	39~45	94.1	82.4	70.6	64.7
5	46~52	100	52.6	78.9	31.6
6	53~59	92.9	57.1	57.1	35.7
7	60 & over 60	90	60	20	70

In Group 1, every subject owns a laptop computer, whereas only 11.8% of them own a desktop computer. By contrast, 90% of participants in Group 7 own a laptop

computer, but 60% of them also own a desktop computer. The percentage of the subjects who have desktop computers in Group 1 is extremely smaller than any other age group. The differences also reflect the possession of mobile phones. Half (50%) of participants of Group 1 own a smartphone, and 38.2% own a regular phone. However, only 20% participants of Group 7 have a smartphone, but 70% of them have a regular cell phone.

Group 4, with participants ranging from 39 to 45 years in age, seem more open to both old and new technology than other groups. When considering the three groups with the most participants who own each device, a percentage of Group 4 is presented in every category (Table 5).

Table 5. Top three groups with highest number of device possession

Rank	1		2		3	
	Group	Percentage (%)	Group	Percentage (%)	Group	Percentage (%)
Laptop	Group 1, 5	100	Group 3	94.4	Group 4	94.1
Desktop	Group 4	82.4	Group 3	77.8	Group 7	60
Smartphone	Group 5	78.9	Group 4	70.6	Group 2	60
Regular Phone	Group 7	70	Group 4	64.7	Group 3	38.9
iPad	Group 4	35.3	Group 3	33.3	Group 6	28.6
E-book Reader	Group 7	30	Group 3	27.8	Group 4	23.5
iPod Touch	Group 4	41.2	Group 1	32.4	Group 5	26.3

However, subject age is not the only factor that has influenced these results. In fact, the final result is determined by the intervening effect of various demographic factors. The income level is another critical factor that affects the choice of device, especially for tablets. The survey results demonstrate that for monthly income ranges under $8,000, the number of subjects who own a tablet (iPad) increases with income level (Table 6). It also shows subjects who have higher income are more likely to purchase both a laptop computer and desktop computer (Table 7). Because some of the participants in the group with monthly income over $8,000 did not mention their currency unit, the data of this group is not convincing enough to draw a conclusion.

Table 6. Influence of monthly income on the possession of tablets

Monthly Income ($)	Subjects Owning an iPad (%)
⩽ 2000	14.6
2100~4000	30
4100~6000	38.9
6100~8000	50
> 8000	31.6

Table 7. Influence of monthly income on the possession of computers

Monthly Income ($)	Subjects Owning Both Laptop & Desktop (%)
⩽ 2000	19.5
2100~4000	36.7
4100~6000	72.2
6100~8000	87.5
> 8000	63.2

Furthermore, when examining users' professions, the results indicate that except for the laptop computer, the non-student group has a higher percentage of device possession than the student group in each category (Table 8). This result shows users' choice of devices associates their working environments and job tasks. Regarding tablets, the data proves that non-student subjects are more likely to own an iPad than students. This result also confirms the correlation between income level and possession of tablets.

Table 8. Influence of professions on the possession of device

Professions	Students	Professors	Others[1]
Laptop	93.6%	92.9%	96.3%
Desktop	25.5%	61.9%	57.4%
Smartphone	46.8%	54.8%	63%

[1] The "others" group mainly includes designers, engineers, marketing-related jobs, IT-related jobs,

Regular	38.3%	45.2%	40.7
iPad	12.8%	33.3%	37%
E-book	12.8%	19%	22.2%
iPod Touch	29.8%	23.8%	24.1%

3.4.1.2 How Often Do People Use Their Devices?

Participants of the survey reported the frequency of using their electronic devices by answering an open-ended question. Their answers are categorized as "extremely high– several times per day", "high– daily", "medium–several times per week" and "low– weekly". The result analysis focuses on the top two devices that most participants have– laptop computers and smartphones. In order to explore the experience of reading electronic newspapers, the frequency of using an iPad is also examined.

The results suggest 79.7% of the subjects who have a laptop computer use the device everyday, 20% of which claim they use the device for constant hours or several times per day. Similarly, 81.5% of subjects who have smart phones state they use the device daily, 27% of which use it at a very high frequency. This data falls in accord with the result of the users' device possession situation. It confirms that laptop computers and smartphones are the most common device for people's daily use. Although the possession of an iPad is not as common as laptop computers and smartphones, the usage frequency of this device is also high for most owners. The survey results reveal 70.8% of tablet owners use the device everyday. This evidence proves the tablets have become another important personal device for people's daily use.

3.4.2 Reading Habits of Daily News

Participants' reading habits of news are investigated from two perspectives: (1) general news reading experience, including the frequency of reading daily news and participants' preference of news information format; (2) reading experience of digital news, including what device people usually use to read daily news, and how often they use the device to read news.

3.4.2.1 General News Reading Experience

How often do people read news?

Figure 7 demonstrates how often people read news in detail. Since only 5% of survey participants state they read news every morning and night, both participants who read news twice per day and several times per day are accounted for in one group labeled "reading news multiple times per day". The survey results suggest more than 75% of survey participants read news daily (including participants who read news daily, twice per day and several time per day), and around 40% of them access news multiple times per day. Therefore, reading news every day is the common behavior for most people.

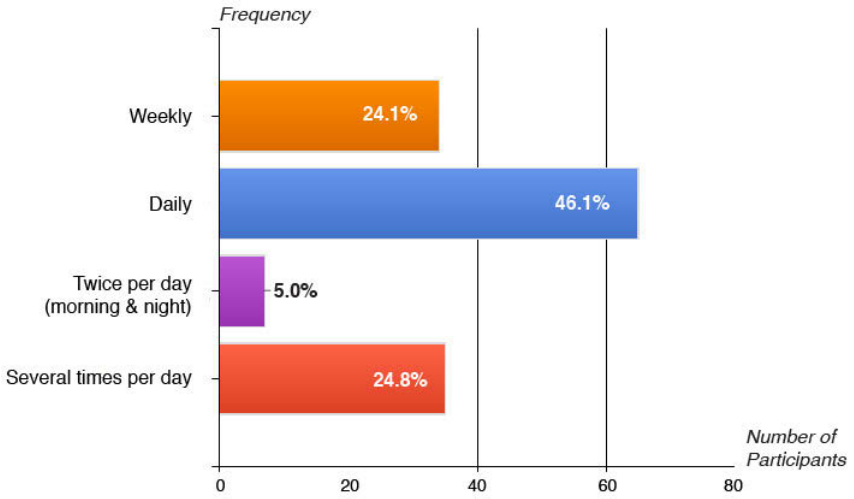


Figure 7. Participants' news reading frequency

However, the frequency of news reading is various for people with different demographic backgrounds. According to the responses from seven different age groups, subjects under age 30 seem to read less news than those over age 30 (Table 9). This difference is especially obvious for the group with ages ranging from 18 to 24 (Group 1). In Group 1, the ratio of subjects who read news daily compared to those who read news weekly is 1.36, a number much lower than the ratios in other groups except Group 7. However, as the survey sample in Group 7 is only 10 subjects, it is not safe to conclude subjects age 60 and over read news at similar frequencies as subjects in Group 1. The data also shows that Group 3 has the highest percentage of subjects who read news everyday (94.4%), implying that participants in the age range 32~38 read news more than other age groups.

Table 9. News reading frequency of different age groups

Group	Age	Multiple times per day (%)	Daily (%)	Weekly (%)
1	18~24	20.6	35.3	41.2
2	25~31	23.3	53.3	20
3	32~38	33.3	61.1	5.6
4	39~45	47.1	47.1	5.9
5	46~52	26.3	42.1	31.6
6	53~59	35.7	50	7.1
7	60 and over	40	20	40

Subjects of different professions also read news at different frequencies. According to subjects' professions, the participants are grouped as "students", "professors", and "others". The news reading frequency of each profession group is illustrated in Table 10. The data in Table 10 show subjects who work in industrial areas access news more than subjects in academic areas. In addition, the subjects in student groups read less news than subjects in non-student groups.

Table 10. News reading frequency of different professions

Profession	Multiple times per day (%)	Daily (%)	Weekly (%)
Students	8.5	53.2	31.9
Professors	38.1	38.1	21.4
Others	40.7	44.4	14.8

The study also finds that 53.7% of the participants with monthly income less than $2,000 read news everyday. By contrast, 86.7% of the subjects with monthly income over $2,000 read news daily. As the subjects ranging age from 18 to 24 years old, or with monthly incomes less than $2,000, can be interpreted as students, the survey result implies students are less likely to read daily news.

Which news format do readers prefer?

In this study, participants were asked to select their preference of news information format "text only", "text & image" and "video & audio". The result

described in Figure 8 proves the information presented by text and image is the favorite format for the majority of participants. The data indicates 86.7% of participants prefer to access news by text and image, but only 26.6% of participants prefer video and audio format. As video and audio are the dominant components of multimedia, the video and audio format can represent an innovative news format of electronic newspapers while the text and image format can be considered a conventional news format. The results imply the new multimedia news format is not as popular as the conventional news information format. This confirms Sundar's (2000) previous research about multimedia effects on news websites.

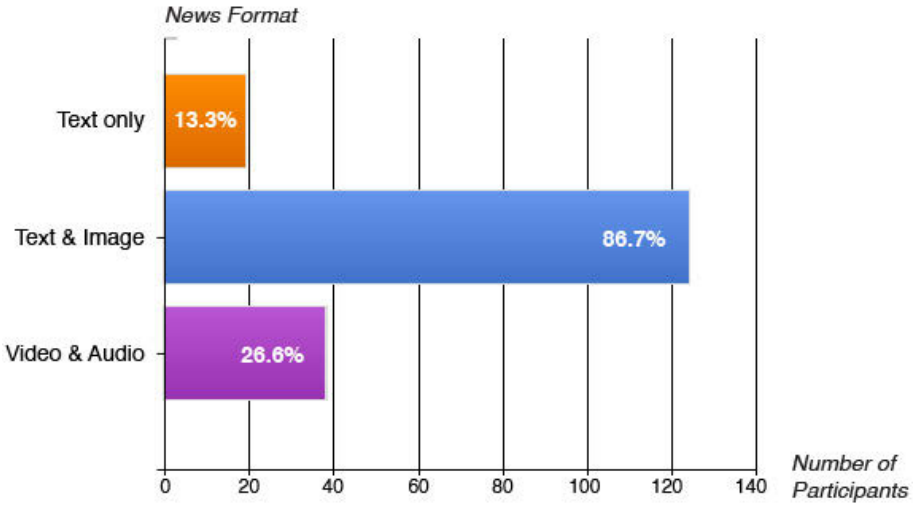


Figure 8. Participants' preference of news format

By observing participants' demographic backgrounds in detail, the study finds no significant differences between subjects with various backgrounds regarding the conventional news format. However, subjects over 50 years of age tend to have more positive attitudes toward video and audio news than those under 50 years of age . In addition, the multimedia format news is more popular for Chinese speakers than English speakers. Table 11 presents the percentage comparison of subjects who prefer to access video & audio format news of different age groups. The results show that 50% of subjects in Group 6 and 40% of subjects in Group 7 prefer video and audio format news, which is about two times more than the percentage in other age groups. Furthermore, there are

only 25% of subjects age 50 years or older among the total 145 participants. Results show 39% of participants age 50 or older indicate they prefer video and audio format news, equaling about 38% of all the subjects who like multimedia news. However, since the sample of this age group is not large enough to strongly support the conclusion, further research needs to be done to confirm the result.

Table 11. Percentage of subjects who prefer video & audio format news in different age groups

Group	Age	Number of subjects who prefer to access video & audio format news (%)
1	18~24	25.7
2	25~31	17.2
3	32~38	27.8
4	39~45	17.6
5	46~52	21.1
6	53~59	50
7	60 and over	40

The study also finds Chinese speakers prefer to access video and audio format news more than English speakers. By comparing the percentages of subjects who indicate they prefer video and audio format news in the English speaking group, Chinese speaking group, and international group (Table 12), it can be determined that almost half (48%) of the Chinese speakers reported preferring multimedia format news, about two times more than the subjects in the English speaking group and international group.

Table 12. Native language influences on preference of news format

Native Language	Text Only (%)	Text & Image (%)	Video & Audio (%)
English	13.5	86.5	21.9
Chinese	16	84	48
International	5	90	25

3.4.2.2 Reading Experience of Digital News

What device do people use to access news?

A total of 143 survey participants reported the devices they use to access daily news. The percentage of subjects who choose each device is demonstrated in Figure 9. The statistics show more than 90% of participants read news by computer, which is about twice the number who read printed newspapers. However, about half of the participants (46.2%) indicate they read traditional newspapers, which is higher than people who access news by mobile devices (less than 20%). It shows that computers have replaced printed newspapers as the dominant news communication medium. However, traditional newspaper still plays an important role in people's daily lives. By comparing how people use mobile device to access news, the graphic indicates the Internet is more popular than mobile news applications. Therefore, the survey result confirms the essential role of the Internet in news communication.

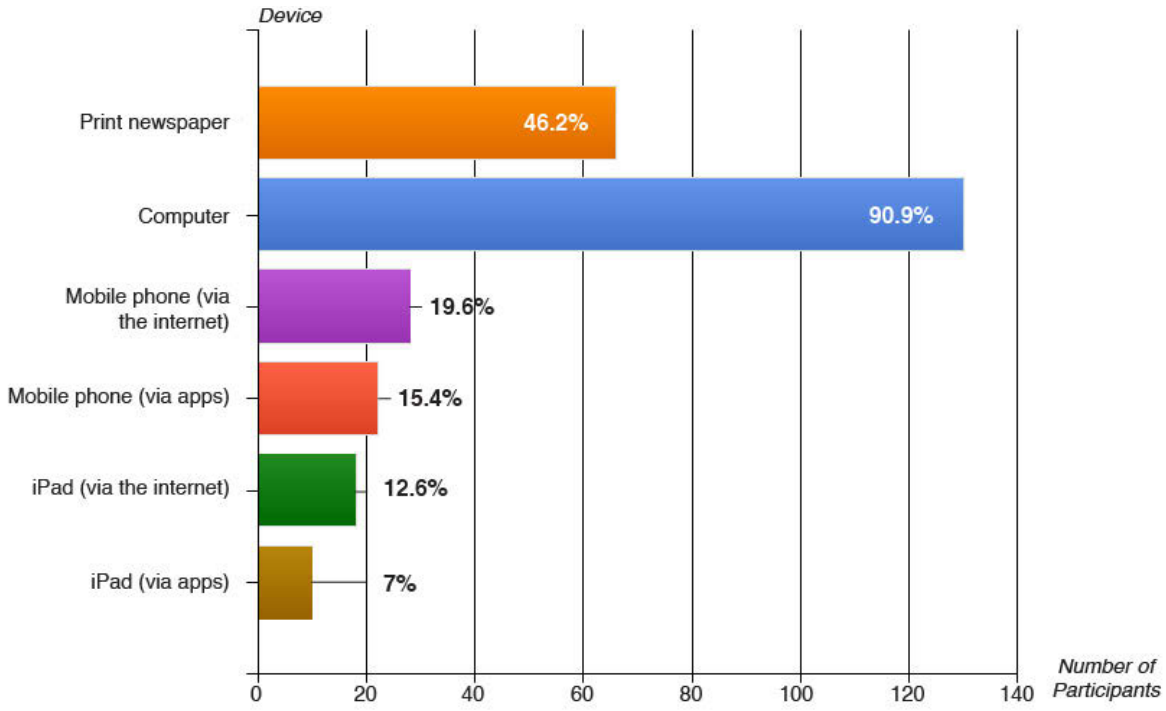


Figure 9. Percentage of people who access news via various devices

The study also found in general, how users access news directly associates with the devices they possess. For instance, the group of subjects ranging between 53–59 years of age has the highest number of participants who own an iPad. In accordance with this

result, subjects in this group read less news through computer and printed newspapers but more news through an iPad than other age groups. The subjects in the student group possess the lowest amount of iPad devices; therefore, the percentage of participants who access news via an iPad is lowest in this group. There are also several findings relating to subjects in specific demographic groups. Table 13 displays the number of subjects who acquire news with each type of device in different age groups. This chart shows participants 25–31 years of age favor printed newspaper least, and none of the subjects age 60 or older access news by mobile device.

Table 13. Number of subjects who access new by different devices

Group	Age	Printed Newspaper (%)	Computer (%)	Mobile Phone (%)	iPad (%)
1	18~24	60	94.3	37.1	29
2	25~31	24.1	93.1	20.7	24.1
3	32~38	61.1	94.4	33.3	33.3
4	39~45	41.2	94.1	47.1	17.6
5	46~52	47.4	89.5	21.1	21.1
6	53~59	28.6	78.6	28.6	28.6
7	60 and over	90	80	0	0

In addition, more male participants prefer printed newspapers, whereas more female participants prefer to read news via computers, university professors prefer printed newspapers more than other professions, and Chinese participants prefer to access news via an iPad more than both English speakers and international participants. However, the differences between these groups are not very significant.

How often do people use various devices to access news?

In regards to the question, “how often do participants use their electronic devices to access news?”, 65.9% of subjects who access news by computers state they read news everyday. In comparison, 57.9% of subjects who acquire news through traditional newspapers read news daily, and 24.6% of all participants read news several times a week. This study implies the news of traditional newspapers is not as immediate as

electronic newspapers. The digital format news provides users with a more convenient way to acquire information than printed newspapers. Among the subjects who read news via an iPad, 80% of them indicate they access new news every day via this device. Although the iPad has not been widely spread, the study proves it has become an important tool to acquire information for iPad owners. Many survey participants also mentioned the frequency of accessing news is also affected by the news feed function of news applications or some social networking program like Twitter. This response supports the idea that electronic media emphasizes the role of readers in the news communication process. Readers have become the core of this process.

3.4.3 Evaluation of Electronic Newspaper

The evaluation of digital format newspaper aims to acquire subjects' general attitudes toward current electronic newspaper design. In this section, participants rated each question on a 1-5-point scale; 1-point (strongly disagree) to 5-point (strongly agree), based on their personal opinions. In addition, participants' opinion about the advantages and disadvantages of electronic newspapers are also investigated in the survey.

3.4.3.1 Participants' Attitude to Electronic Newspaper and Printed Newspaper

Table 14 displays the detailed results of participants' attitudes to each question. 52.8% participants suggested they prefer to read digital format newspapers, which is over two times the amount of participants who prefer to read printed newspapers (23.3%). Therefore, the overall preference of electronic newspapers is higher than traditional printed newspapers. For the statement "e-newspaper is easier to share and makes discussing news with other people easier", more than half of participants selected "strongly agree", resulting in a mean score of 4.28. This result implies the majority of users agree that digital format newspapers have the advantage to exchange information with other people. It confirms that interpersonal interactivity is a significant feature of electronic newspaper, and the communication pattern of newspaper is changing from "allocation" to "conversation" (Li & Zeng, 2006, Bordewijk and van Kaam, 1986). However, this survey does not strongly support previous research findings that electronic newspapers are more likely to cause visual fatigue than printed newspaper. The resulting

data shows the average rate of the statement "e-newspaper causes more visual fatigue" is 3.19, which is very close to 3– the rating score of "neutral". The percentage of the subjects who felt "neutral" with this statement (25.9%) is also higher than the percentage of other attitudes. This result means with the development of display technology, the comfort level of electronic reading devices has improved. Visual fatigue has not been a major factor that diminishes the experience of reading digital content.

Table 14. Users' attitude about electronic newspapers

Item	*Mean*	*Attitude*				
		Strongly disagree–1	Disagree–2	Neutral–3	Agree–4	Strongly agree–5
E-newspaper is easier to find information	3.81	7.7%	5.6%	25.4%	20.4%	**40.8%**
E-newspaper is easier to navigate readers to the content they are interested in	3.7	8.5%	11.3%	19.9%	22.7%	**37.6%**
E-newspaper is harder to store useful information	2.39	**36.2%**	18.4%	24.8%	11.3%	9.2%
The multimedia content of e-newspaper is helpful to get information better	3.45	12.8%	9.2%	26.2%	23.4%	**28.4%**
E-newspaper is easier to share and discuss news with other people	4.28	2.1%	4.2%	16.2%	18.3%	**59.2%**
E-newspaper is harder to retrace old information	2.51	**31.2%**	22.7%	22.7%	10.6%	12.8%
E-newspaper will cause more visual fatigue	3.19	18.7%	11.5%	**25.9%**	20.1%	23.7%
Overall, I prefer e-newspapers than printed newspapers	3.54	12.7%	10.6%	23.9%	16.2%	**36.6%**

Through analyzing the association between subjects' demographic information and their responses to these questions, three key factors that affect users' attitudes are identified: users' age, profession, and nationality.

Age Influence:

The survey result found the age factor has notable influence on subjects' attitudes towards the following items: (a) digital format newspapers make it easier for users to find information; (b) digital format newspapers make it easier for readers to navigate to their interested content; (c) digital format newspapers are easier to share with others and makes discussing news with other people easier; (d) subjects' overall preference about digital format newspapers (Table 15).

Table 15. Age influence of participants' attitude toward electronic newspapers

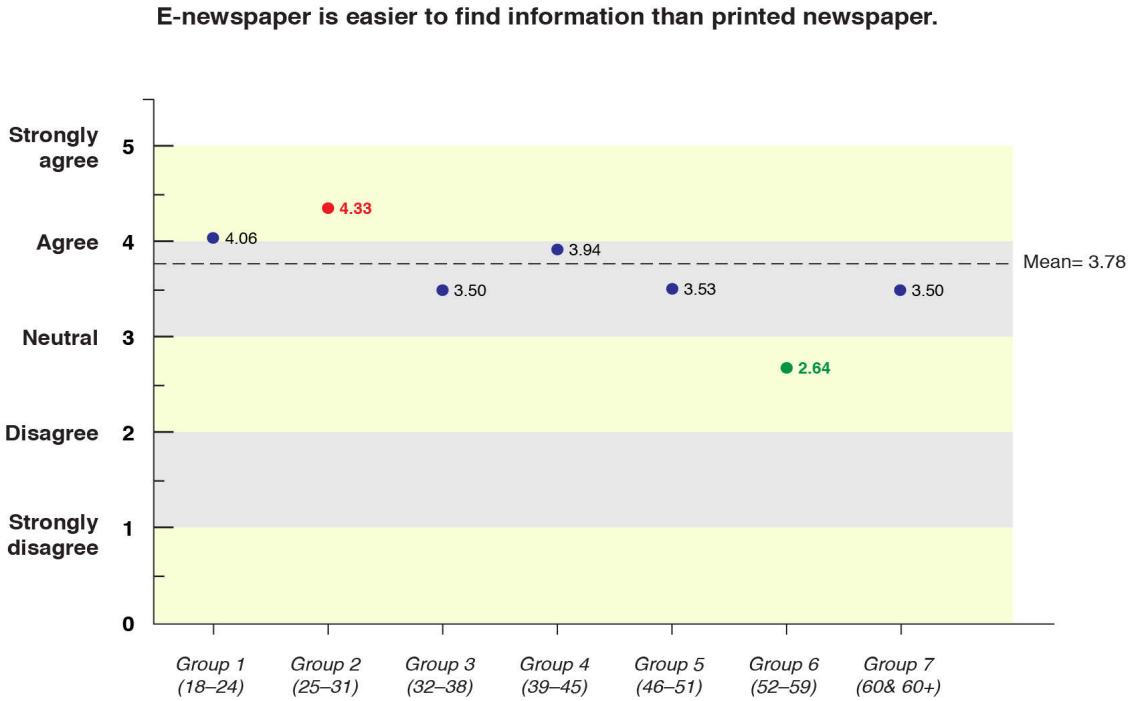
Item	*Squares*	*df*	*Mean square*	*F*	*Sig.*
E-newspaper is easier to find information	33.791	6	5.632	3.793	**0.002**
E-newspaper is easier to navigate readers to the content they are interested in	27.363	6	4.561	2.573	**0.022**
E-newspaper is harder to store useful information	2.977	6	0.496	0.264	0.953
The multimedia content of e-newspaper is helpful to get information better	22.790	6	3.798	2.070	0.061
E-newspaper is easier to share and discuss news with other people	16.830	6	2.805	2.558	**0.022**
E-newspaper is harder to retrace old information	1.085	6	0.181	0.090	0.997
E-newspaper will cause more visual fatigue	19.193	6	3.199	1.466	0.195
Overall, I prefer e-newspapers than printed newspapers	56.910	6	9.485	5.554	**0.000**

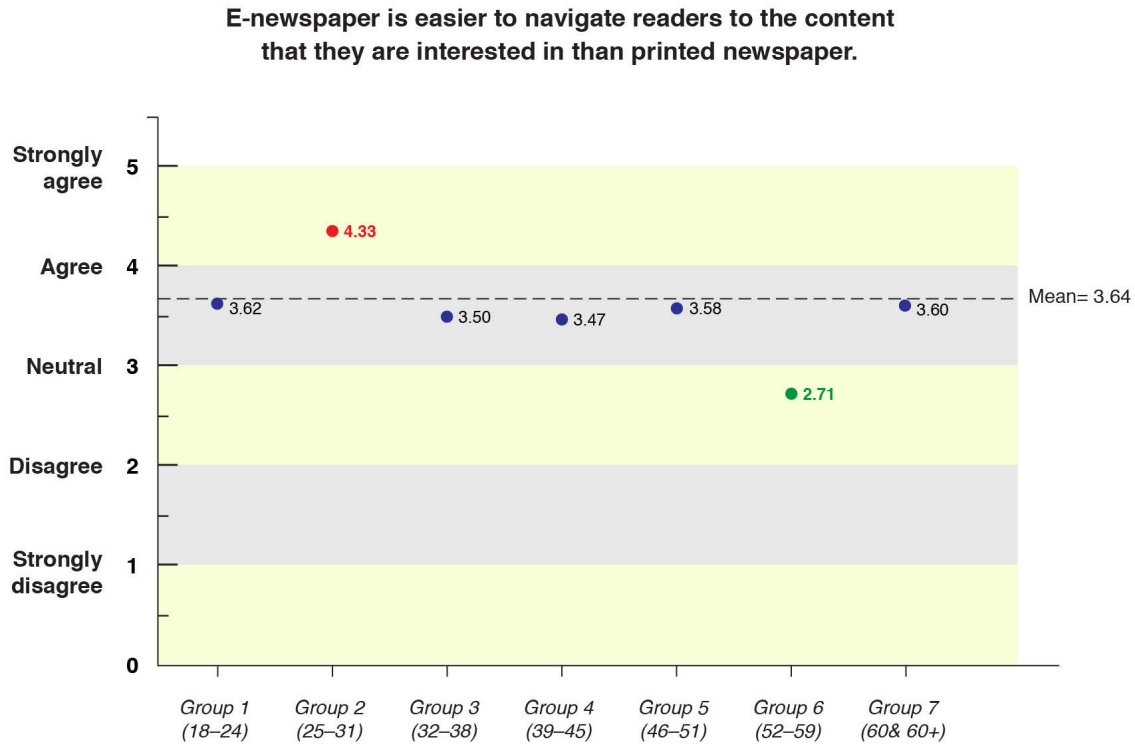
Figure 10 describes the comparison of the average rating of participants' attitudes between each age group. The diagram shows in general that participants under the age of 30 and over the age of 50 have opposite attitudes towards electronic newspaper and printed newspaper. The responses of subjects in Group 2 (ages 25–31) and Group 6 (ages 53–59) are especially different from other groups. For the overall rating of the preferences of electronic newspaper and printed newspaper, the attitude rate of subjects in Group 2 (ages 25–31) is 4.33, which falls between "agree" and "strongly agree" with regards to the statement "I prefer to read electronic newspaper to printed newspaper". By contrast, the rate of subjects in Group 6 (ages 53–59) is 2.21, which is closer to "disagree" with this statement. In addition, there is no significant difference of subjects' preferences of electronic newspaper between Group 1 (ages 18–24) and Group 2 (ages 25–31). Similarly, the subjects in Group 6 (ages 53–59) and Group 7 (ages 60 and over) share similar attitudes toward electronic newspaper (Table 16). If the participants are generally grouped as: under 30 years of age, between ages 30 to 50, and over 50 years of age, the survey results indicate that participants younger than 30 years of age have the most positive attitudes towards electronic newspapers while subjects age 50 and over have the most negative attitudes. Compared with the two age groups, subjects between ages 30 and 50 are open to both electronic newspaper and printed newspaper.

Table 16. Comparison of overall preference of electronic newspaper in Group 2, Group 6, and other age groups

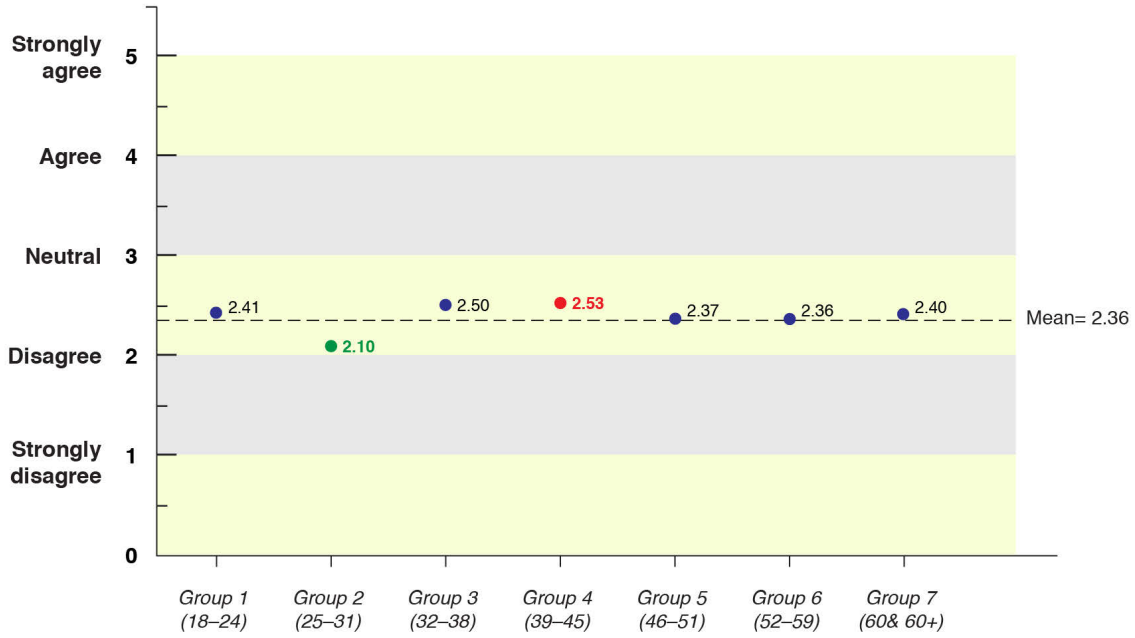
Group A	*Group B*	*Mean*	*Sig.*	*Group A*	*Group B*	*Mean*	*Sig.*
Group 2 (25–31 years old) *Mean= 4.33*	**Group 1** (18–24 years old)	3.82	0.122	**Group 6** (53–59 years old) *Mean= 2.21*	**Group 1** (18–24 years old)	3.82	0.000
	Group 3 (32–38 years old)	3.39	0.017		**Group 2** (25–31 years old)	4.33	0.000
	Group 4 (39–45 years old)	3.47	0.031		**Group 3** (32–38 years old)	3.39	0.013
	Group 5 (46–52 years old)	3.26	0.006		**Group 4** (39–45 years old)	3.47	0.009
	Group 6 (53–59 years old)	2.21	0.000		**Group 5** (46–52 years old)	3.26	0.024
	Group 7 (60 & over 60 years old)	2.60	0.000		**Group 7** (60 & over 60 years old)	2.60	0.477

Figure 10. Comparison of the average rating of electronic newspaper and printed newspaper between each age group

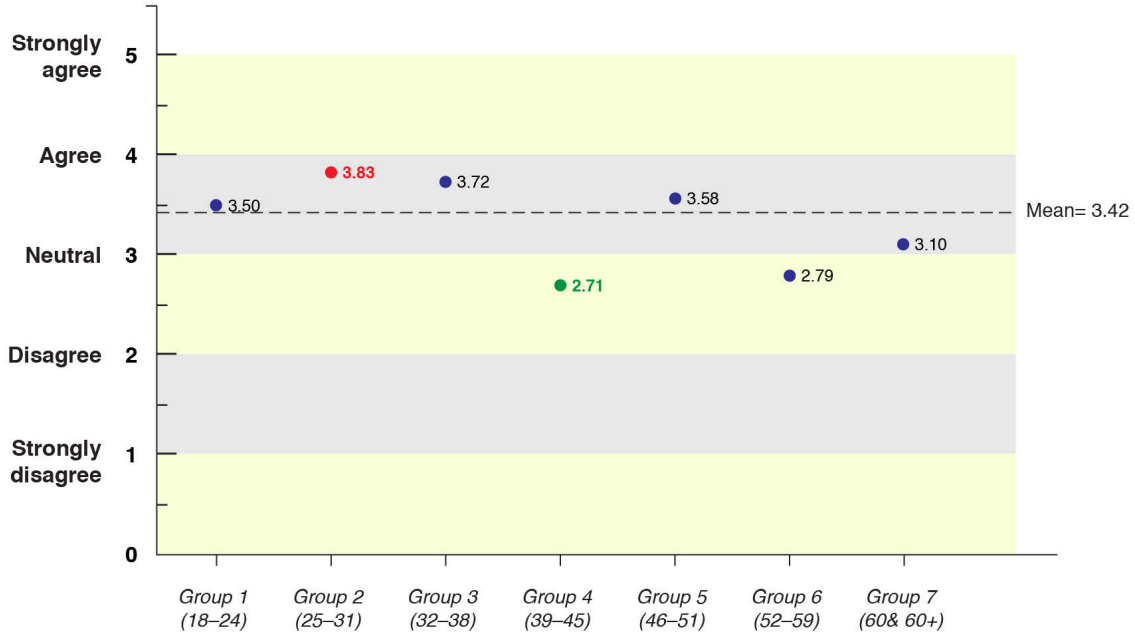




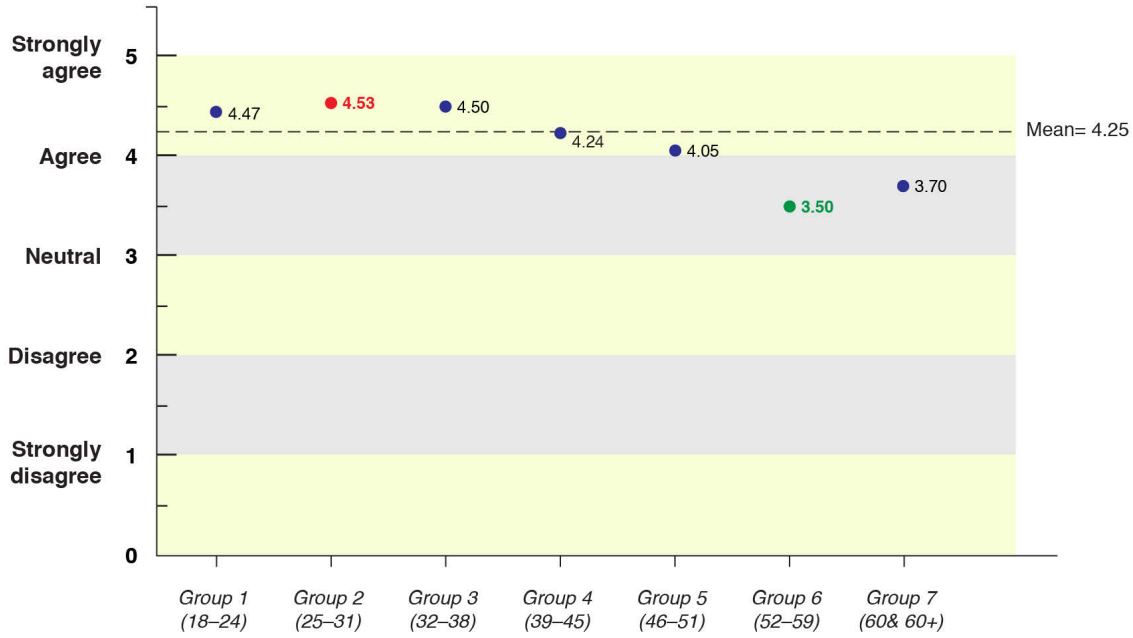
E-newspaper is more difficult to store useful information than printed newspaper.



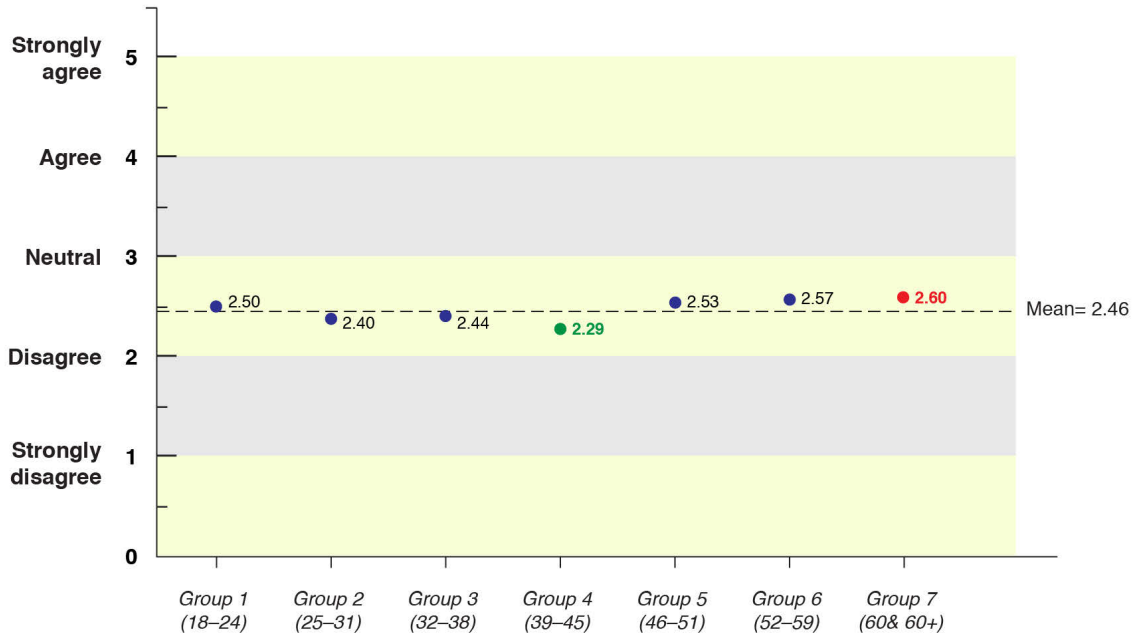
The sound and video used in digital news is helpful to get information better.



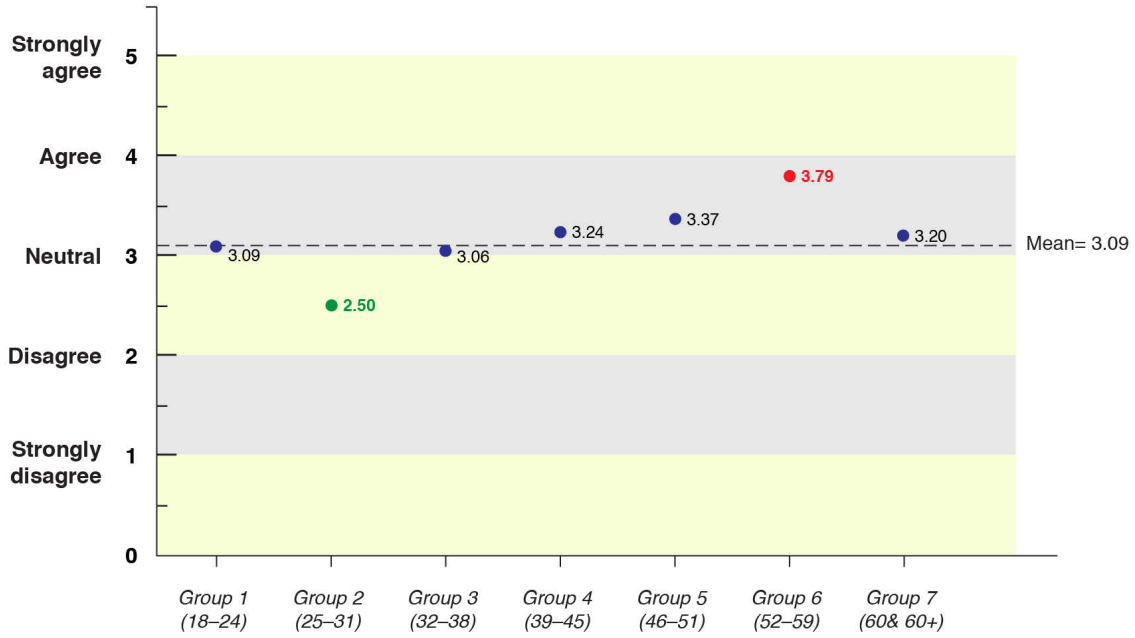
E-newspaper is easier to share and discuss news with other people than printed newspaper.



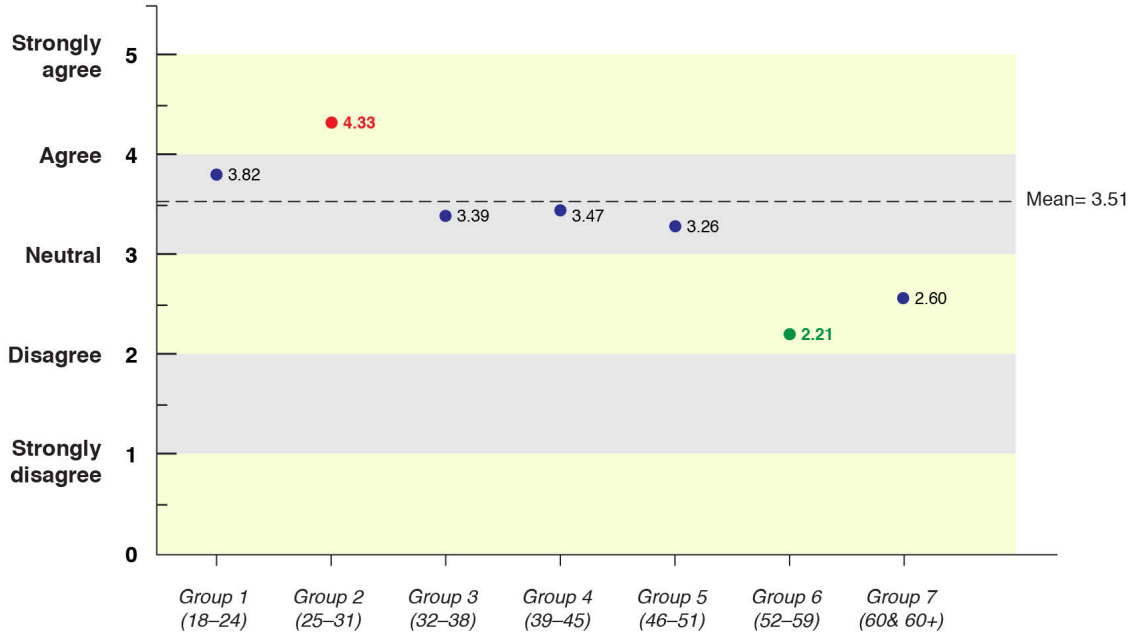
E-newspaper is more difficult to retrace old informtation than printed newspaper.



E-newspaper will cause more visual fatigue than printed newspaper.



Overall, I prefer E-newspaper than printed newspaper.



Profession Influence:

This study compares subjects' preference differences of electronic newspapers between a student group, a university professor group, and an industrial profession group. The results show that profession variation has significant impact on subjects' attitude to the interpersonal interactivity feature of electronic newspaper and the overall preference of electronic newspapers. The mean attitude evaluation indicates university professors prefer digital format newspapers less than students and subjects who work in industrial environments (Table 17).

Table 17. Profession influence of participants' attitude towards e-newspapers

Item	*Students Mean (n= 45)*	*Professors Mean (n= 37)*	*Other Professions Mean (n= 60)*	*Total Mean (n= 142)*
E-newspaper is easier to find information	4.07	3.38	3.82	3.78
E-newspaper is easier to navigate readers to the content they are interested in	3.71	3.30	3.78	3.63
E-newspaper is harder to store useful information	2.20	2.49	2.35	2.34
The multimedia content of e-newspaper is helpful to get information better	3.62	3.00	3.47	3.39
E-newspaper is easier to share and discuss news with other people	4.49	3.84	4.33	4.25
E-newspaper is harder to retrace old information	2.47	2.62	2.35	2.46
E-newspaper will cause more visual fatigue	3.00	3.27	3.05	3.09
Overall, I prefer e-newspapers than printed newspapers	3.84	2.89	3.67	3.52

* 1= Strongly disagree 2= Disagree 3= Neutral 4=Agree 5=Strongly agree Highest score Lowest score

The attitude differences between university professors and students are more obvious than the differences between university professors and subjects working in an industrial environment. The differences are especially significant for the following aspects: (a) digital format newspaper makes it easier for users to find information (sig.= .016); (b) the multimedia content of digital format newspaper improves the acquisition of information (sig.= .016); (c) digital format newspaper is easier to share with others and discussing news with other people easier (sig.= .006); (d) subjects' overall preference about digital format newspapers (sig.= .002).

Nationality Influence:

By analyzing variations of attitudes from subjects with different native language backgrounds, the survey result finds four aspects are significantly affected by native language background: (a) digital format newspaper makes finding information easier; (b) the multimedia content of digital format newspaper improves the acquisition of information; (c) digital format newspapers is easier to cause visual fatigue; (d) subjects' overall preferences about digital format newspapers (Table 18).

The research indicates in general, that native English speakers have different attitudes toward electronic newspapers compared to other language speakers. Generally, Chinese speakers and subjects in the international group have more positive attitudes about electronic newspaper than English speakers (Table 19). For the statements "It is simpler to find information on e-newspaper than printed newspaper" and "it is simpler to navigate to preferred content on e-newspaper than printed newspaper", the attitude differences between Chinese speakers and English speakers are especially notable ($p < .05$). These two statements are related to navigation issues. Therefore, it can be assumed that Chinese speakers are more used to interacting with electronic newspapers than English speakers. The subjects in the international group and Chinese speaker group also agree multimedia content can assist in the acquisition of information more than English speakers. The difference between English speakers and international subjects is especially notable ($p < .05$). The Chinese speaker's attitude about the multimedia content of electronic newspaper is coherent with the survey about preference of news format which indicates that Chinese speakers are more in favor of multimedia news than English

speakers. Moreover, the international subjects feel the digital format newspapers do not cause more visual fatigue than printed newspapers, which is significantly different from both English speakers (sig= .011) and Chinese speakers (sig= .004).

Overall, the international subjects and Chinese speakers favor digital format newspaper more than English speakers. The frequency of the statement "I prefer to read digital format newspaper than printed newspaper" of subjects in the international group is highest among the three groups. The mean of 4.47 is very close to "strongly agree". Alternatively, the English speakers have a more reserved attitude of digital format newspaper. They rate the same statement at 3.27, which is close to "neutral". Since the international group consists of subjects from various countries, more samples need to be collected to investigate the variations between attitudes of subjects from different countries.

Table 18. Native language influence of participants' attitude toward e-newspapers

Item	*Squares*	*df*	*Mean square*	*F*	*Sig.*
E-newspaper is easier to find information	11.729	2	5.865	3.664	0.028
E-newspaper is easier to navigate readers to the content they are interested in	11.125	2	5.563	3.046	0.051
E-newspaper is harder to store useful information	0.884	2	0.442	0.247	0.782
The multimedia content of e-newspaper is helpful to get information better	20.766	2	10.383	5.793	0.004
E-newspaper is easier to share and discuss news with other people	4.064	2	2.032	1.756	0.176
E-newspaper is harder to retrace old information	0.322	2	0.161	0.084	0.920
E-newspaper will cause more visual fatigue	19.708	2	9.854	4.657	0.011
Overall, I prefer e-newspapers than printed newspapers	25.598	2	12.799	6.794	0.002

Table 19. Comparison of attitude about e-newspapers between subjects with different native language backgrounds

Item	*English Speakers Mean (n= 98)*	*Chinese Speakers Mean (n= 25)*	*International Subjects Mean (n= 19)*
E-newspaper is easier to find information	3.59	4.28	4.11
E-newspaper is easier to navigate readers to the content they are interested in	3.45	4.12	3.95
E-newspaper is harder to store useful information	2.35	2.44	2.16
The multimedia content of e-newspaper is helpful to get information better	3.14	3.84	4.11
E-newspaper is easier to share and discuss news with other people	4.15	4.60	4.32
E-newspaper is harder to retrace old information	2.44	2.56	2.42
E-newspaper will cause more visual fatigue	3.15	3.52	2.21
Overall, I prefer e-newspapers than printed newspapers	3.27	3.80	4.47

* 1= Strongly disagree 2= Disagree 3= Neutral 4=Agree 5=Strongly agree

3.4.3.2 Advantages and Disadvantages of Electronic Newspaper

In this survey, participants were provided with multiple-choice questions to indicate their personal opinions about the advantages and disadvantages of electronic newspaper. The advantages of electronic newspaper included “good portability”, “eco-friendly”, “quick-updated information”, “easy navigation”, “multimedia (audio & video)

content" and "ability to compare information of different presses". In addition, subjects could also comment on other advantages not listed. The disadvantages of electronic newspaper included " difficult to read", " difficult to use the device or interface", "unable to mark or write", "visual fatigue" and "expensive price". Similar to the advantages, participants were encouraged to comment on other disadvantages of electronic newspaper beyond the provided options.

Advantages of Electronic Newspaper

Participants' evaluation about the advantages of electronic newspaper is described in Figure 11. The result shows 86.5% participants selected "quick updating" in the survey, which indicates the immediacy of information is the most important advantage of electronic newspaper. Moreover, more than 60% of participants also consider "portability", "eco-friendly feature" and "multimedia news" as the benefits of electronic newspapers. Several participants give the explanation of "eco-friendly" as "consuming less paper" and "no newsprint on hands". In addition, participants also mentioned the search function of electronic newspapers enables them to find specific information or read history, which is another significant benefit not provided by printed newspapers.

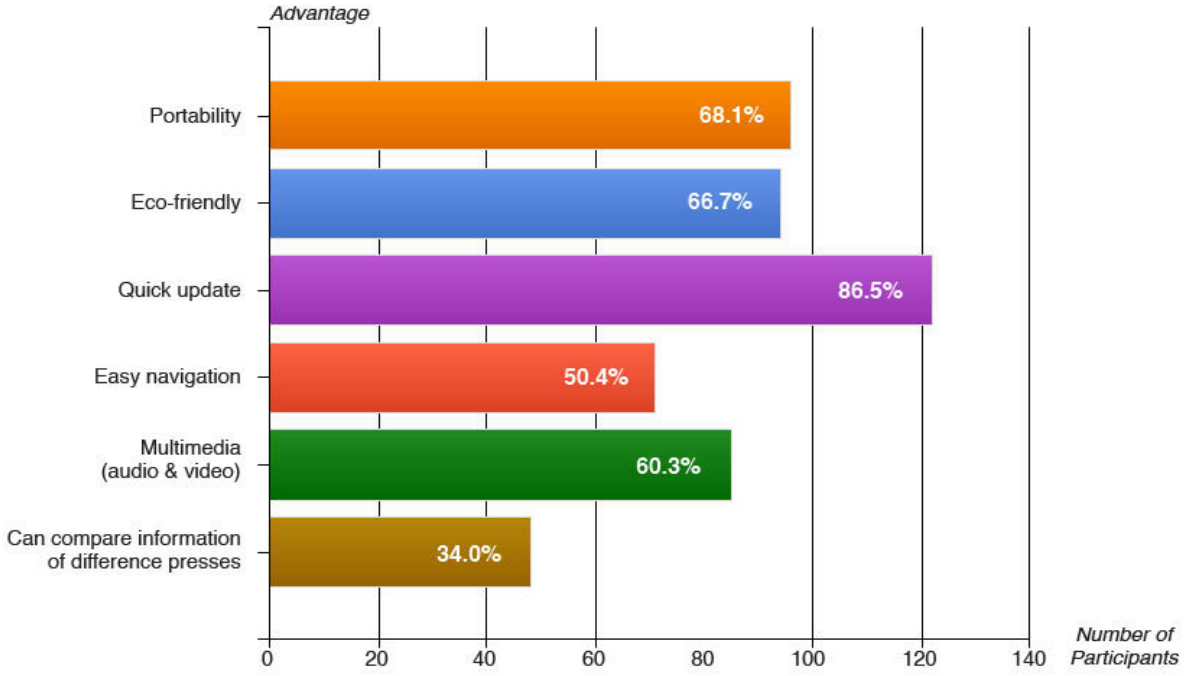


Figure 11. Participants' opinion about the advantages of E-newspaper

Disadvantages of Electronic Newspaper

Figure 12 illustrates participants' opinions about the disadvantages of electronic newspaper. The results demonstrate the features "unable to mark or write" and ability to cause "visual fatigue" are the two main disadvantages of electronic newspapers. However, the "expensive" option is a controversial factor of e-newspaper. Many participants in the survey argue that electronic newspapers are less expensive than printed newspapers, because they can read news through the Internet for free. Actually, some participants consider this feature an advantage of electronic newspaper. Alternatively, some participants take into account that e-newspaper relies on a reading device and Internet access, which is not as convenient as printed newspaper. In addition, participants also suggested another two major disadvantages of e-newspaper: (a) the visual design of e-newspaper is not as sophisticated as printed newspaper design; (b) sometimes e-newspaper will force readers to read advertisements without any control. Therefore, adopting new technology to improve people's news reading experience of electronic newspaper through design is a new challenge for designers.

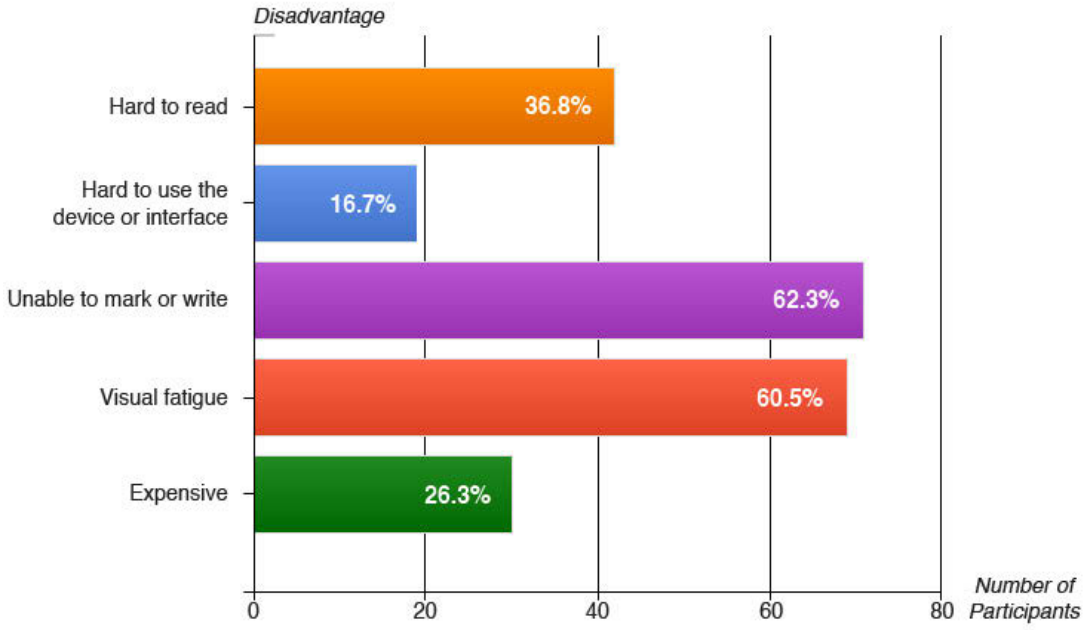


Figure 12. Participants' opinion about the disadvantages of E-newspaper

3.4.4 Usage of an iPad for Reading Daily News

In this online survey, 35 subjects claim they possess an iPad, equaling 24.6% of the total subjects. Of the subjects who responded to the question, 85.7% indicated they read news daily, and about half of them implied they access news daily via an iPad The survey results also show more than 80% subjects suggested they use an iPad to read news at home. As some subjects also mentioned, they usually use the iPad for news and entertainment after work, it can be concluded that the iPad is often used in a home environment. The subjects also listed the websites and iPad applications that they usually use to access news. The popular websites included CNN.com, NewYorkTimes.com, msnbc.com and huffingtonpost.com. As for the iPad applications, the top 3 news apps are CNN, Huffington Post, and New York Times. The overall responses from participants also confirmed that users access news more via the Internet than via news applications.

3.5 Conclusion & Findings

This survey illustrates an overall understanding of people's acceptance of e-newspaper and the demographic factors that influence the preference of e-newspaper and printed newspaper.

In general, the laptop computer and smartphone have become the most common electronic devices in people's daily lives. Accessing the Internet through these two devices is the most popular way to acquire and exchange information for the majority of users. As an important medium of mass communication, newspaper still plays an essential role to deliver everyday information to people all over the world. However, with the development of technology, newspaper is also experiencing the transition from printed format to digital format. This survey suggests electronic newspapers, especially the news websites, have replaced the traditional printed newspapers to become the dominant channel to communicate news information. However, printed newspapers are still important and are difficult to remove from everyday life.

In regards to the preference of digital format newspaper and traditional newspaper, the survey indicates that participants prefer e-newspaper than printed newspaper, but the preference is not strong. However, the interpersonal communication feature of e-newspaper is strongly supported by the participants. In addition, the search

function and the non-linear design of news communication of e-newspaper are also favored by the majority of participants.

Through examining the demographic information of participants, the survey finds several key correlations between demographic factors and readers' preferences of printed news and digital news.

Age Influence:

The survey finds that according to the acceptance of technology and news reading habits, participants can be divided into three age groups: Group 1 with subjects ages 18-30 ; Group 2 with subjects ages 30-50 ; and Group 3 with subjects over 50 years of age . The participants in Group 1 are more likely to accept new technologies, and they have positive attitudes towards e-newspapers. However, due to the low income level, the major devices for subjects in this group are laptop computers and mobile phones. Research also finds that subjects in Group 1 read less news than Groups 2 and 3. The subjects in Group 2 accept both new and old technologies. The study finds the majority of iPad owners belong in Group 2. These subjects also have very positive attitudes to e-newspapers. Compared to Group 1 and Group 2, the participants in Group 3 are less in favor of new technology and have less positive attitudes toward e-newspapers. Therefore, subjects ages 30–50 are the potential users who will read news via an iPad.

Profession & Income Influence:

Participants' profession and income level are also associated with their choices of device and attitudes toward e-newspapers. In this study, the subjects are grouped as students, professors, and other professions. The students and professors are also considered as subjects who work in academic environments. The results indicate subjects who work in academic environments read less news than those who work in industrial environments, and students read least news among the three groups. The study also finds the professor group subjects, when compared to the student group and other professions group, favor e-newspaper less than the subjects in the other two groups. Moreover, the possession of an iPad is directly associated with participants' income levels. The higher income subjects have, the more likely they will own an iPad.

Nationality Influence:

The survey participants are grouped as English speakers, Chinese speakers, and international group. The results show Chinese speakers read more news via an iPad than other language speakers and also prefer e-newspaper better than the other two groups. Subjects in the English-speaking group prefer e-newspaper least among the three groups. However, the difference of preference is not significant.

Participants' Attitude to the Multimedia News:

As an important feature of e-newspapers, the multimedia news (video and audio format) brings readers a different reading experience compared with printed newspapers. However, the preference of multimedia news still varies from reader to reader. The survey results indicate subjects age 50 and over prefer multimedia more than subjects under 50 years of age. The survey also finds that Chinese speakers favor multimedia news more than other language speakers.

CHAPTER 4. CASE STUDIES OF E-NEWSPAPER DESIGN

Based on previous research about electronic newspapers and the findings of online surveys, this study conducts three case studies to provide a detailed analysis of the newspaper iPad application design and website design of the iPad device. According to online survey results and customs' evaluations, the New York Times, USA Today and Huffington Post are chosen as three popular newspaper examples. The iPad application design and website design are examined from typographic and usability aspects. From the typography perspective, the study explores how the applications and websites create page structure, establish visual hierarchy, and communicate brand identity to users. From the usability perspective, the study investigates the navigation and interaction methods of applications and websites. Moreover, the study also compares the customizable functions of these three newspaper iPad applications. Through the case analysis and comparison studies, the similarities and differences between different newspaper apps, as well as the differences between newspaPer iPad apps and websites can be discovered.

4.1 New York Times

Homepage Layout

The homepage of the New York Times iPad app applies different grid structures for the landscape view and portrait view, which are four columns for horizontal orientation and three columns for vertical orientation (Figure 13). However, there are no differences between the two orientations of a website grid system. Compared to the iPad app, the New York Times website homepage has a more flexible grid system (Figure 14). The top half of the page is divided into two parts– section navigation on the left side, and main content on the right side. The main content is designed based on a five-column grid system. As the other half of the page does not contain the navigation menu, it is divided into five columns, but three of them are wider than the other two columns. In short, the website sometimes breaks the grid system to fit the specific requirements of information display.

Homepage Landscape View

Homepage Portrait View

Figure 13. Homepage grid structure of New York Times iPad application

Figure 14. Homepage design of New York Times website

Figure 15 shows the different approaches of visual design for the New York Times iPad app and its website. The iPad app emphasizes its brand identity through displaying the classic logo at the top of the page and applying the black and white color scheme. The overall design is highly text dominant, which follows the visual style of its printed version newspaper. The visual hierarchy of the app design is created through the contrast of photo size and type size and weight. Besides, the red type of news publishing time also punctuates this information. However, the website has a better balance of text and photos. The blue color used in article titles enables each article to stand out from the basic black and white page, which provides readers a visual cue to start. However, the blue color also weakens the brand identity of the newspaper.

iPad app homepage

Website homepage

Figure 15. Comparison of brand identity of New York Times iPad app and website

Content Organization & Display

The news stories of the New York Times are usually categorized according to different topics, and each topic designates one section of the whole newspaper. The major content of newspapers usually consists of the latest top updating news stories. Individual section top news are the latest or most popular news of each section. The iPad app sets top news as its homepage, which only displays the general updating stories. The content of other sections can be accessed through the navigation menu located at the left bottom

corner of the screen. The top news articles are listed on two pages: the first page design integrates traditional printed newspaper design style that uses photo and type contrast to identify the importance of the news articles while the second page lists articles in equal space that provides the reader with an extremely organized visual structure. Readers can simply swipe horizontally to navigate between these two pages (Figure 16). However, the website presents more information on the homepage (Figure 17). The website homepage can be divided into two parts: the top half displays the top news as the app does while the bottom half shows the top news of each section as well as recommended news or related articles. In this way, readers are able to obtain an overall landscape of the content of the whole newspaper. Compared to the iPad app, the website gives readers more news options on the homepage.

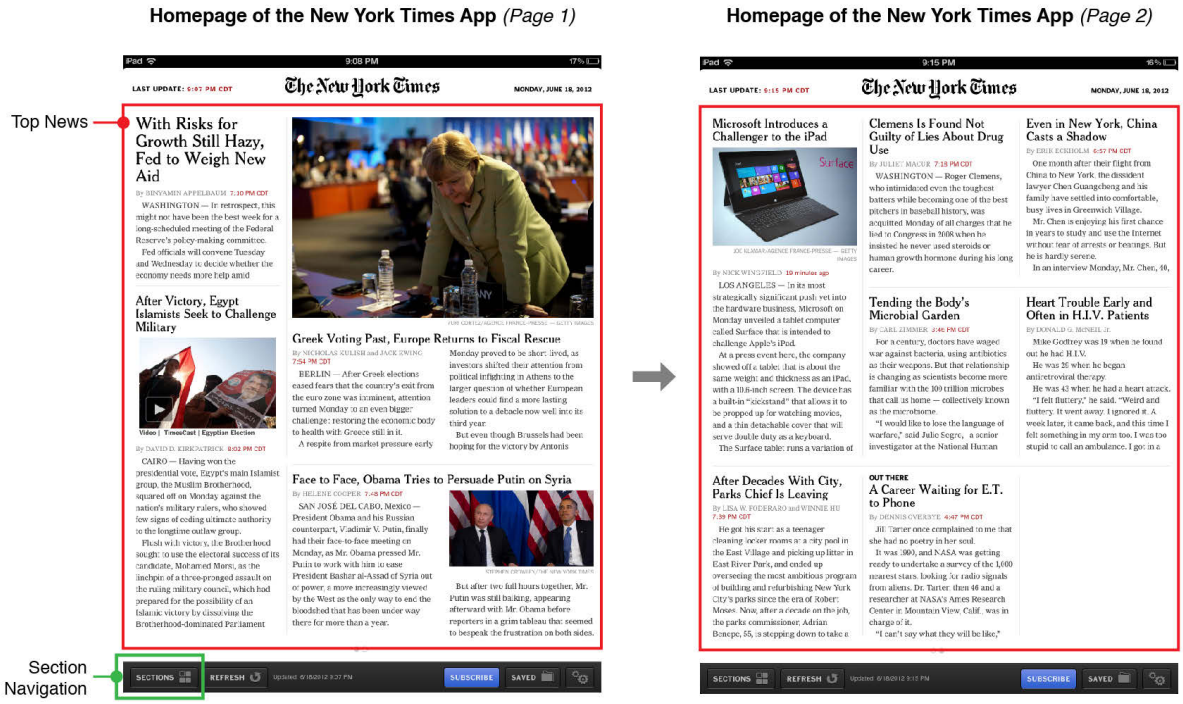


Figure 16. Content display of the New York Times iPad app

Figure 17. Content display of the New York Times website

Story Page Layout

Compared to the homepage, the story page of the New York Times app changes the page structure from four-column to three-column of the landscape view, and three-column to two-column of the portrait view. The overall page design concentrates on displaying a single story without other visual distractions (Figure 18). In comparison, the grid structure of the website story page is the same for portrait view and landscape view. But similar to the homepage, the page content is design based on five uneven columns: the news story is presented in three slightly wider columns, and the recommended news and advertisements are presented in two narrow columns. Therefore the grid structure of a website story page is not as consistent as that on the app. Instead of only presenting news articles on the page, the website also provide readers with links to related news and information on the story page. Users are also able to add comments and share ideas with other readers on the same page (Figure 19).

Figure 18. New York Times iPad app story page design

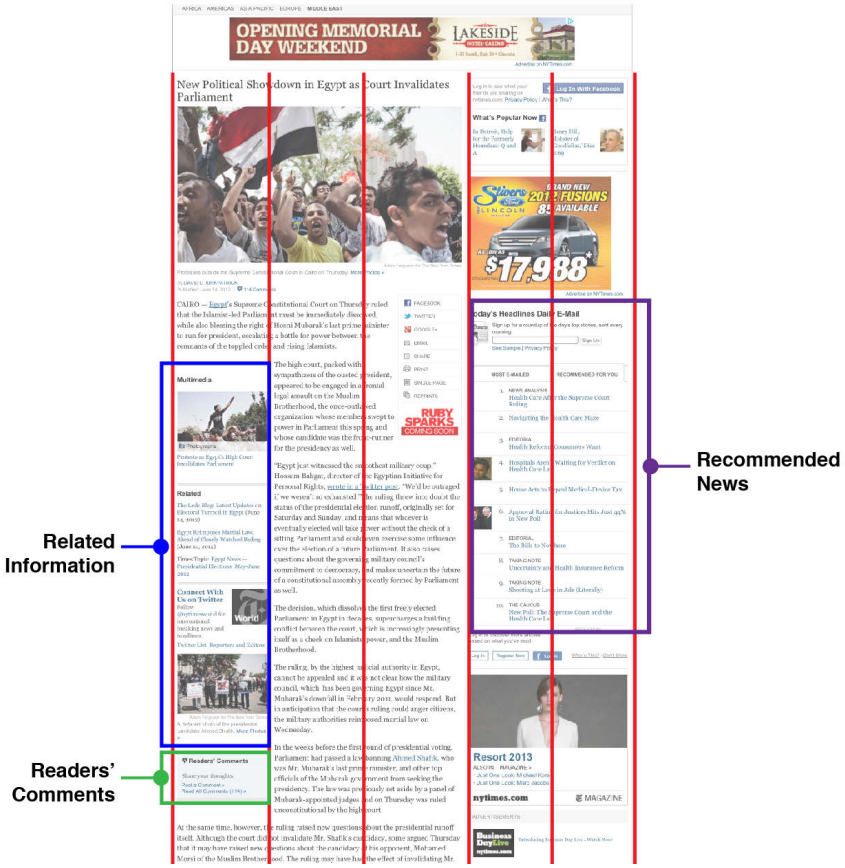


Figure 19. New York Times website story page design

The iPad app story page also separates the photo display from its main content. When users tap the photo on the screen, a popup window will present a series of high-

resolution news photos with detail captions which enables users to get a better perspective of the news story (Figure 20). Users can also access the same series of photos on the website by clicking the link "more photos" found embedded in the caption (Figure 21). But when compared with the iPad app, the visual cue of this link is too weak to be noticed by readers.

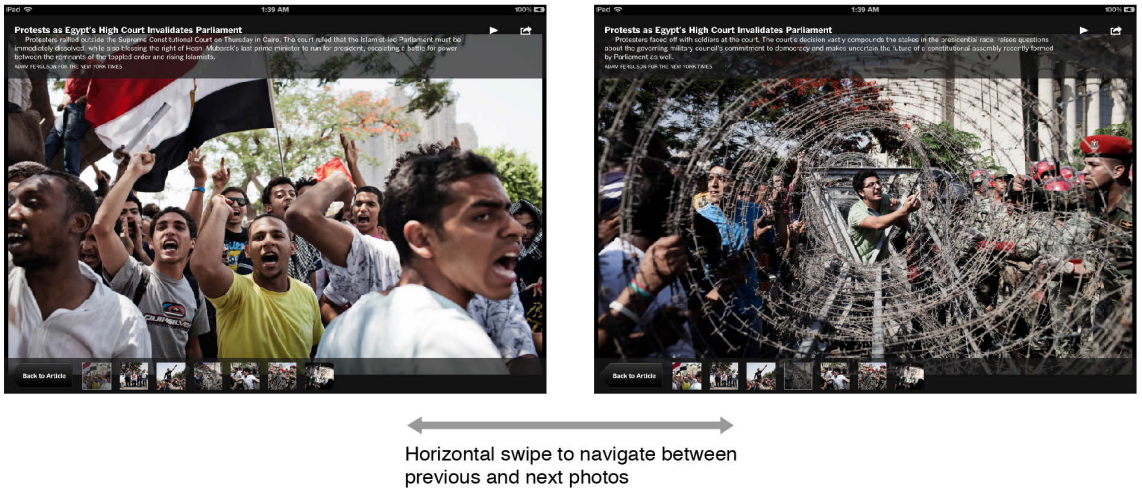


Figure 20. Photo display of New York Times iPad app

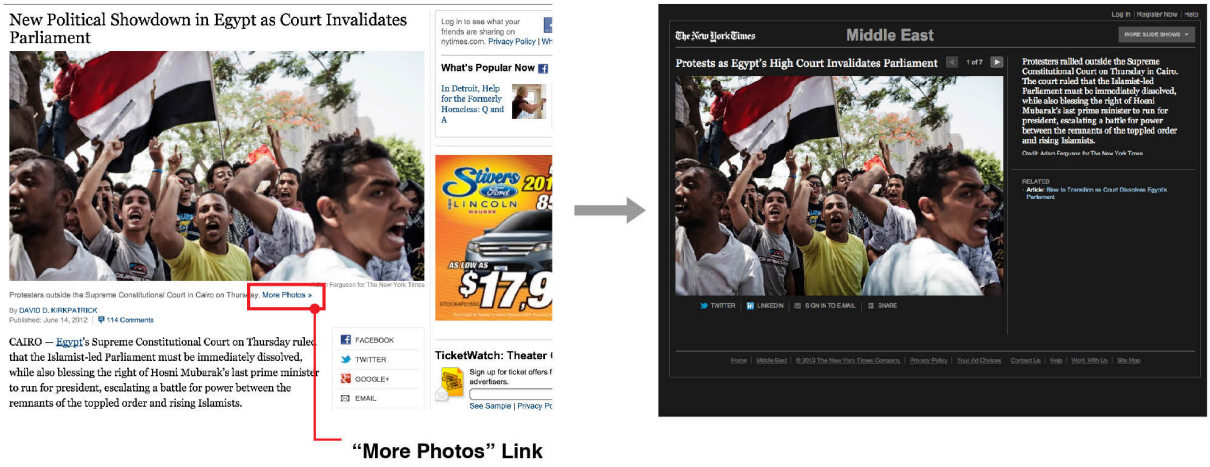


Figure 21. Photo display of New York Times website

Interface Design

Rice (2010) developed an iPad app architectural map to illustrate the basic navigation and interaction of the USA Today iPad app (Figure 22). A similar method can

also be applied to analyze the interface design of the New York Times app and website. The interface design is examined considering navigation and interaction. Figure 23 to Figure 26 illustrate the navigation maps of a homepage and story page for the iPad app and website. They also demonstrate how users interact with the app and website to search and read news.

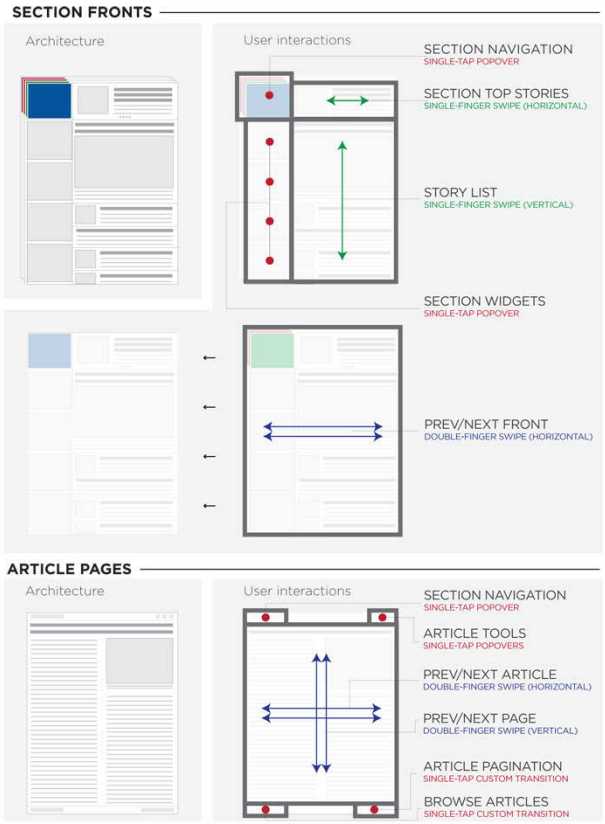


Figure 22. Rice's iPad app architectural map

The main difference of interface design between the New York Times app and website is caused by the unique interaction feature of the iPad device. As the app is designed especially for the iPad, the touch screen makes swipe and tap become most common interactive actions. But as the website is designed for multiple devices, including tablets, computers, and smartphones, it follows the basic interaction rules of web design. Therefore, users need to use their fingers to replace a mouse to scroll the page and click links.

The main navigation of the New York Times newspaper is one that leads users to various sections. On the app homepage, the section navigation is displayed as a button at the left bottom corner of the screen. Through tapping the "section" button, a popup window will appear to present each section on the menu (Figure 23). However, the website has a more complex navigation system than the app. The section navigation is located on the left side of the page. But the website also categorizes news as "today's newspaper", "video" and "most popular" on the top of the page. Users are able to select each category through the category navigation at the top left corner of the screen (Figure 24). The website also provides users with a search function, which is not included in the iPad app. On the website homepage, users can swipe vertically to scroll the page and scan the news information. But this purpose will be realized by horizontal swipe on the app homepage.

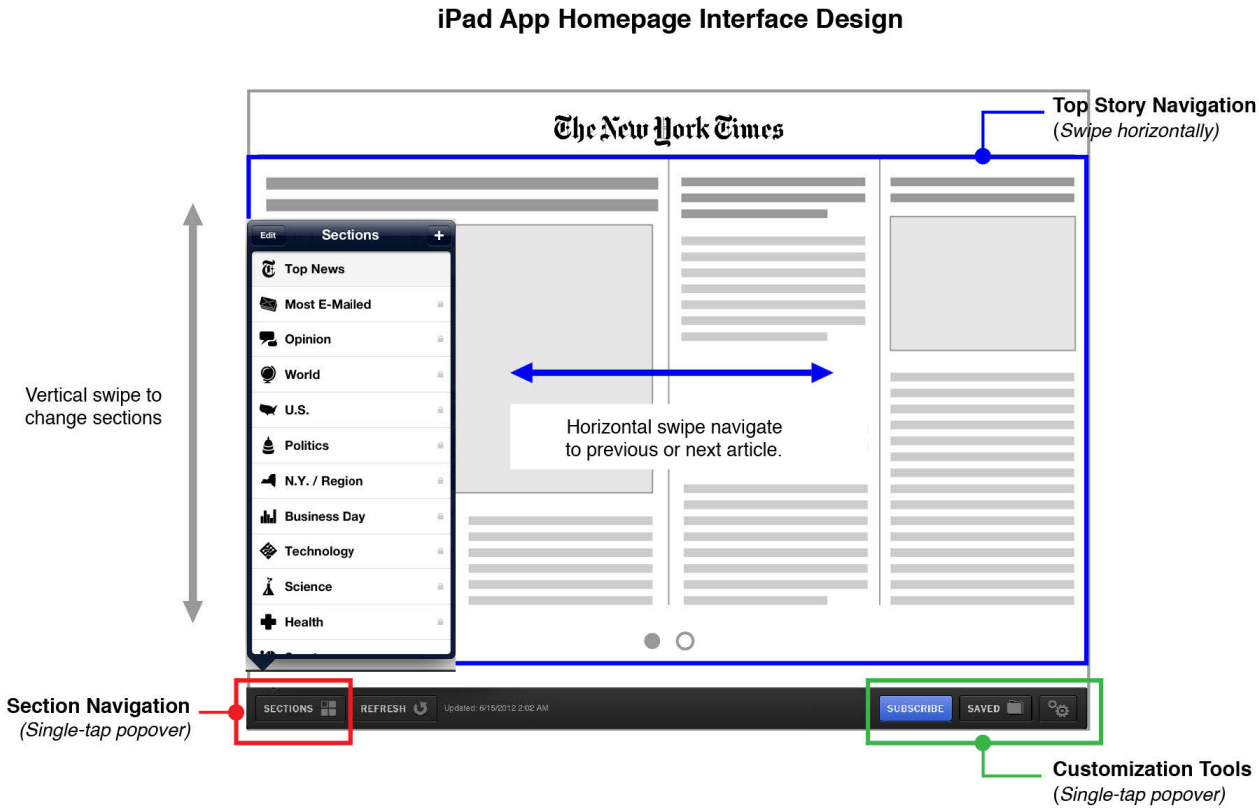


Figure 23. Homepage interface designs of the New York Times iPad app

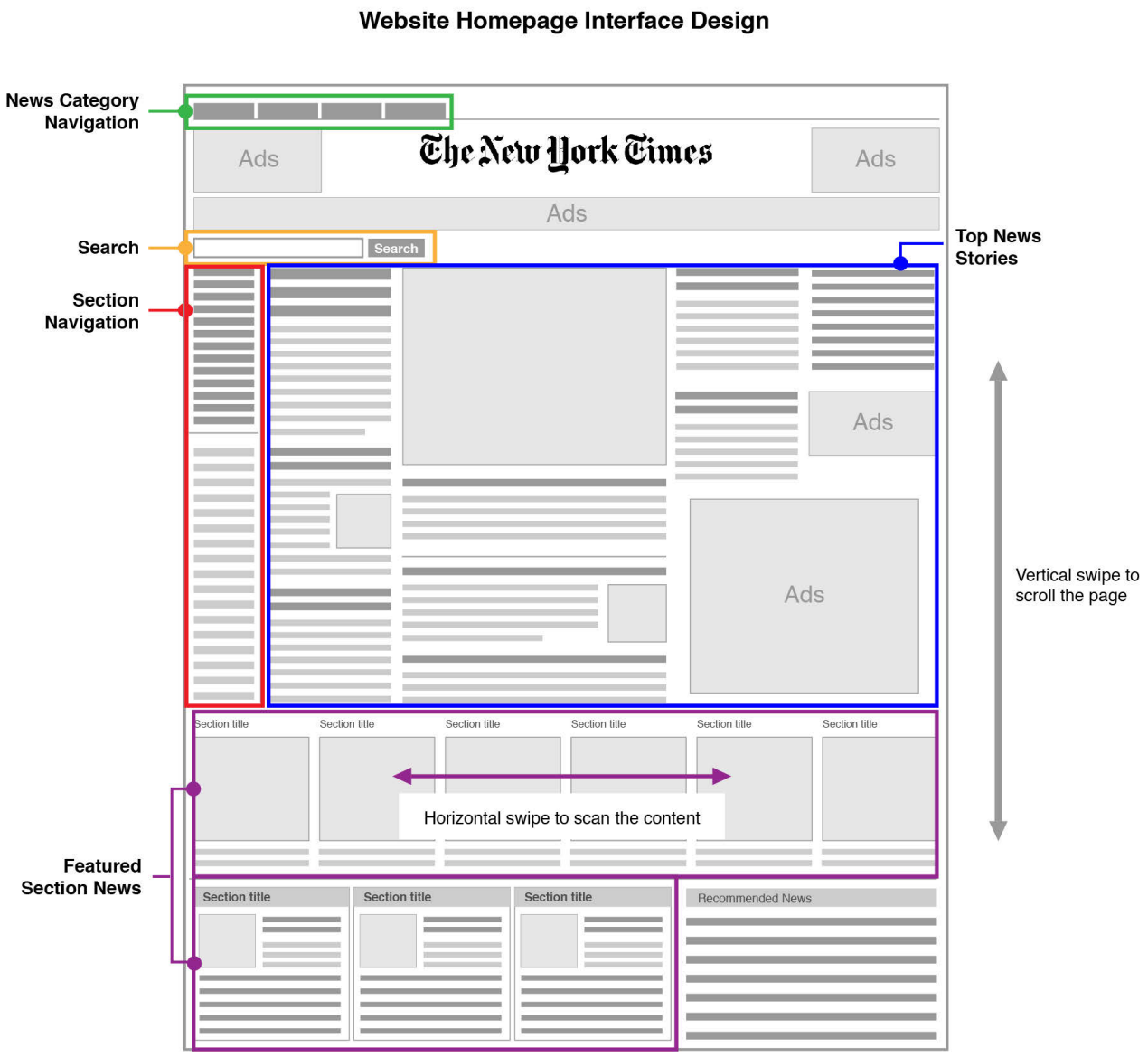


Figure 24. Homepage interface designs of the New York Times iPad website

The interface design of the story page for the New York Times app is similar to the homepage interface design. By locating all the navigations at the bottom of the page, the story page creates sufficient space to display news articles. The horizontal swiping gesture will help users better navigate to previous or next pages of articles. With the exception of the section navigation, the interface of the story page adds a button to assist users to go back to the homepage of each section easily. A list of news stories with titles and photo thumbnails is also displayed next to the section navigation button. By swiping

this list horizontally, users are able to scan the top news of this section conveniently (Figure 25). The app story page also contains utilities that aid readers to customize their newspapers. The article tools presented at the top right corner allow users to adjust font size, save articles, and share news. This function meets personal requirements of various readers. By contrast, the website story page displays various links within the article space. Except for the category navigation and section navigation that are separate from the main article content on the top of the page, the other information such as related topic links and recommended news links are presented next to the main content (Figure 26). Because of the clear visual hierarchy and grid structure of the page, these elements do not interrupt users' reading process. When compared to the interface of app story page, the website has a different approach: the iPad app separates navigation from the main content, emphasizing the news story itself while the website combines navigation with the main content, focusing on establishing an information net of the news story.

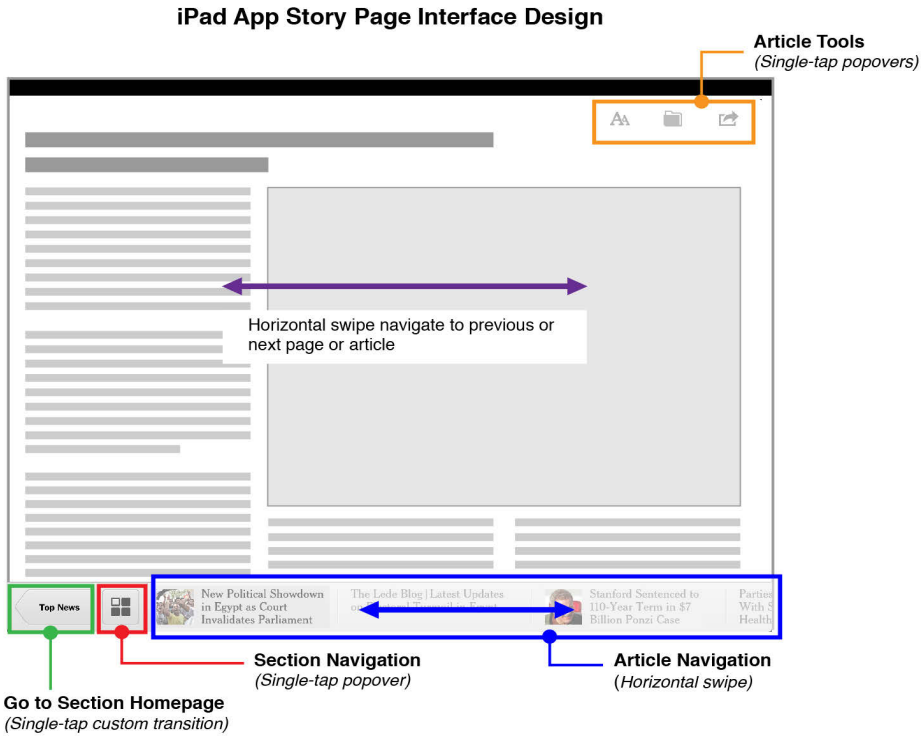


Figure 25. Story page interface designs of the New York Times iPad app

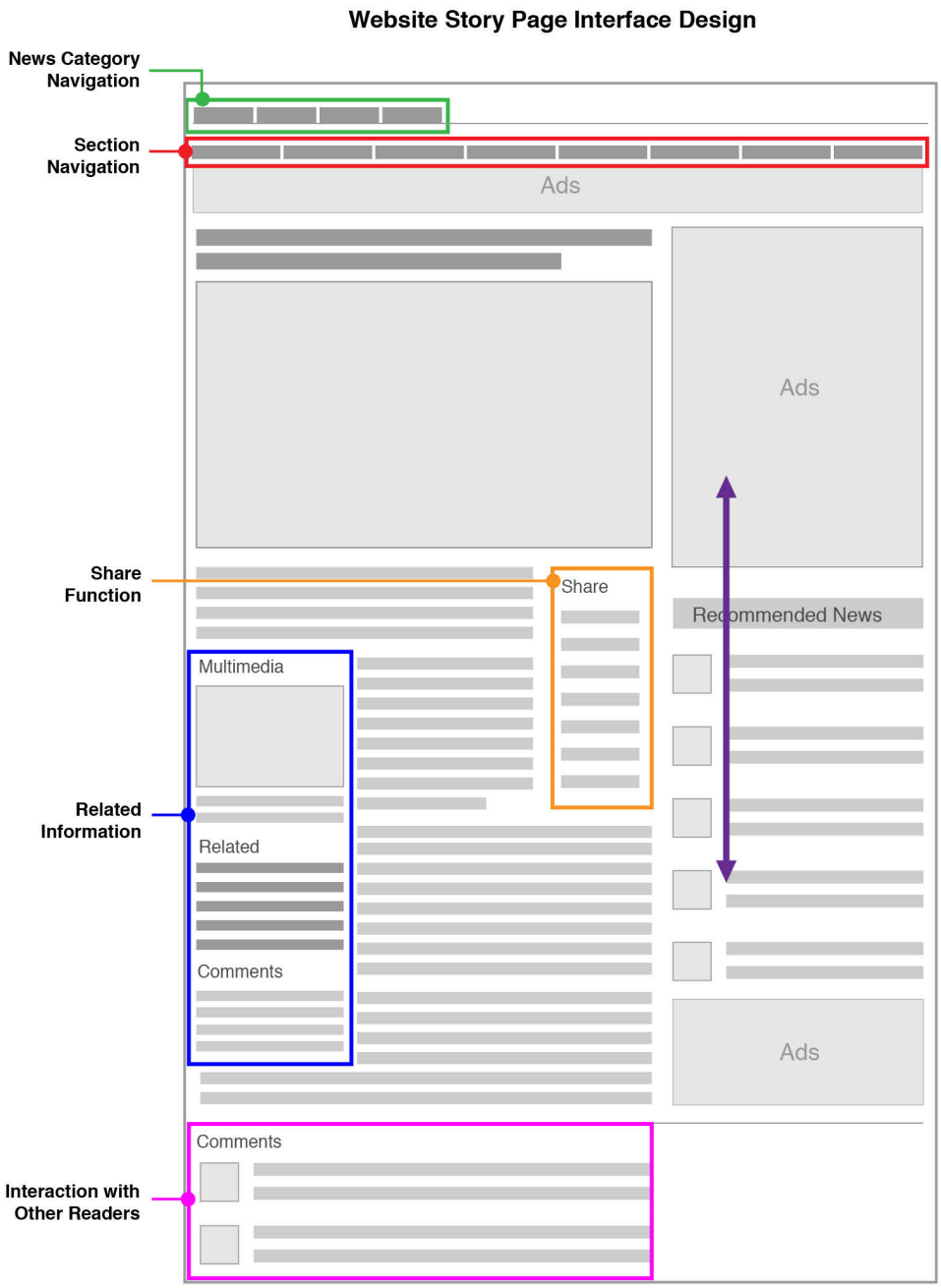


Figure 26. Story page interface designs of the New York Times website

User Customization

Another feature of the New York Times iPad app is it enables users to customize their newspapers. The customizable functions include setting up a personal account, saving articles, adjusting type size, and sharing information to social networks (Figure 27). On the app homepage, the customization tool at the bottom right corner enables

readers to manage their personal account and news updating method. The "save" function on both homepage and story page can help readers save an article for future. On the story page, readers may also select font size from the article tool. These features of the iPad app will meet the diverse needs and requirements of various readers. The zoom in or zoom out feature of the iPad device and the "bookmark" function of the web browser enable the website to achieve the same goal of customization as the app does (Figure 28). However, it is difficult for users to discover these functions if they are not familiar with the iPad device.

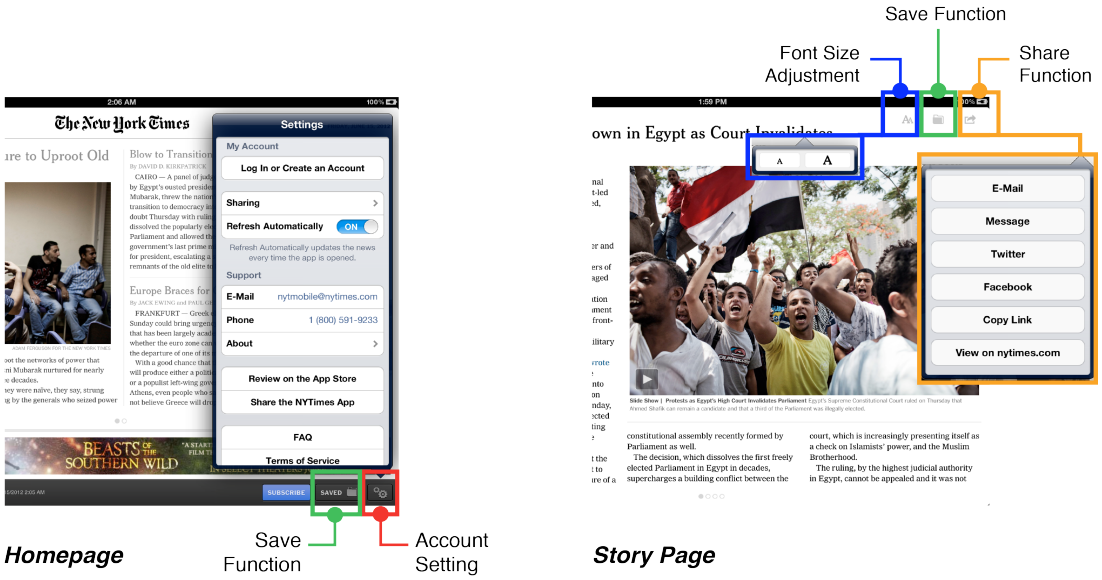


Figure 27. Customizable functions of the New York Times iPad app

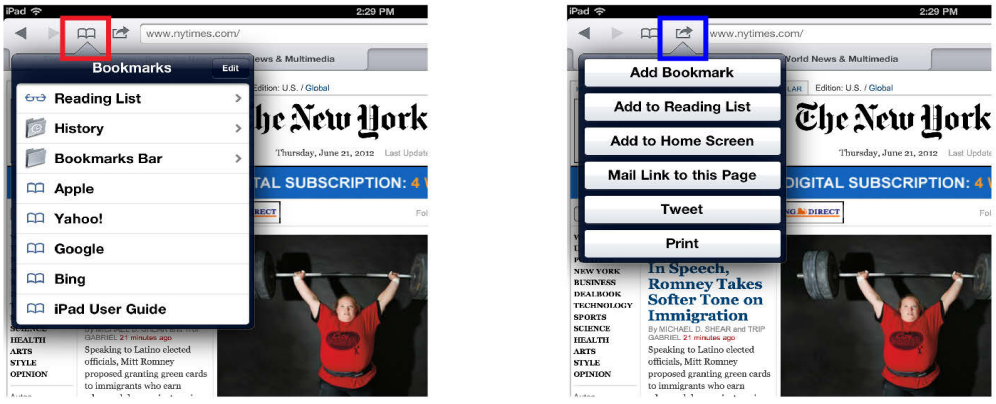


Figure 28. Customizable functions of the New York Times website

Summary

The design analysis proves the New York Times iPad app and website have different design approaches to communicate news information to iPad users. A brief comparison is demonstrated in Table 20. Compared to the website, the iPad app embraces more of the printed newspaper design traditions for its visual presentation. The black and white color scheme, unique logo typeface, and strict grid structure emphasize the visual feature of "New York Times", which provides readers with a better sense of branding than the website. The interface design of the iPad app displays all navigations and utilities as buttons that can be found at the bottom or top of the page. It creates functionality areas separate from the article displaying are which assists readers in concentrating on the news content without visual distraction. The interface of the website is designed in a different form. It follows the general website structure that locates navigation at the top or on the left side of the page and integrates articles and links together on the web page. In this way, the website establishes a network for news that will navigate readers to related information easily.

Table 20. Comparison of New York Times iPad app & website design

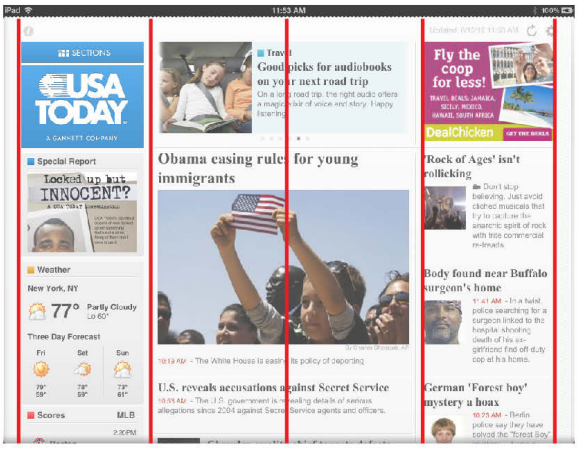
<table>
<tr><th></th><th></th><th>App</th><th>Website</th></tr>
<tr><td rowspan="4">Layout</td><td rowspan="2">Column</td><td>Landscape View: 4-column (homepage)
3-column (story page)</td><td rowspan="2">5-column, flexible grid structure</td></tr>
<tr><td>Portrait View: 3-column (homepage)
2-column (story page)</td></tr>
<tr><td>Branding</td><td>Black & white color scheme
The New York Times logo</td><td>The New York Times logo</td></tr>
<tr><td>Hierarchy</td><td>• Type size & weight contrast
• Photo size contrast
• Color contrast</td><td>• Type size & weight contrast
• Photo size contrast
• Color contrast</td></tr>
<tr><td>Layout Structure</td><td>Printed newspaper-like layout</td><td>Website layout</td></tr>
</table>

Content	*Information Display*	• Limited amount of information • Single article display without other visual distraction (magazine-like display)	• Large quantity of information • News article accompanied by related news links
	Advertisement	Limited amount of ads on the homepage	Several ads are displayed on the same page as articles
	Contents	• "Top news" section on the homepage • Only displays article content on the story page	• Top news of all the sections on the homepage • Article content, related news and readers' comments on the story page
Navigation	*Display*	Popup menu	Navigation bar
	Information Presentation	Popup menu/window	Link to another page
Interaction	*Behavior*	Swipe/tap	Tap
	Search	No search function	Search box
Customization	*Function*	Adjust type size/share information/ save articles	Zoom in & zoom out whole page/Share information/bookmark articles

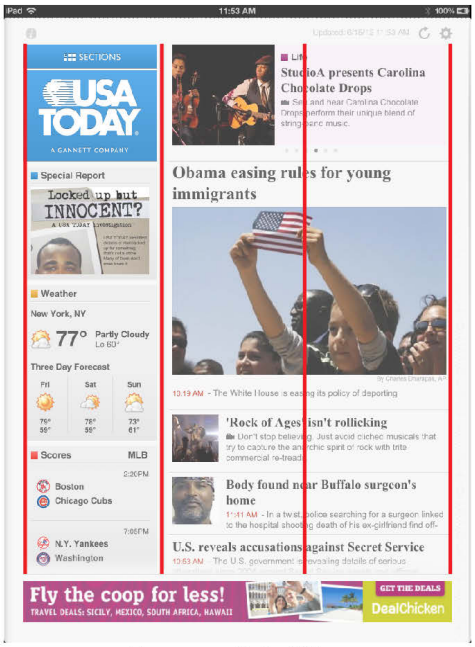
4.2 USA Today

Homepage Layout

The homepage of the USA Today app has the same grid structure as the New York Times app: three-column of the portrait view and four-column of the landscape view. The newspaper brand identity is demonstrated by the large-sized logo at the top-left corner (Figure 29). As for the website homepage, there is no difference of grid structure between vertical and horizontal orientations (Figure 30). Instead of emphasizing the logo size, the website uses a small logo but applies the identity color across the header at the top to stress the newspaper brand.

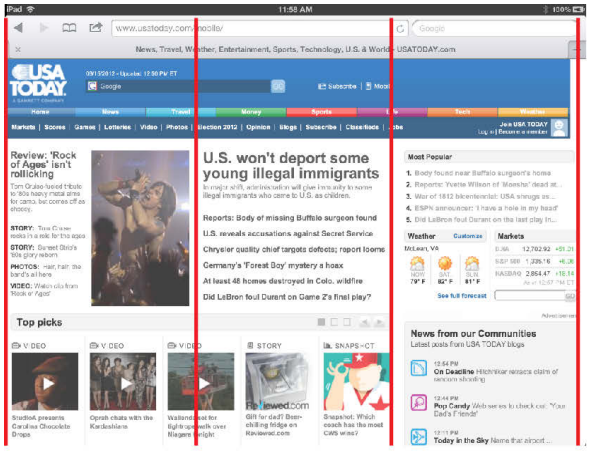


Homepage Landscape View

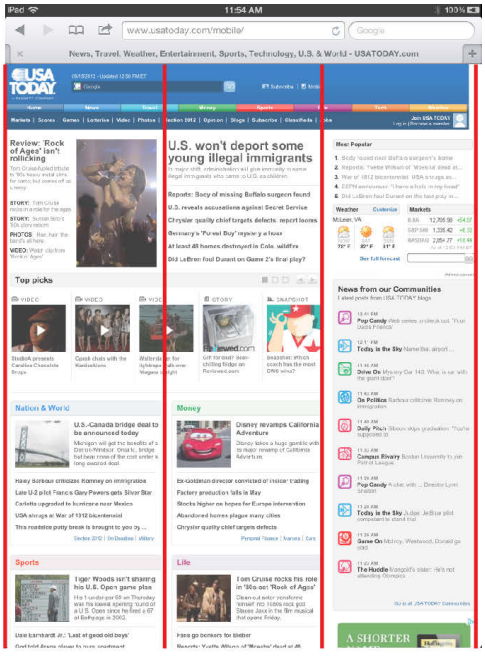


Homepage Portrait View

Figure 29. Homepage design of USA Today iPad app



Homepage Landscape View



Homepage Portrait View

Figure 30. Homepage design of USA Today website

The overall layout of the USA Today app homepage has a fluent linear visual flow. The visual hierarchy is primarily established by the size contrast of the titles and photos. However, because the USA Today website has a more flexible grid system, the overall page layout is divided into different rectangular sections, which lead to a non-linear visual flow. Because of the more complex page structure, the visual hierarchy of the website homepage is achieved by an integrative application of various typographic elements, such as color, type size and weight, image, and so on. The differences of the creation of visual hierarchy between the app homepage and website homepage can be illustrated by the way they display the main content (Figure 31 & 32).

USA Today iPad app homepage

Figure 31. USA Today iPad app content display

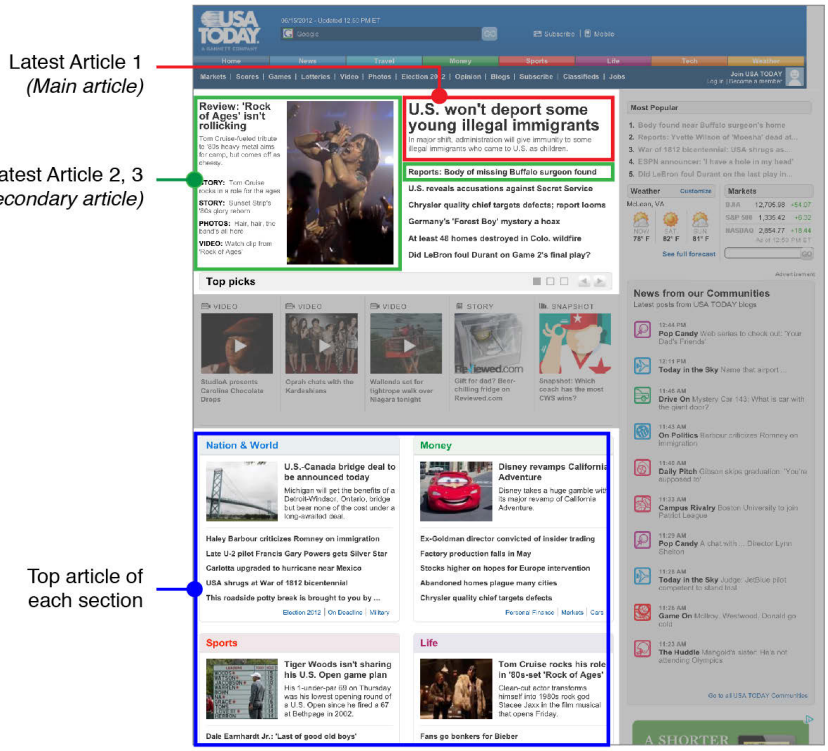


Figure 32. USA Today website content display

Content Organization & Display

The main content on both app and website homepages can be summarized as latest news, which consist by series of updating articles and section top stories, which display the feature story of each section (Figure 31 & 32). On the app home page, the main content is organized on the right side of the page. The large-sized photo that takes two columns can draw readers' attention immediately. It not only separates latest news and section top stories, it also serves as a starting point of the page. The latest news articles also contain main articles and secondary articles, identified by the different type sizes of the title and photo sizes of each story. However, the website homepage adopts a different layout design, especially for its latest news section. In general, the website homepage has more variety of type size contrast and color contrast than the app page. The main article displayed on the app homepage is presented by a large bold title, and one of the secondary articles on the app homepage is accompanied by a photo. In

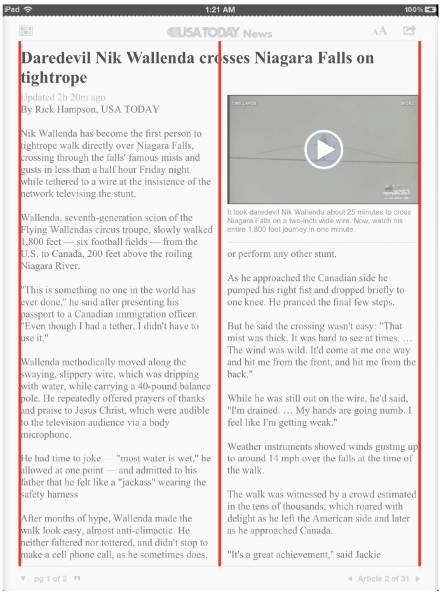
addition, the links of detailed information of the secondary articles are also listed under the title, so it takes larger space than the main article. Therefore, the hierarchy of the articles on the website homepage is different than the app homepage. Moreover, the different sections on the website are displayed in modules, identified by various type colors of section names. The top article of each section is shown with a photo, a larger title, and brief summary of the content so it provides readers with a sense of importance. Compared to the iPad app, the website gives users an overview of all the subsections and general content of each section on the homepage.

Story Page Layout

Figure 33 illustrates the story page of the USA Today app and website. Like the New York Times, the iPad app also uses three-column to display the news story for its landscape view, and two-column for portrait view. The overall page design is text-dominant, which eliminates other distracting visual elements, but only concentrates on one story on the full screen. Similarly, the website story page uses the same grid structure for both portrait view and landscape view as the homepage. However, the overall page does not keep a consistent grid structure from the top to the bottom. Instead of concentrating on a single article, the story page also lists other content such as links of related articles, readers' comments, advertisements, and so on. Therefore, users have more interaction with both story content and other readers. In addition, the story page of the iPad app and website provide different ways to view a video from an article. On the website story page, users can simply click the play button to start the video at the top of the story. When using the iPad app, a pop-up window will display a larger sized video (Figure 34).

USA Today iPad App Story Page

Story Page Landscape View



Story Page Portrait View

USA Today Website Story Page

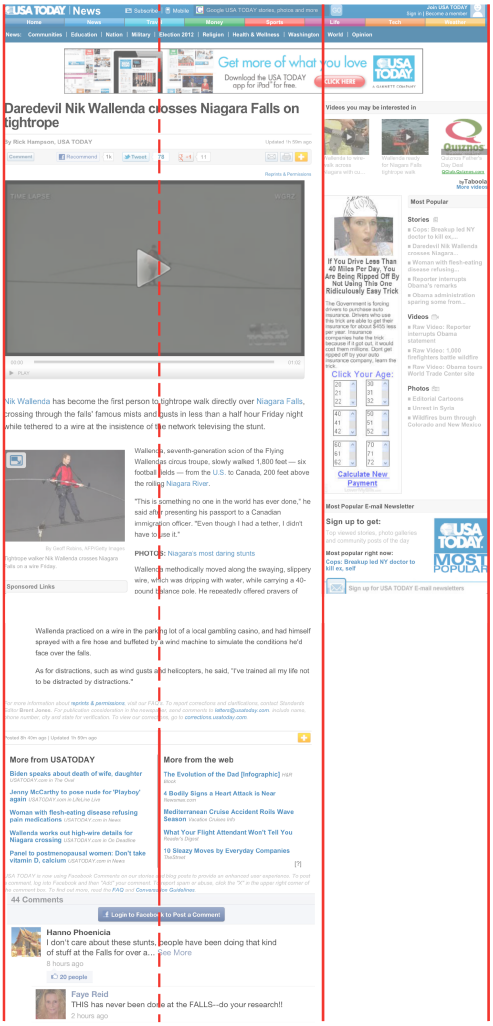


Figure 33. Comparison of story page design of USA Today iPad app and website

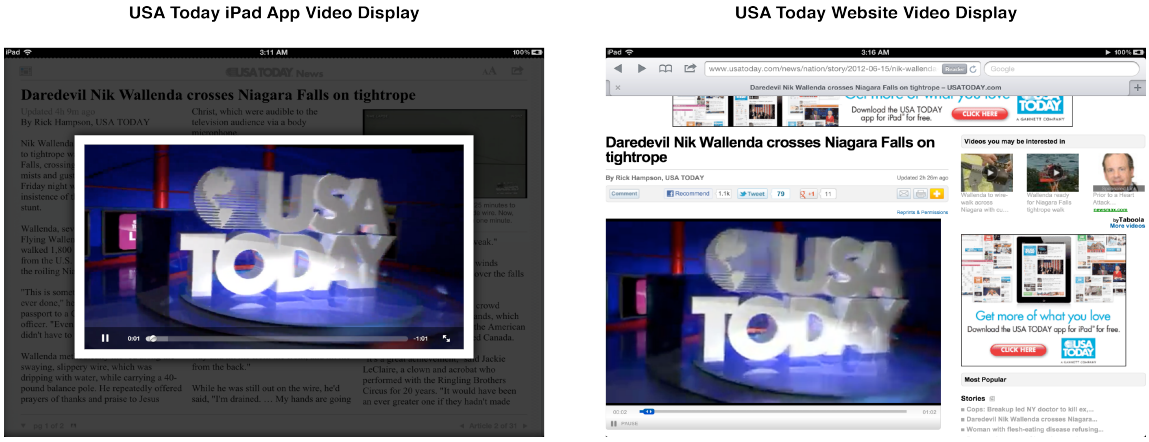


Figure 34. Comparison of video display of USA Today iPad app and website

Interface Design

Similar to the New York Times iPad app , the main method of interaction used on the USA Today iPad app is also based on a swiping gesture which is different from the clicking gesture used on the website. Figure 35–38 describe the different interface designs of the USA Today iPad app and website.

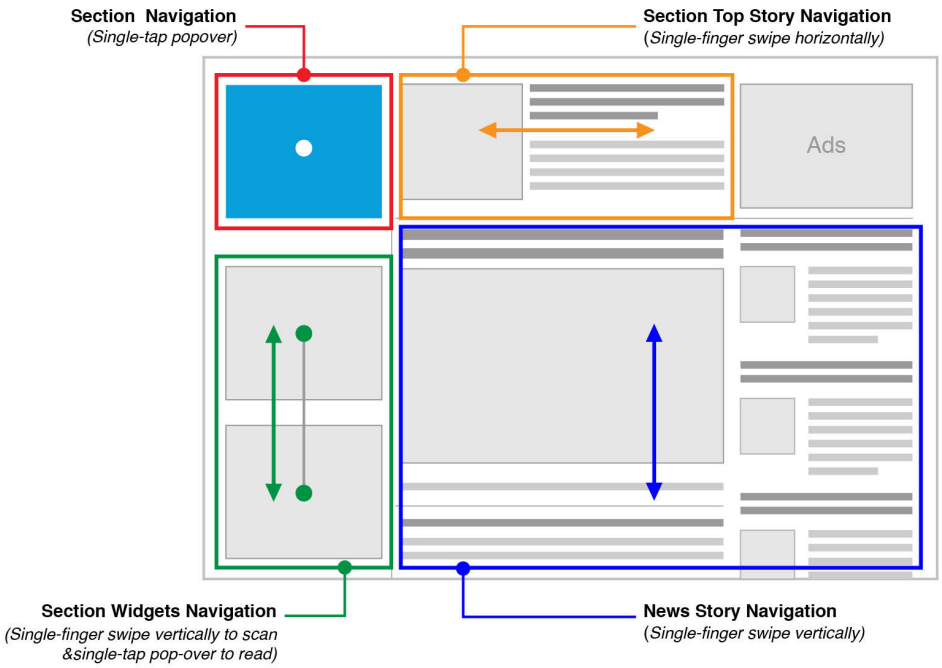


Figure 35. Homepage interface designs of USA Today iPad app

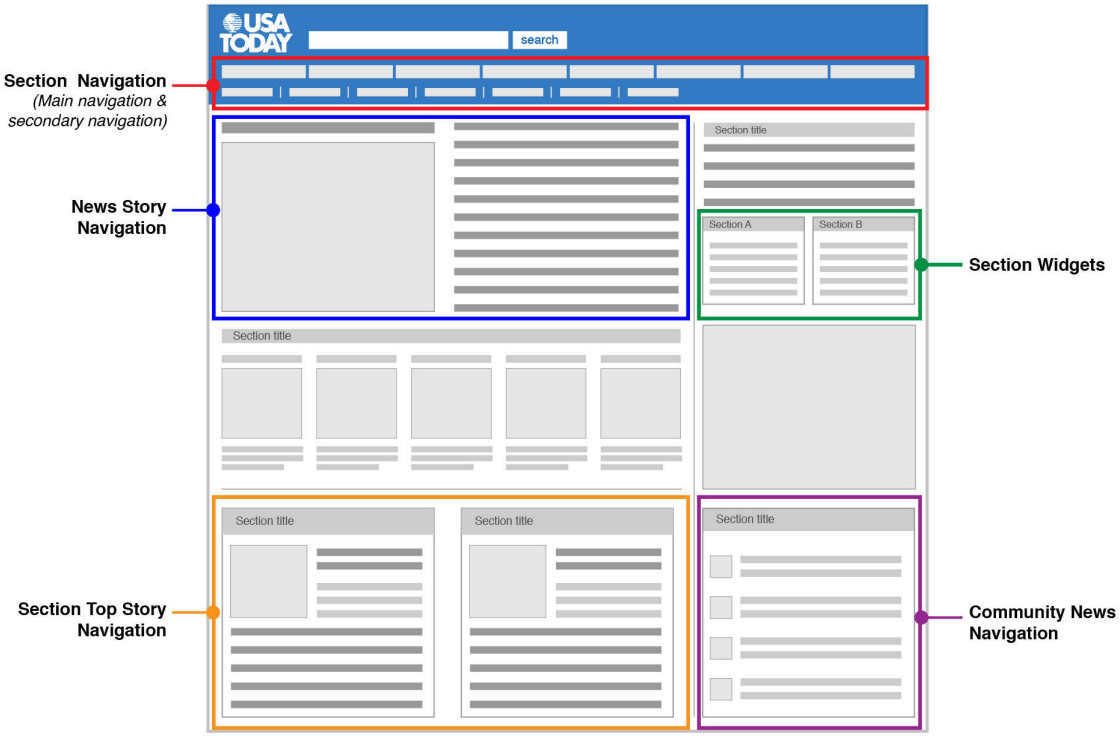


Figure 36. Homepage interface designs of USA Today website

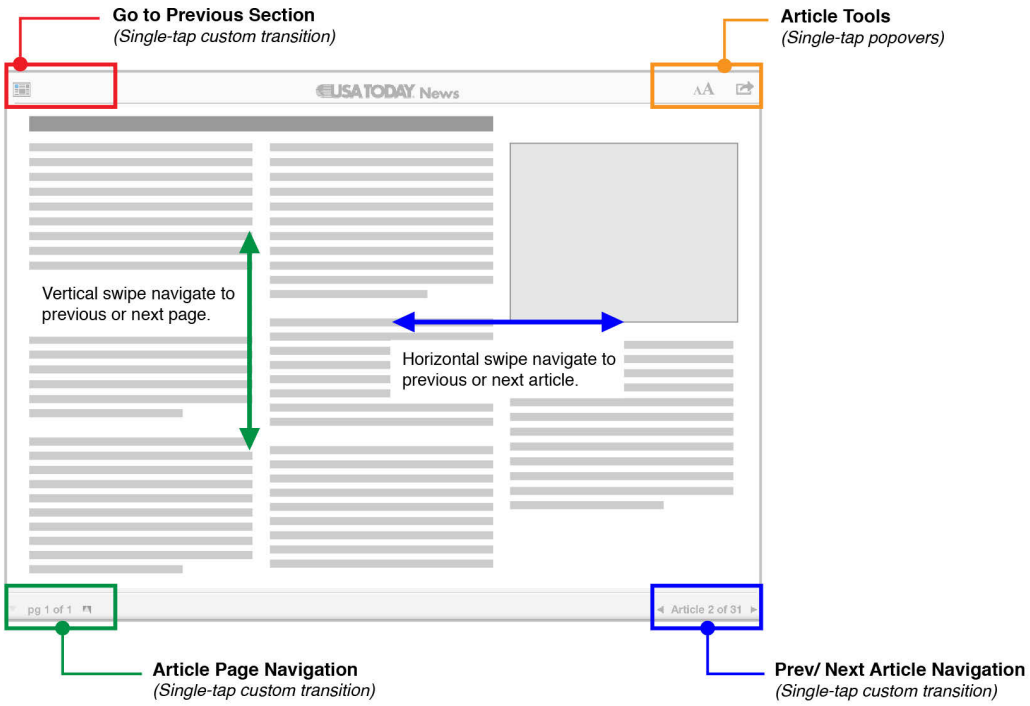


Figure 37. Story page interface designs of USA Today iPad app

Figure 38. Story page interface designs of USA Today website

In general, the interface of the design of the USA Today iPad app is based on various functional areas. The main navigation that leads users to different sections is presented as a logo at the top-left corner on the screen. When users click the logo, a horizontal bar with icons of each section will pop up to show readers all section names (Figure 39). Each section is identified by a specific color, and the logo is always located in the same place to maintain consistency on each page. By contrast, the website uses a basic web design structure, which aligns the navigation bar at the top of the page. The interface of the website preserves the top navigation bar on every page to link to different sections. The same location helps users navigate easily when visiting several pages.

Figure 39. USA Today iPad app section navigation

Similar to the differences of interface design between the New York Times app and website, the USA Today app interface also focuses on filtering information and establishing a positive reading experience for users while the website concentrates on organizing large quantities of information and assisting users to maximize their reading efficiency on the screen. The two different approaches are especially obvious when considering the story page design. For the iPad app, readers will always be presented a single article on the screen and the swiping gesture will be the primary interaction during the reading process (Figure 35, 36). In comparison, the information on the story page of a website includes article content, related topic news, recommended news, and reader comments. The essential interaction of a website on an iPad is the same as a website on a computer. However, the movement of fingers on the iPad screen replaces the action of operating a mouse with a computer.

User Customization

The USA Today newspaper iPad app also enables users to customize the newspaper to meet their personal requirements. On the story page of the app, an article tool at the top right corner enables readers to adjust font size and share information easily (Figure 40). In comparison, the website offers an embedded "share" function in article content. By moving fingers in the opposite direction, users are able to zoom in or zoom out of the web page on the screen. Compared to the website, the iPad app better

separates other tasks from the reading process and provides users with clear visual cues to customize their newspaper and reading experience.

Figure 40. Customizable function of USA Today iPad app

Summary

In summary, the differences between the USA Today iPad app and website are similar to the differences of the New York Times iPad app and website; the overall designs are influenced by the feature of the iPad device. The iPad app emphasizes the reading experience of the news articles, but the website stresses the interconnections between readers and information, as well as readers and readers. In order to achieve the goal of each platform, the app design minimizes the visual elements to reduce the visual distraction during the reading process. Alternatively, the website take advantages of typographic rules to organize information and establish an information net based on the associations of various information. Table 21 illustrates these differences in detail.

Table 21. Comparison of USA Today iPad app & website design

		App	Website
Layout	*Column*	Landscape View: 4-column (homepage) 3-column (story page) Portrait View: 3-column (homepage) 2-column (story page)	3-column, flexible grid structure
	Branding	Emphasis on the large logo	Small logo/background color
	Hierarchy	Type size & weight contrast Photo size contrast	Type size & weight contrast Photo size contrast Background color
	Layout Structure	Linear visual flow	Non-linear visual flow
Content	*Information Display*	Limited amount of information Single article display without other visual distraction (magazine-like display)	Large quantity of information News article accompanied by related links
	Advertisement	Limited amount of ads on the homepage, or poster format ads displayed on the whole page	Several ads are displayed on the same page as articles
	Contents	Only article content on the story page	Article content, related news, and readers' comments on the story page
Navigation	*Display*	Pop-up menu	Navigation bar
	Information Presentation	Pop-up menu/window	Link to another page
Interaction	*Behavior*	Swipe/tap	Tap
	Search	No search function	Search box at the top of the page
Customization	*Function*	Adjust type size, share information	Zoom in & zoom out whole page, Share information

4.3 Huffington Post

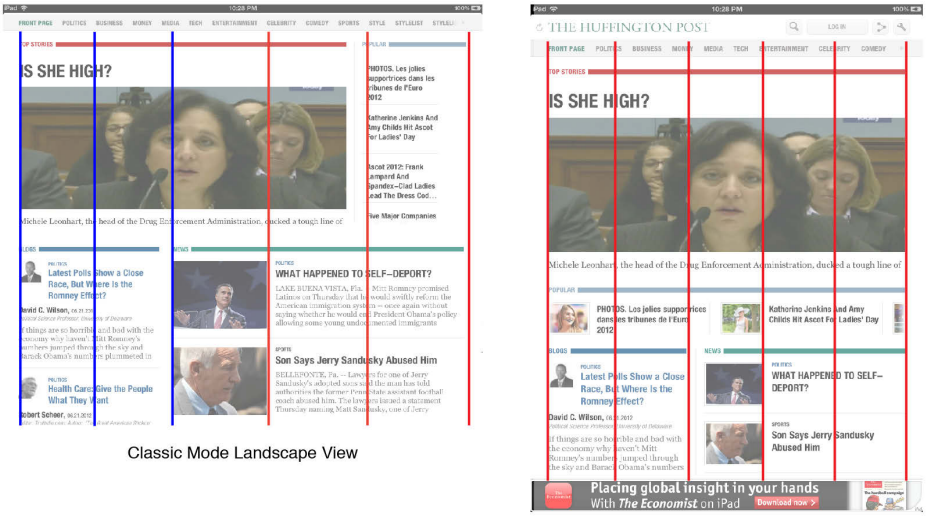
As two classical newspapers, the New York Times and USA Today concentrate on integrating users' interaction experience into news communication process. Therefore, the iPad app design of these two newspapers creates a balance between the traditional printed newspaper layout and a new interactive reading experience. But unlike the New York Times and USA Today, the Huffington Post features a more experimental approach through its iPad app design. The Huffington Post iPad app takes advantage of interactive features of electronic newspaper. The innovative page layout and interface design create a new reading experience to users. However, this innovative design also challenges the conventional news reading habits of readers.

Homepage Layout

In order to fit various needs of different readers, the Huffington Post app creates two modes to display news on the homepage: Classic mode and NewsGlide mode. The Classic mode follows the conventional page layout design format that divides the page into several columns to display news information. Basically, the Classic mode uses a five-column grid structure for both landscape view and portrait view. Additionally, the column width of the landscape view is adjusted to fit the specific content layout. The news stories are organized as "blogs" and "news". The "blog" section is displayed in two narrow columns, and the "news" section is presented in three wider columns. Compared to the landscape view, the portrait view of the Classic mode divides the page into five columns with equal width. However, the "popular news" section under the large-sized photo is placed horizontally across the page. As users can swipe horizontally to scan the news of this section, it does not follow the grid structure of the whole page (Figure 41).

By contrast, the NewsGlide mode creates an innovative way to display the information (Figure 42). The whole page is divided into a navigation area on the left side and news list area on the right side. The navigation area is presented as a narrow column that takes about one-sixth of the width of landscape view, and one-fifth of the width of portrait view. Instead of displaying news lists in columns, the NewsGlide mode uses horizontal-orientated structure to organize the news of different sections. In general, the news stories of each category are presented as a series of slides next to each other in a

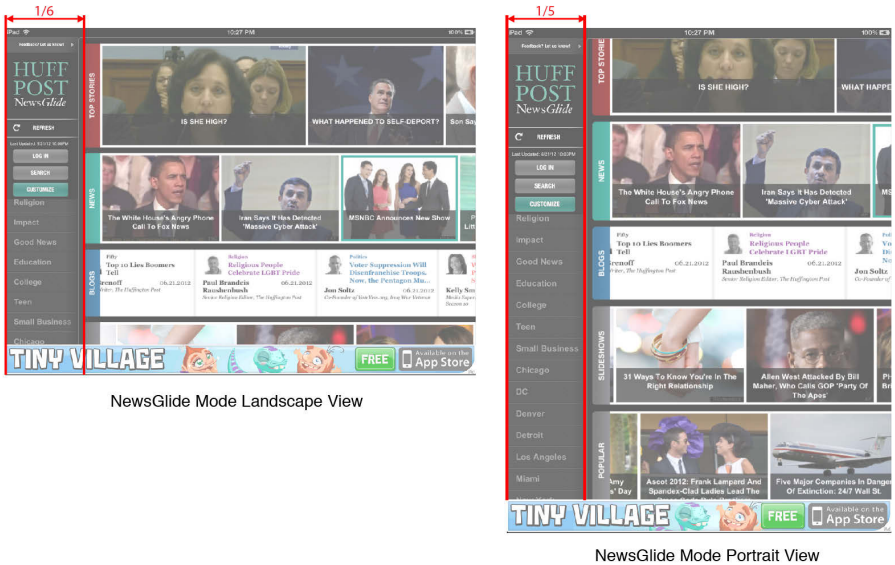
horizontal bar. Each news story is displayed with a photo and title, which takes about one-third the width of the news story list space. However, as users can swipe each news list bar horizontally, the width of each news module on the news list bar is flexible rather than fixed. The visual presentation of the NewsGlide mode is more dynamic than the Classic mode.



Classic Mode Landscape View

Classic Mode Portrait View

Figure 41. Homepage design of Huffington Post iPad app (Classic Mode)

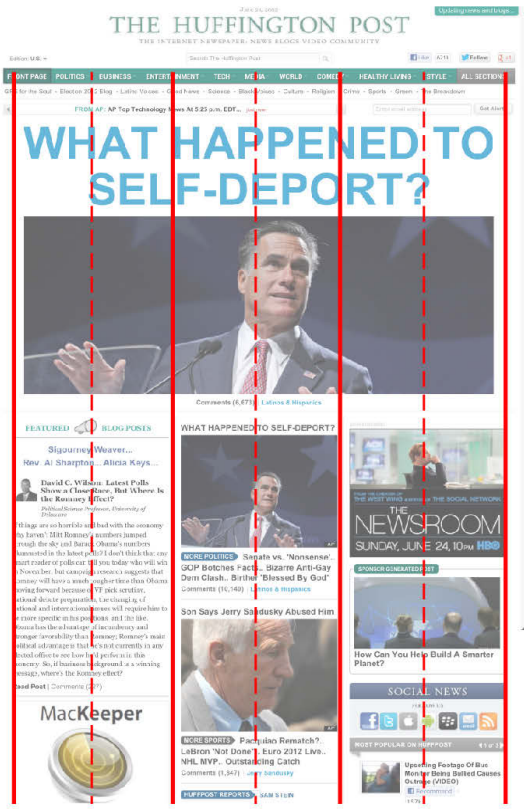


NewsGlide Mode Landscape View

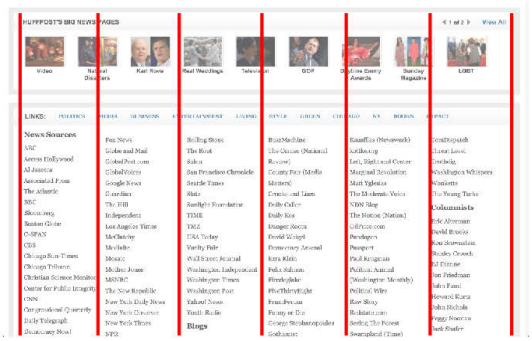
NewsGlide Mode Portrait View

Figure 42. Homepage design of Huffington Post iPad app (NewsGlide Mode)

Compared to the iPad app and website used by the New York Times and USA Today, the Huffington Post website has a simpler structure. The overall page uses a six-column grid structure to organize news content. The large-sized photo on the top of the page occupied the six columns to draw readers' attention. The news story lists of different sections are displayed in a three-column grid structure whereas the links of other news sources at the bottom of the page are presented in six columns (Figure 43).



Top Part of the Website Homepage



Bottom Part of the Website Homepage

Figure 43. Homepage design of Huffington Post website

Content Organization & Display

The main content of the Huffington Post app is presented as four sections in the Classic mode: top stories, popular news, blog news, and top news of each section (Figure 44). The layout of various sections follows the hierarchy of the information. As the most important news, the top story is emphasized by a large-sized photo and bold title with all capital letters. The popular news section placed next to the photo can be noticed easily

after scanning the top story. The top stories of blog news and sections are presented as lists of titles and article summaries. The various type sizes and colors differentiate section titles, article titles, and news summaries. However, because each news item on the news article list occupies the same amount of space in the blog news section and top news section, the hierarchy of each news item appears equal for users.

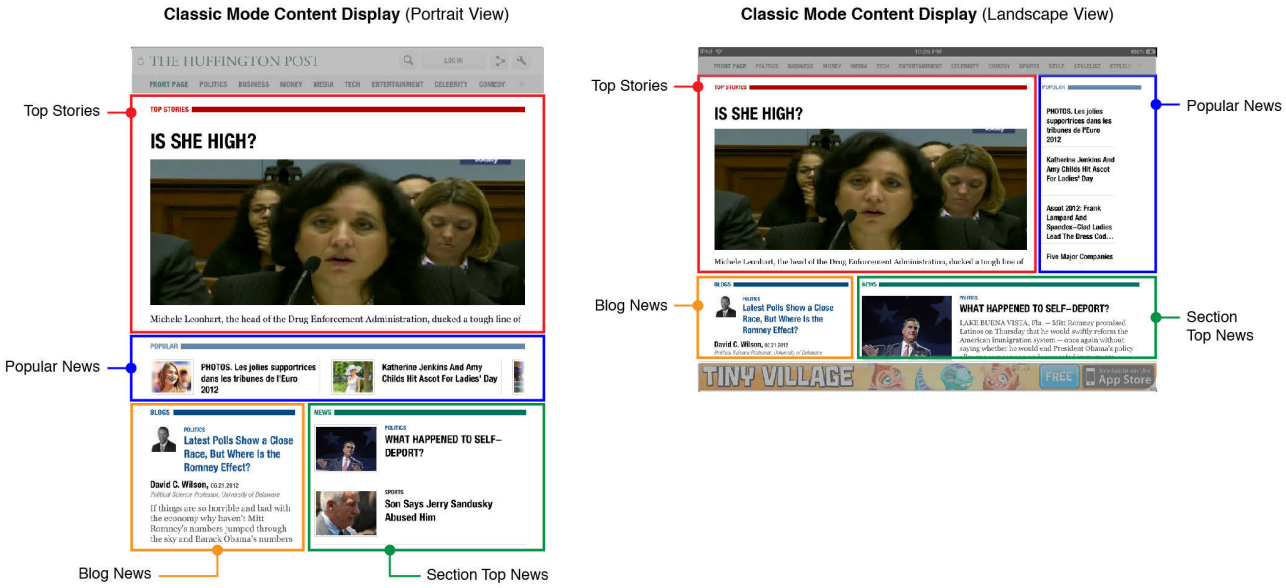


Figure 44. Content display of Huffington Post iPad app (Classic Mode)

The NewsGlide mode has five sections of the news content: in addition to the four sections of the Classic mode, it also features a "slideshows" section that uses photos to tell news stories. The five sections are displayed as horizontal bars arranged one under another on the page. The vertical oriented category titles with different color backgrounds are presented as category labels to help readers identify each section. Because of the similar height of each section bar and the same photo size of each article, there is no prominence of specific section on the page. However, the horizontal orientated design format breaks the width constraint of the page which enables users to swipe each section bar and browse more news articles than the Classic mode (Figure 45).

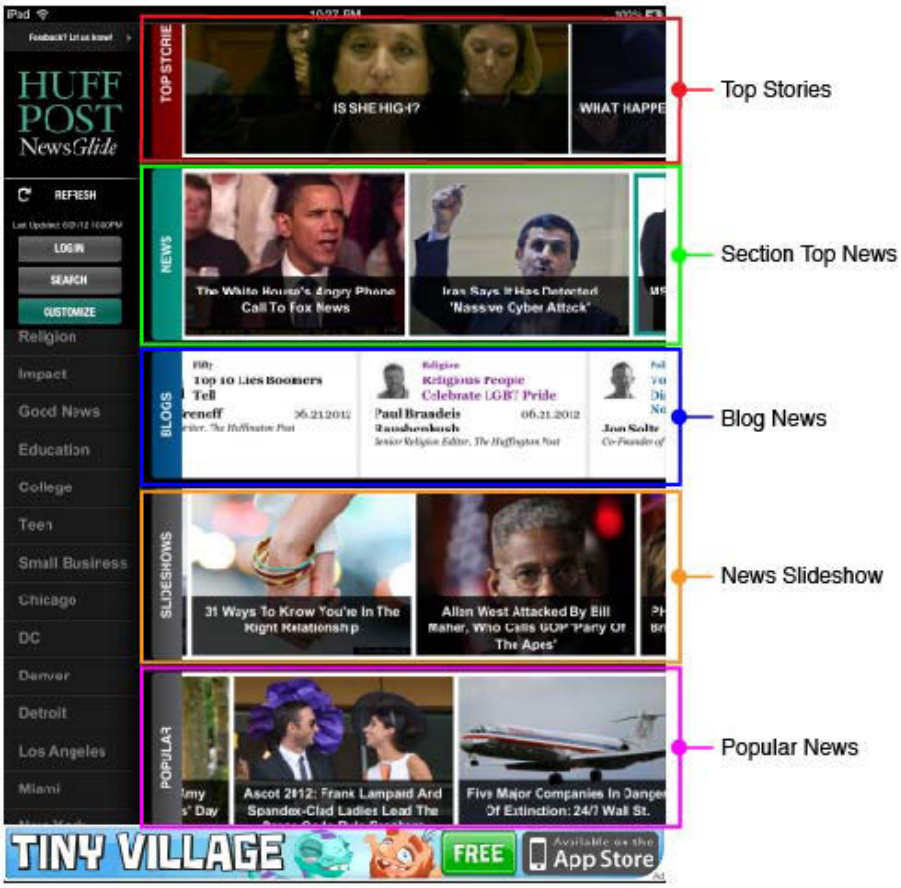


Figure 45. Content display of Huffington Post iPad app (NewsGlide Mode)

The Huffington Post website has a similar visual presentation style to the Classic mode. However, the information organization is not as clear as its app design. A large-sized photo is also displayed at the top of the page, and the main content on the website is categorized as blog news and featured news. On the iPad app, each section has a title name presented in different colors. A line that follows the title with the same color of the type separates each section and gives users a visual cue to assist them to group information in the same category. Since all the news story are listed in an equal amount of space on the webpage, and each section title is presented in front of the news title with all capital letters on a colorful background, it is difficult for users to immediately categorize the news stories that belong to the same section (Figure 46). Another distinct feature of the Huffington Post website is an added "social news" section that posts the most popular news found on various social networks. This section emphasizes the social

connection feature of electronic newspapers which enables users to participate in the news communication process.

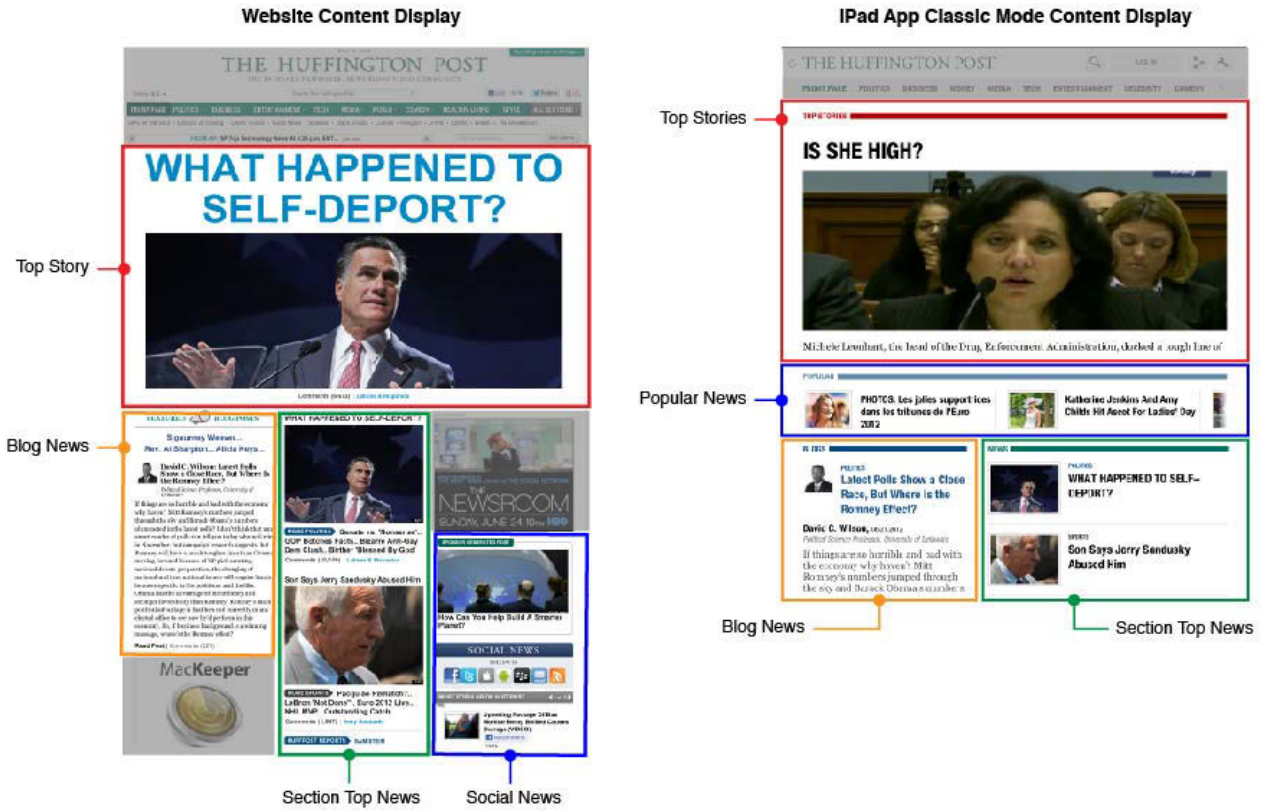


Figure 46. Content display comparison of website & app Classic mode

Story Page Layout

The Classic mode and NewsGlide mode of the Huffington Post app have different story page designs. A news story in the Classic mode is displayed in one column aligned in the center of the page. However, when a photo is embedded in the article, the area containing the photo is divided into two columns. The wide margins on both sides of the page create sufficient negative space, which assists readers to concentrate on the main content of the page (Figure 47).

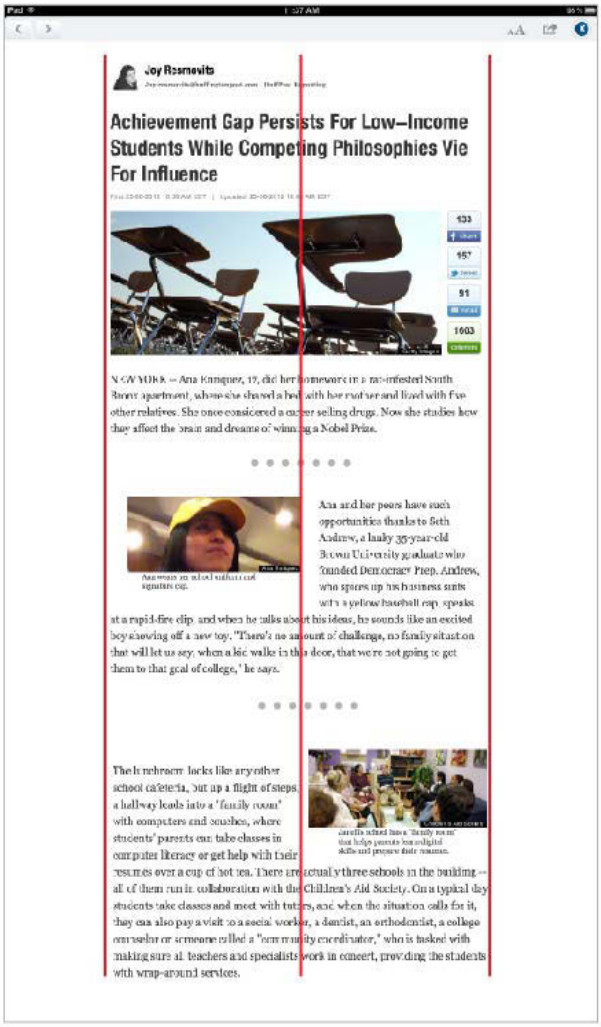


Figure 47. Story page layout of Huffington Post iPad app (Classic Mode)

The NewsGlide mode has a more innovative approach to displaying news stories. In general, the NewsGlide mode gives users more flexibility to customize news articles displayed by offering two display formats: layer display format and absolute display format. The default news story presentation format is layer display format and shows the news article as a new layer above the homepage. When a reader selects a specific news article, a page with the article content will slide from the right side of the screen, but the navigation area and news lists sremain on the page instead of being covered by the article. Users can change from layer display format to absolute display format by simply tapping the expanded icon at the top of the article. The absolute display format gets rid of all navigation elements and only presents the article content in a three-column structure

for the landscape view and two-column structure for the portrait view. This allows readers to concentrate on the news story content without any visual distraction (Figure 48).

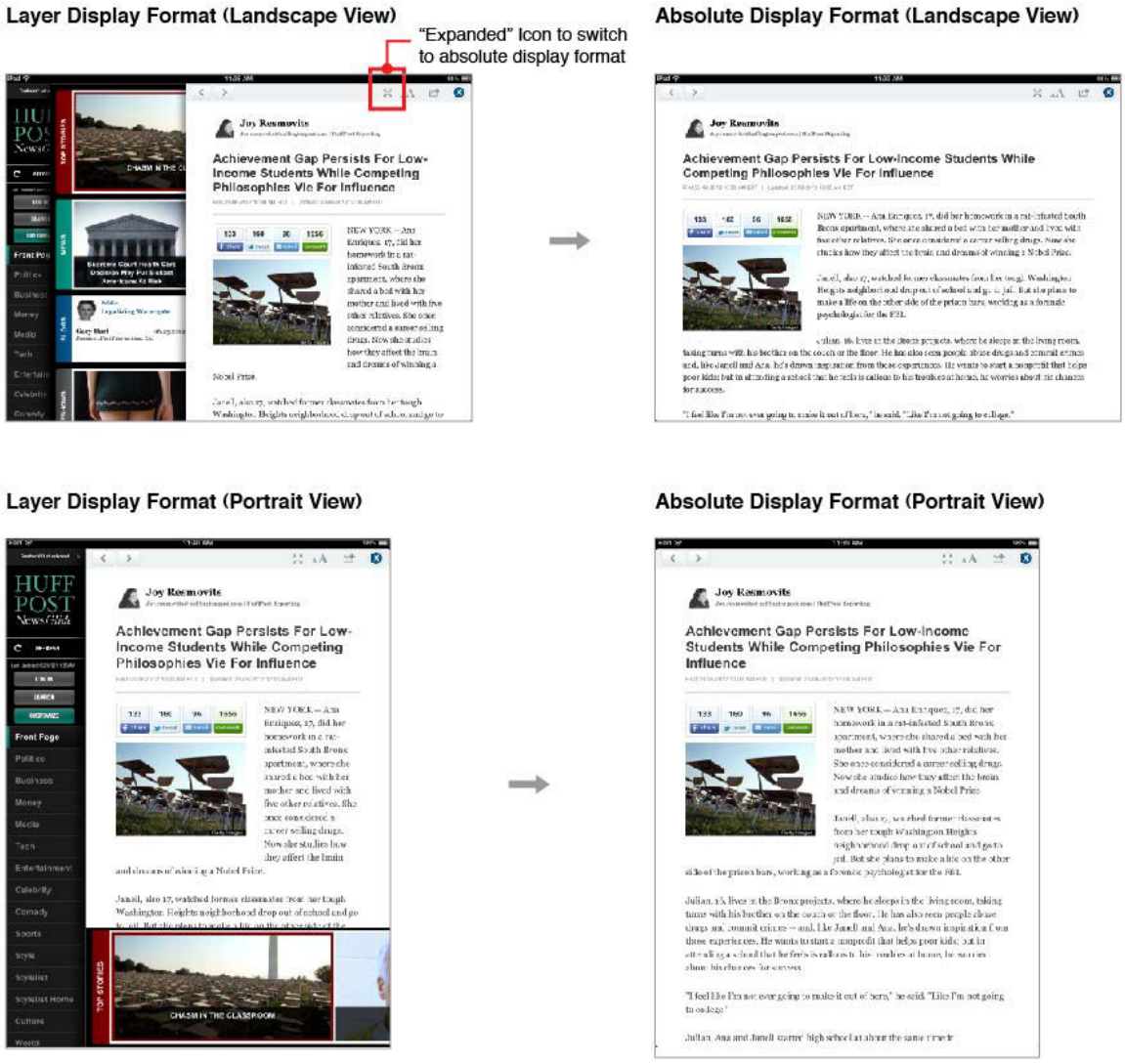


Figure 48. Story page layout of Huffington Post iPad app (NewsGlide Mode)

The story page of the Huffington Post website follows a three-column grid structure like the homepage. It combines the left two columns to present the news article content and keeps the "social news" section oin the one right column. Compared to the iPad app, the website also displays the links of section top news, related news, and

"social news" on the news story page. It provides readers with a convenient way to access other news stories without completing another search process (Figure 49).

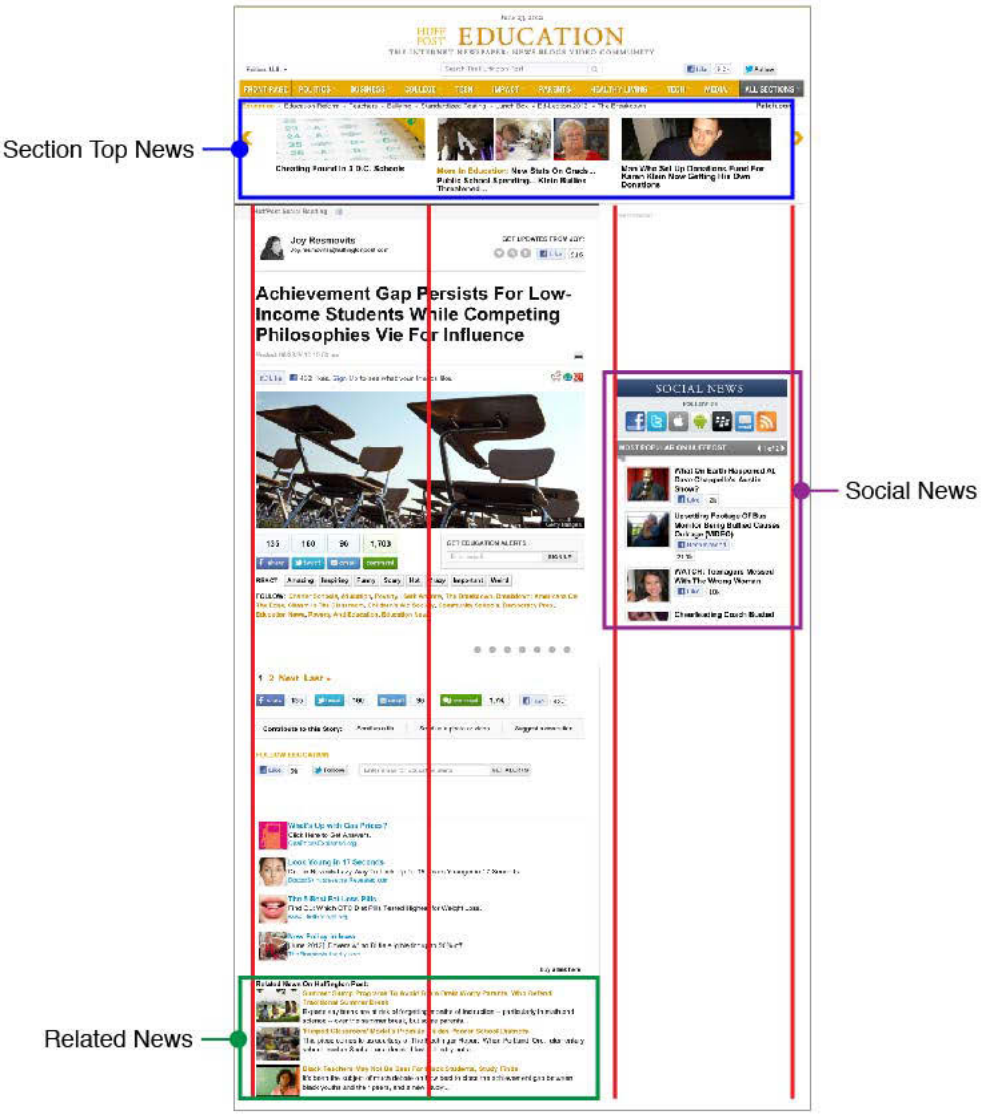


Figure 49. Story page layout of Huffington Post website

Interface Design

In general, the Huffington Post iPad app and the website have two interface design formats: the Classic mode of the iPad app and website share a similar interface that presents a navigation bar at the top of the page,; whereas the NewsGlide mode creates another structure that displays a navigation menu on the left side of the page. Compared to the apps of the New York Times and USA Today, the Huffington Post app

adopts a more website-like interface structure which reduces the number pop-up windows and keeps navigation visible at all times.

The Classic mode homepage interface designs of both apps and websites have a more intuitive approach that requires simple interactive tasks (Figure 50). Similar to interacting with a website, users can access news from a specific section by tapping the section button on the navigation bar. Then, the vertical swiping gesture enables them to scroll the page to scan a news list in each category. For the iPad app, the popular news list is presented as a separate section that can be scanned by swiping the section area vertically. The news title listed on the page will navigate users to the content of a specific news story. The interface of a website news story page is similar to its homepage. In order to maintain consistency, the website story page keeps the navigation bar at the same position as the homepage. The overall story page is also scrolled by a vertical swiping gesture (Figure 51). In comparison, the news story page interface of the iPad app minimizes the navigation to two buttons at the top of the page to lead readers to the next article or return back to the section homepage. The article tools that enable users to adjust font size and share news stories are also placed at the top right corner of the screen (Figure 52).

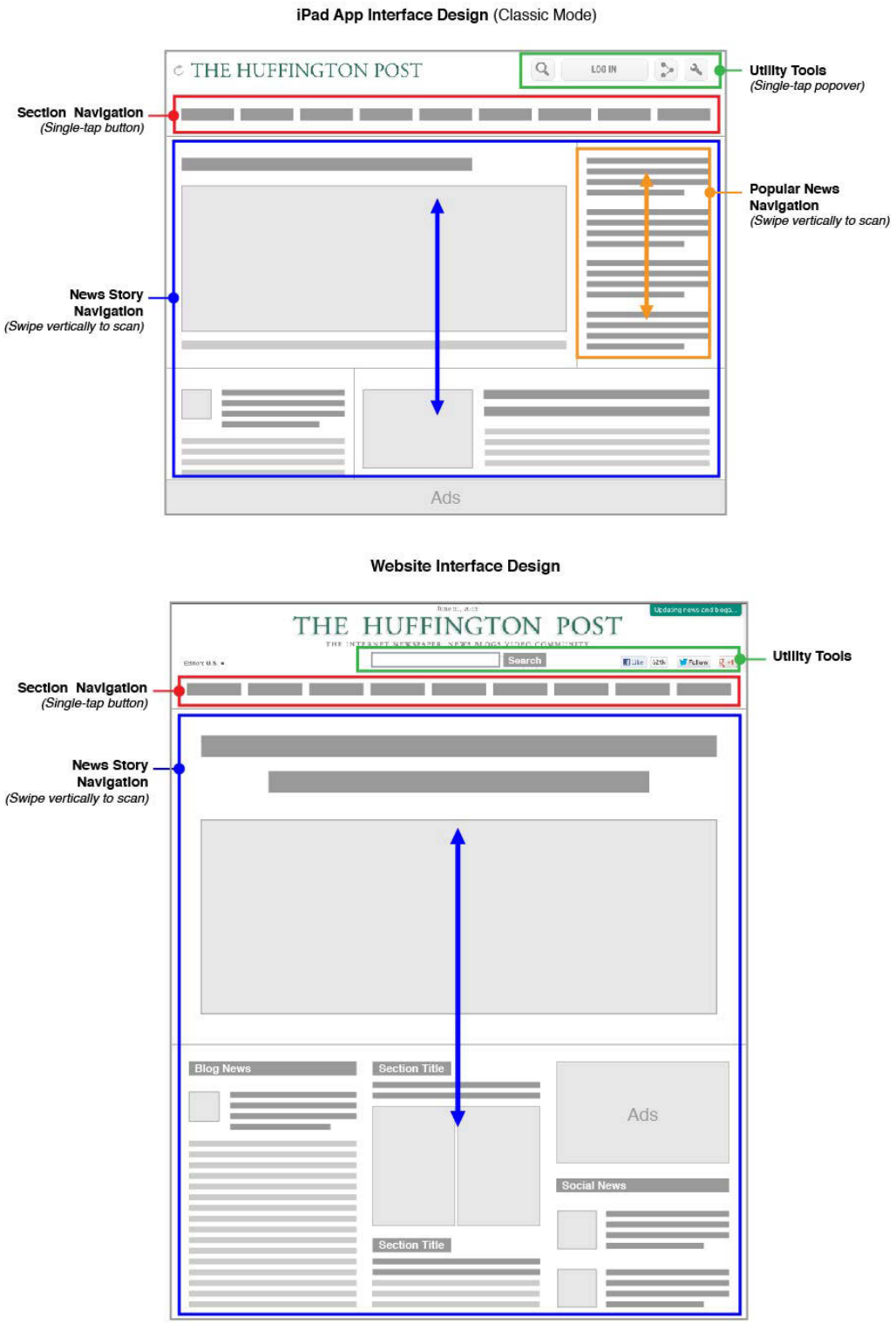


Figure 50. Comparison of homepage interface designs of Huffington Post iPad app Classic mode and website

Figure 51. Huffington Post iPad app story page interface design (Classic mode)

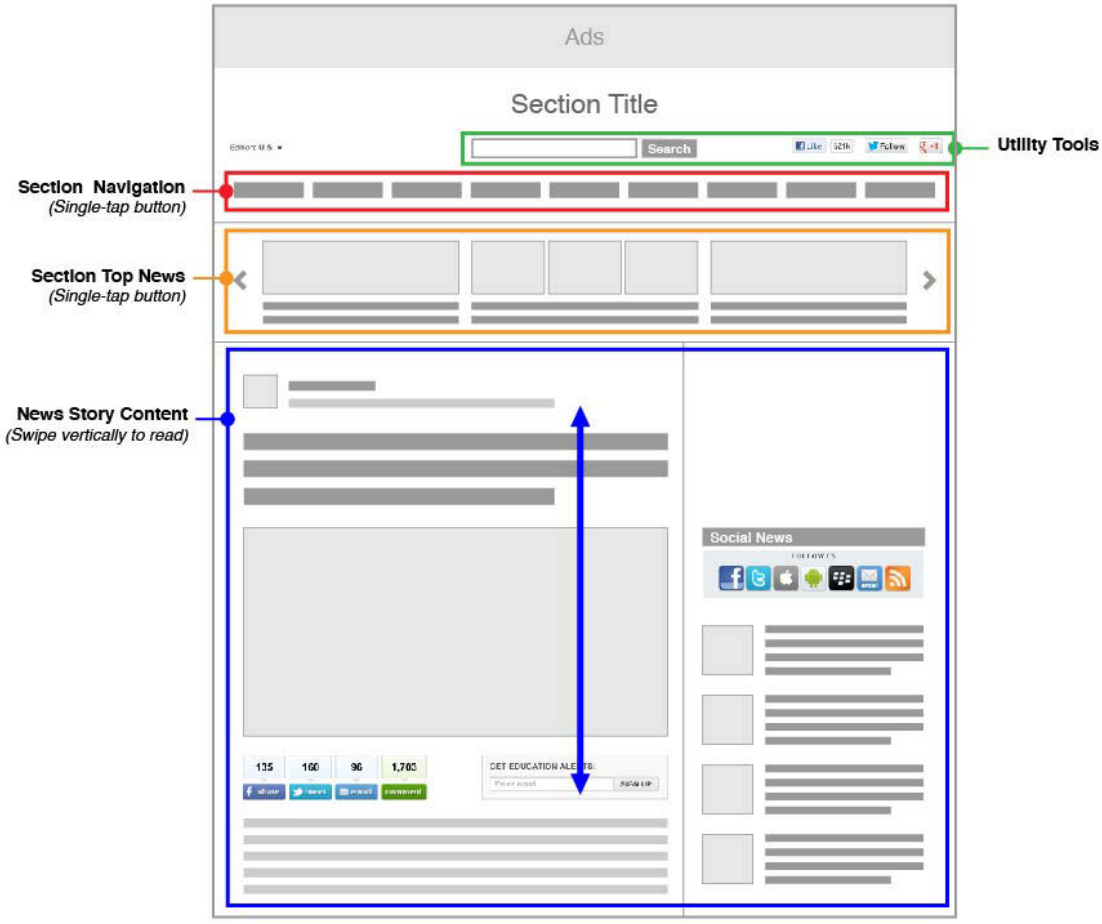


Figure 52. Huffington Post website story page interface design

The interface design of the NewsGlide mode of an iPad app creates an innovative interaction experience for users. The NewsGlide mode separates the navigation area from the main content on the homepage. By presenting the section navigation as a vertical menu on the left side of the page, users can swipe vertically to browse different section names and tap a certain section label to access news of a specific topic. Instead of using a vertical swiping gesture to scroll the page to scan news lists, the horizontal orientated section bars simulate a slideshow presentation format that enables users to swipe horizontally to scan the featured news of each section (Figure 53).

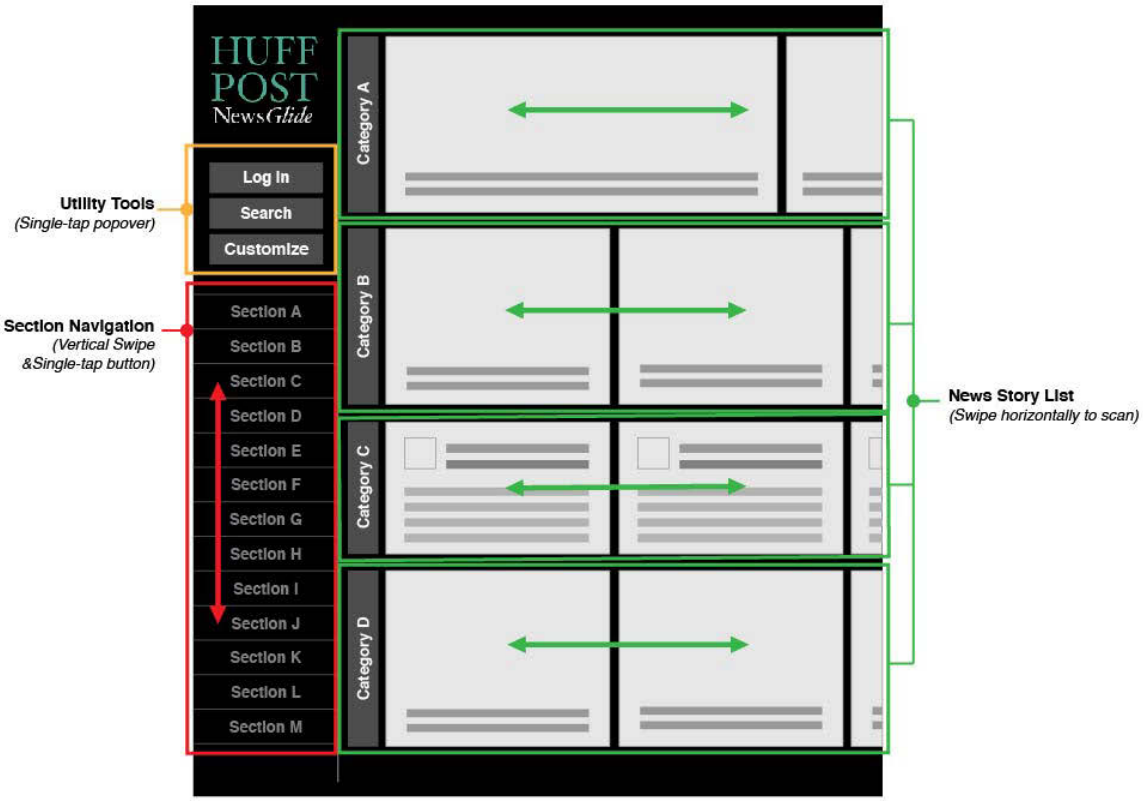


Figure 53. Huffington Post iPad app homepage interface design (NewsGlide mode)

The previous section has analyzed the story page layout design of the NewsGlide mode. The interface of NewsGlide mode story page is designed based on its typographic structure. By tapping the title of a certain news story, users can access news content displayed as a separate layer that overlap a part of the homepage. Readers can also swipe the news story layer vertically to scroll the page to read the full content of the story. On the story layer, all navigation buttons and utility tools are presented on the top layer. The

"previous" and "next" buttons will navigate readers to the next article or return back to the homepage. In addition, the article tools located at the top right corner of the story layer also provide the flexibility to adjust font size, share article information, and change the news story display format to meet their personal needs (Figure 54).

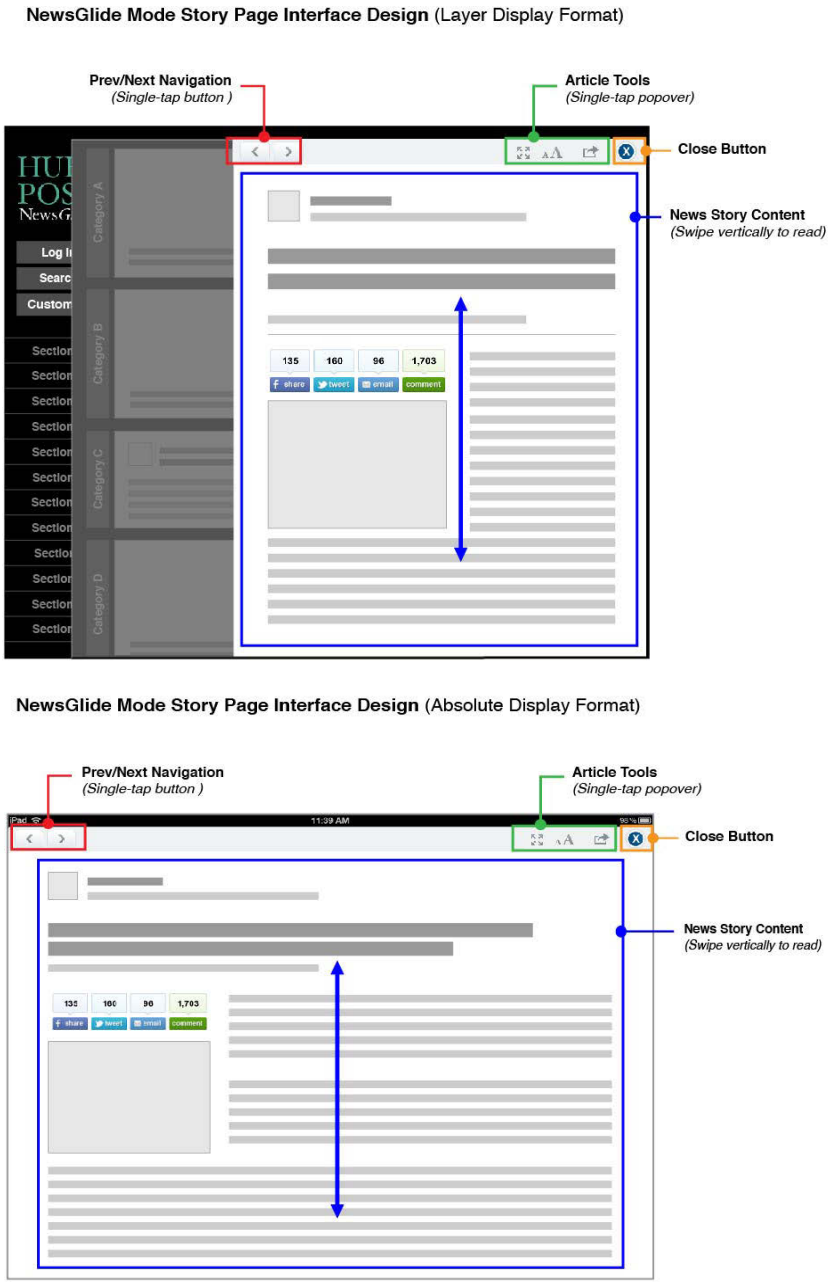


Figure 54. Huffington Post iPad app story page interface design (NewsGlide mode)

User Customization

Compared to the iPad apps of the New York Times and USA Today, the Huffington Post app provides more customizable functions to users. In addition to setting up a personal account, adjusting font size, and sharing news articles through social networks, a distinct customizable feature offered by the Huffington Post app enables users to customize the design of their newspapers. The Huffington iPad app designs page layouts and interfaces in various formats (Figure 55). By tapping the "customize" button, the setting panel will pop up. Users can then choose news edition, display mode, color theme, and font size based on their needs. It also provides users with two different formats to display news story articles. The diversity of designs meets users' different demands and preferences, emphasizing the role of users in the interaction process.

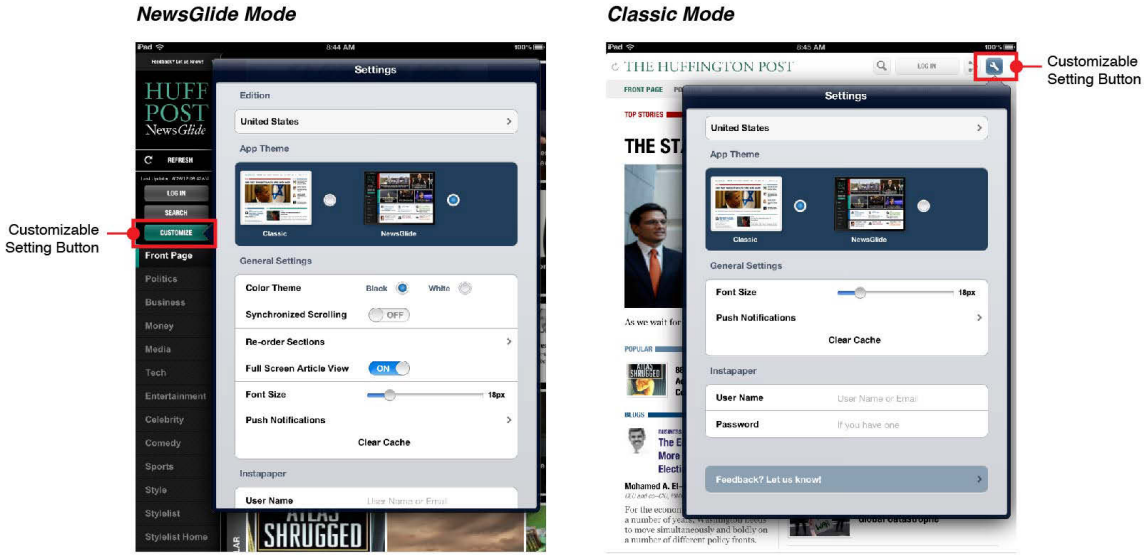


Figure 55. Customizable functions of the Huffington Post iPad application

Summary

In summary, the differences between the Huffington Post iPad app and website is now as distinct as the USA Today and New York Times iPad apps and websites. The overall design refers to the advantages of website usability and interface design which takes into account the general behaviors of how users interact with electronic media. The Classic mode of the Huffington Post app and website have similar visual presentation

styles of the homepage layout design. The large-sized photo, contrast of type size, and weight of news titles are used to establish visual hierarchy to differentiate the importance of each news story. The five-column or six-colum grid structures of the Classic mode used in both the app and website create a clear organization of the main content on the homepage. The story page designs of the Classic mode in both the app and website also use simple layout structures and simple navigation methods to assist users to concentrate on the reading process.

By contrast, the NewsGlide mode of the iPad app creates a more innovative design to present information and navigate users. Instead of displaying content vertically in several columns, the NewsGlide mode adopts a horizontal oriented layout that enables users to scan the information in a film slide format. The news story is also presented which keeps all navigation elements visible on one page. Even though the new interface design challenges the conventional interaction experience of users, the clear visual cues help create a more user-friendly interface. Moreover, the customizable functions of the iPad app also meet the diverse needs of different users which make the newspaper a personal information resource for users. In Table 22, a detailed comparison study of the Huffington Post iPad app design and website design is presented.

Table 22. Comparison of Huffington Post iPad app & website design

<table>
<tr><th></th><th></th><th>App</th><th>Website</th></tr>
<tr><td rowspan="5">Layout</td><td rowspan="2">Column</td><td>Classic Mode: 5-column (homepage)
2-column (story page)</td><td rowspan="2">6-column</td></tr>
<tr><td>NewsGlide Mode:
Flexible grid structure</td></tr>
<tr><td>Branding</td><td>Huffington Post logo</td><td>Huffington Post logo</td></tr>
<tr><td rowspan="2">Hierarchy</td><td>Classic Mode:
• Type size & weight contrast
• Photo size contrast
• Type color</td><td rowspan="2">• Type size & weight contrast
• Photo size contrast
• Type color</td></tr>
<tr><td>NewsGlide Mode:
Text color background</td></tr>
<tr><td>Layout Structure</td><td>Classic Mode:
Vertical visual flow</td><td>Vertical visual flow</td></tr>
</table>

<table>
<tr><td></td><td></td><td>NewsGlide Mode:
Horizontal visual flow</td><td></td></tr>
<tr><td rowspan="4">Content</td><td rowspan="2">Information Display</td><td>Classic Mode:
Moderate amount of information
Single article display without other visual distraction on the story page (magazine-like display)</td><td rowspan="2">Moderate amount of information
News story content & other news links are displayed on the story page</td></tr>
<tr><td>NewsGlide Mode:
Moderate amount of information
News article is displayed either on another layer above the homepage, or on a separate story page without other visual distractions</td></tr>
<tr><td>Advertisement</td><td>• One advertisement located at the bottom of the homepage</td><td>Limited amount of ads on the homepage & story page</td></tr>
<tr><td>Contents</td><td>Classic Mode:
• News story list on the homepage
• News story content & readers’ comments on the story page
NewsGlide Mode:
• News story listed on the homepage
• News story content & readers’ comments overlaps the news list for layer display format
• News story content & readers’ comments for the absolute display format</td><td>• News story list on the homepage
• News story content, readers’ comments and other news links (section featured news, related news & social news) are on the story page</td></tr>
<tr><td rowspan="2">Navigation</td><td>Display</td><td>Classic Mode:
Navigation bar
NewsGlide Mode:
Navigation menu</td><td>Navigation bar</td></tr>
<tr><td>Information Presentation</td><td>Links to other pages</td><td>Links to other pages</td></tr>
<tr><td rowspan="2">Interaction</td><td>Behavior</td><td>Swipe/tap</td><td>Tap</td></tr>
<tr><td>Search</td><td>Pop-up panel with search box</td><td>Search box at the top of the page</td></tr>
<tr><td>Customization</td><td>Function</td><td>Adjust type size, share information,</td><td>Zoom in & zoom out whole page, Share information</td></tr>
</table>

4.4 Comparison Study of the Three E-newspaper iPad Application Designs

Design case studies show that e-newspaper website designs follow the general design principles of websites; therefore, the websites of different newspapers share similar characteristics of visual presentation and interface designs. However, the e-newspaper iPad application designs emphasize the unique features of each brand, which highly associate with the conventional design style of its printed format newspaper.

4.4.1 Design Comparison

Visual Presentation Styles of the Three E-newspaper iPad Applications

The influence on newspaper design traditions of a certain brand's iPad application visual presentation can be discovered through three examples. Because the New York Times and USA Today are two classic newspapers that have a long history of producing printed newspapers, their iPad application designs of are also consistent with each printed newspaper design style. In contrast, the Huffington Post originated as a news website, so it applies website design style to its iPad application design (Figure 56).

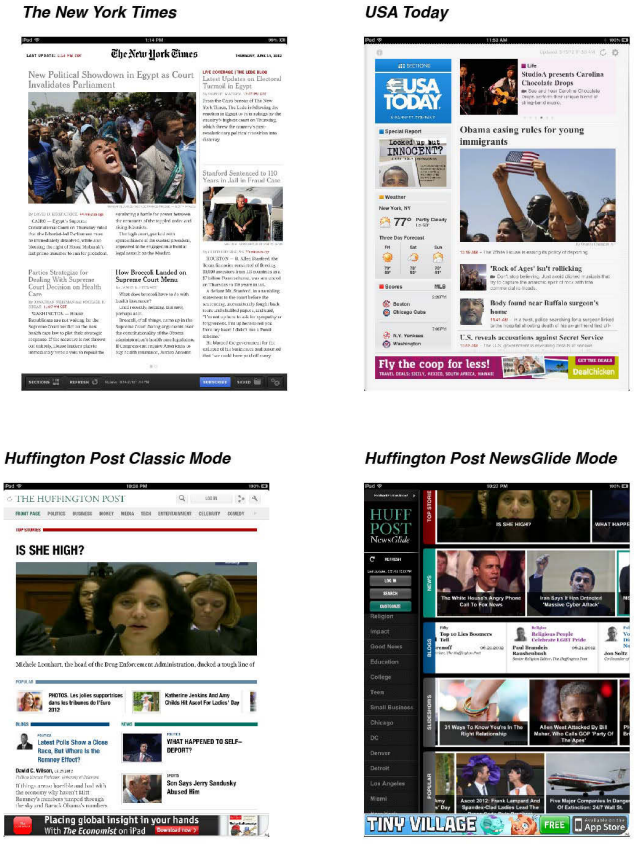


Figure 56. Visual presentation styles of three e-newspaper iPad applications

The New York Times application has a strict grid structure that creates visual order of information. The text dominant page layout and black and white color scheme simulate the printed newspaper visual design styles. The USA Today has a similar design approach to the New York Times. By applying a clear grid system to organize information, the overall typographic structure creates a fluent visual flow for readers. Compared to the printed newspaper design styles of the New York Times and USA Today applications, the website design structure used by Huffington Post creates a different visual appearance for the application.

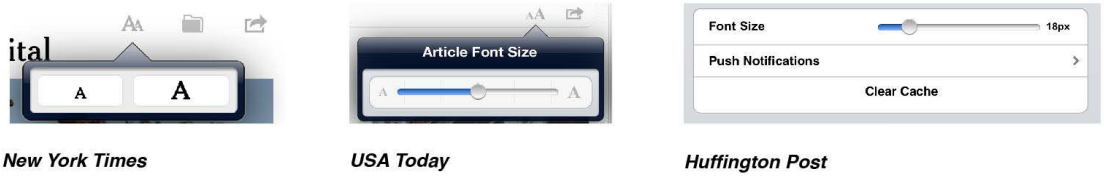
Usability of the Three E-newspaper iPad Applications

Visual presentation styles also affect the usability of different e-newspaper applications. The New York Times and USA Today applications have newspaper-like appearances. Therefore, the applications emphasize the page typographic design and limit the display space for navigation and interaction. For these two e-newspaper applications, navigation and interaction elements are hidden from the screen. Users need to tap small functional buttons to access the pop-up menu or setting panels. On one hand, this design method creates an interaction area so that reading activities and interaction activities are conducted as two separate processes. On the other hand, the interaction buttons are usually identified by icons which makes recognition difficult for users who are unfamiliar with the applications. The website-like design of the Huffington Post application makes all the navigations and interactions consistent and visible, enabling users to find these elements easily. However, the navigation bar or menu reduces the content display space on the screen. Therefore, presenting information on different layers becomes one of the solutions for this problem.

Customizable Functions of Three E-newspaper iPad Applications

The feature of customization is one of the significant advantages of e-newspaper iPad applications. The three e-newspaper applications have different customizable functions to meet the diverse needs of readers. In general, changing display orientations and adjusting display font size are two common customizable functions for the three e-newspaper applications. The font size adjusting function is designed in two formats. The

Huffington Post and the USA Today applications allow users to slide the font size adjusting button to set the font at any size. Alternatively, the New York Times application presents zoom in and zoom out buttons on the font size setting panel, which requires multiple tapping to change a font to a different size. Therefore, the Huffington Post and USA Today e-newspapers provide users more flexibility to adjust the font size (Figure 57).



New York Times *USA Today* *Huffington Post*

Figure 57. Font size adjusting functions of the three e-newspaper iPad applications

4.4.2 Personal Evaluation of Three E-newspaper Designs on iPad

According to Krug's (2006) research about website usability and Li's (2006) analysis of information retrieval efficiency, this author developed a design analysis matrix to evaluate the overall design of the three newspaper iPad application designs (Appendix C). Based on this author's personal observation, the research results are reported in Table 23.

Table 23. Overall design comparison or the three iPad newspaper apps

	Items	New York Times	USA Today	Huffington Post	
Visual Presentation	Presentation style	Text-dominant	Balanced	*Classic mode:*	Balanced
				NewsGlide mode:	Graphic-dominant
	Clarity of navigation	Somewhat clear– The navigation is hidden on the story page screen	Not clear– The main navigation is hard to identify; The buttons are not clearly labeled	Clear	
Information Structure	Content sections on the homepage	1 section	3 sections	*Classic mode:*	4 sections
				NewsGlide mode:	5 sections
	Number of news articles listed on the first homepage screen	4 news articles	30 news articles	*Classic mode:*	60 news articles
				NewsGlide mode:	100 news articles

Information Accessing Immediacy	Number of steps to access news article content	1~2 steps	2~3 steps	2 steps
News Flow	Navigation flow	Smooth	Not smooth– Users need to look for the navigation or spend time to identify the meaning of the icons on each button	Smooth
	Information loading time	Fast	Fast	Fast

4.5 Findings

4.5.1 Differences Between E-newspaper iPad App Design & Website Design

The three comparison case studies of the New York Times iPad app, USA Today app, and Huffington Post app have demonstrated the basic differences between e-newspaper iPad app design and website design. In general, the e-newspaper iPad apps work as a separate newspaper format that maintains the fundamental function of conventional newspapers; therefore, the overall design emphasizes creating a comfortable reading experience of digital format newspapers for readers. In comparison, the newspaper websites serve as another medium to communicate news information, so the overall design concentrates on organizing a large quantity of information and facilitating readers to acquire information more efficiently. Due to various design purposes, the e-newspaper iPad apps and websites use different methods to deliver news stories to readers.

Typographic Structure Differences

Because the e-newspaper iPad app is designed especially for the iPad device, the overall page layout considers different display orientations. The landscape view usually has more columns than the portrait view, so the text length can be adjusted to the most suitable reading length automatically in different orientated views. However, since the website is designed for various display platforms (such as computers and cell phones), it has the same structure for both landscape view and portrait view. The disadvantage of displaying information in the same structure for different visual orientations is the portrait

view will reduce type size on a page while the landscape view requires more scrolls to scan the whole page.

Another typographic structure difference between e-newspaper apps and websites is the iPad app uses a consistent grid structure to create a clear visual flow for the overall page, but the website has a more flexible grid structure that organizes various information on the page. Samara (2002) states creating grid systems can help establish visual order on the page, but deconstructing grids can meet specific visual communication purposes of design. The website uses a grid system to build the basic structure of the page, but it also adjusts or breaks the grid in some areas to fit the presentation requirement of certain content.

Page Content Differences

The various design purposes of e-newspaper iPad applications and websites are also reflected in how they display news articles to readers. As e-newspaper iPad applications emphasize the reading experience, it only presents news story articles on the story page and minimizes interactive elements such as a navigation menu and customizable tools on the story page. This allows users to concentrate on story content without other visual distractions. On the contrary, a website usually displays a news article with related news and recommended news links on the story page. Therefore, users are able to access related news about the topics they are interested in more conveniently. News websites also have a readers' comment section where users can share and exchange opinions with other readers. For the iPad applications, only the Huffington Post application includes a comment section on its story page. Furthermore, e-newspaper websites also display more advertisements on both the homepage and story pages than the iPad applications.

Navigation Differences

The e-newspaper iPad applications concentrate on displaying news content, so they limit space for necessary navigation elements and interaction elements on the screen. Navigation is usually presented as a small button with text label or icon, and the navigation menu only appears when tapping the button. However, websites present

navigation as navigation bars across the top of the page, and they keep the navigation elements consistent and visible on different web pages. Moreover, because websites need to display tremendous amounts of information, they usually enable users to search a specific topic within the site. The Huffington Post application provides this search function to users, but the other two newspaper applications do not.

Interaction Differences

The touch screen of the iPad device requires users to control an interface through various gestures. This feature also influences how users interact with e-newspaper applications and websites on the iPad device. The main interactive behaviors include swiping and tapping, but the gestures will assume different functions on the application interface and website interface.

The e-newspaper iPad application designs page dimension to fit the screen size; therefore, the swiping gesture will help users turn pages. Furthermore, the iPad applications divide whole pages into various sections to display news stories of different topics. Users can also swipe each section on the screen to scan the information with specific topics. However, the website page is usually designed to be longer than the height of a display screen, so users need to swipe vertically to scroll and read information on the whole page. The interface of e-newspaper iPad applications presents interactive elements as buttons to assist users to control the digital format newspapers. The diverse functions can be realized by tapping a certain functional button and conducting further action to perform a specific task on the functional panel. Unlike the iPad applications, e-newspaper websites are built as information networks that connect different news via hyperlinks. Therefore, the tapping interaction with the website on an iPad device is the substitution of a mouse clicking action on a computer, which will lead users to the content of a certain link.

Users' Customization Differences

Compared to e-newspaper websites, iPad applications offer more flexibility to users when customizing a newspaper based on their personal needs. The common customizable functions include: setting up a personal account, sharing news stories

through social networks, and adjusting display font size. The New York Times app also enables users to save news articles while the Huffington Post app gives the option to select different designs. These customizable functions are distinct features of e-newspaper iPad applications designed especially for diverse users. Even though users are also able to zoom in or zoom out of web pages or bookmark a certain web page to save an article, these customizable functions rely on the feature of the iPad device and web browsers rather than the design of websites.

4.5.2 Common Features of E-newspaper iPad App Design

According to the design analysis of the New York Times iPad app, USA Today app, and Huffington Post app, the common characteristics of e-newspaper application designs can be summarized as follows:

Typographic Structure

E-newspaper iPad applications apply different grid systems for the landscape view and portrait view. A 4-column structure for the landscape view and 3-column structure for the portrait view is the common grid systems used to organize presentation of information on a homepage. For the story page, the 3-column grid for the landscape view and 2-column grid for the portrait view set appropriate line width for reading on an iPad screen.

Page Legibility

The e-newspaper application provides readers with flexibility to adjust font size. The adjustable font size range is various for different e-newspaper applications. However, based on personal observation, the font size range with the best legibility is about 13px~21px, and the default font size is usually set from16px or18px in order to achieve premiere legibility. With the font size of 16px to 18px, the column width is usually about 2.25 to 2.5 inches, which contains 6 to 8 words for each line.

Content Presentation

Although the e-newspaper iPad application has changed a printed format newspaper to a digital format newspaper on screen, there is no significant difference of the news content between these two formats. The news stories of the digital format newspaper are also categorized based on various topics, much like the different sections of the printed newspaper. The different sections of the digital format newspaper are connected by the main navigation of the application. Moreover, unlike a newspaper website that presents a lot of advertisements on the web page, the iPad applications emphasize displaying pure newspaper content and limiting the amount of advertisements.

Usability of Applications

The usability of e-newspaper applications is determined by how the application interface leads users to perform a specific task and how users interact with the interface. The main interactive tasks of reading a newspaper on an iPad device include: searching news stories of interest through navigation and browsing, reading news stories, and setting customizable functions of an e-newspaper. In general, the methods of interaction are designed with features of a touch screen in mind. Swiping on the screen to scan information or turn pages and tapping a button or a link to access additional content are basic interactive activities for using an e-newspaper application. The pop-up windows are widely used to present a navigation menu and other functional settings. It becomes a significant characteristic of e-newspaper application interface.

4.5.3 Differences of the Three E-newspaper iPad App Design

The comparison study and evaluation of the three e-newspapers–New York Times, USA Today, and Huffington Post–reveal the advantages and disadvantages of each newspaper app. The New York Times e-newspaper has a clear visual structure, and the navigation is easily identified. However, the amount of information provided on each page is limited. Users need more swipes to scan the information. The USA Today app creates a clear, page-layout structure, and provides sufficient information to readers, but the navigation of the USA Today app is hard to identify, especially for the user who is not familiar with the interface. In addition, the USA Today mixes both horizontal swipes

and vertical swipes to navigate information of different sections on the homepage. The Huffington Post app displays each section horizontally on the homepage, which enables users to swipe each section separately to scan the information. This display format allows users to scan more news information without turning pages. The navigation bar displayed on the page also makes it easier to switch between different sections.

CHAPTER 5. CONCLUSIONS

The newspaper iPad application is a newly formatted e-newspaper that integrates the features of traditional printed newspaper and a newspaper website. Therefore, the purpose of this research is exploring how to create an appropriate visual presentation and interaction of the newspaper iPad application for users. Through examining users' attitudes toward e-newspapers, analyzing existing newspaper application designs, and comparing the design of newspaper applications and websites, this study concluded several design guidelines for e-newspaper application design.

5.1 Users' Attitude Toward Digital Format Newspaper

In general, users have a positive attitude towards digital format newspapers. The online survey results show most participants prefer reading e-newspapers than printed newspapers. Using a computer to read news stories on the Internet is the most common way to access daily news for the majority of people, but conventional printed newspapers still play an essential role in people's daily life. As a result of technology innovation, the iPad has become a new mobile device to acquire information. The survey demonstrated that reading news online or through the newspaper application was one of the most important uses of this multi-functional tablet.

The survey results also indicate the preference of e-newspaper has a strong association with the user's age and professions. The users' can be divided into three age groups according to participants' familiarity with technology, choices of electronic device, and reading habits of news: Group 1 ranging 30 years and younger, Group 2 ranging from 30 to 50 years old, and Group 3 ranging 50 years and older. The participants under the age of 50 have a more positive attitude toward e-newspaper than those who are over the age of 50. However, the participants in Group 1 (ages 30 and under) read less news than the other two groups, and the main devices they use to access news are computers. The participants aged 30~50 are open to both traditional and new technologies. They read more news than the younger participants and have a more positive attitude toward e-newspaper than the older participants. Additionally, they also

use iPads to read news more than the subjects in the other two age groups. Therefore, the participants ages 30~50 years are the target users of newspaper iPad applications.

The survey also found that participants' professions are important factors that influence their preference of e-newspapers. In general, participants who work in academic environments (university students and professors) read less news than those who work in industrial environments, and university professors prefer the e-newspaper less than other professions. The participants' professions also affect their income levels. The survey results show that participants with higher income levels are more likely to purchase an iPad and read news through this device.

In this online survey participants also evaluated the characteristics of digital format newspapers. The main advantages of e-newspaper include quick content updating, searchable and customizable functions, and the feature of portability. But the feature of "unable to note", visual fatigue, and inescapable advertisements are main concerns of e-newspapers for users. Moreover, participants also mentioned the design of e-newspaper was not as sophisticated as printed newspapers, so looking for an appropriate design strategy to meet readers' needs are important for the study of e-newspaper design.

5.2 Characteristic of Newspaper iPad Application Design

Through the analysis of the New York Times, USA Today, and Huffington Post e-newspaper designs, the common features of newspaper iPad applications were discovered. The newspaper iPad application is a new form of newspaper that combines characteristics of both conventional printed newspaper and newspaper websites. The goals of newspaper application design include establishing a well-organized information visual structure and providing users with a pleasant interactive experience.

For visual presentation aspects, the newspaper iPad applications consider an alternative display orientation, so that two grid structures are applied to landscape view and portrait view to adjust the line width automatically for users. The analysis also implies that visual presentation styles of different brand newspaper applications are influenced by design styles of other newspaper formats of the same brand. Printed newspaper brands will show printed typographic style through their application designs,

and the website rooted brand will refer to the website design features of its application design.

Newspaper applications concentrate on creating a pure reading experience for readers, therefore the display space of interactive elements and advertisements on the homepage is limited, and only single news stories are presented on the story page without links of other related topic news. In accordance with this purpose, newspaper applications usually present interactive elements as small buttons, and pop-up windows are widely used to present a navigation menu and functional settings.

5.3 Comparison of Newspaper iPad Applications and Newspaper Websites

The design case study compared the differences between two formats of digital newspapers: newspaper iPad application and newspaper websites. The study indicates the two formats of e-newspapers have two different design approaches. Newspaper applications emphasize an undistracted reading experience whereas newspaper websites aim to build an information network for users. Therefore, compared to the newspaper applications, the websites provide much more information to users. As the newspaper website focuses on assisting users to acquire large quantities of information efficiently, all information and interactive functions maintain visibility on the page. Navigation bars are usually located on the top or left side of a web page, enabling users to find it easily. The search function of a website can also help users filter information according to their interests. The newspaper website also has a logical organization of information which offers news of related topics and recommended news links on the article page. In addition, the website also emphasizes the social interaction aspect of news communication, which provides sufficient functions to allow users to exchange and share opinions with other users.

However, the sufficient customizable function of newspaper iPad applications is a unique feature compared to a website. Basic functions, such as changing display orientations and adjusting display font size, can help readers obtain the best legibility of an e-newspaper. The distinct functions provided by different e-newspapers can meet readers' needs in diverse levels.

5.4 Suggestions and Recommendations for E-newspaper Application Design

According to the case studies of the three iPad news applications, several deficiencies of e-newspaper application design can be concluded. The literature review, online survey results and design analysis provide general guidelines to improve the current newspaper iPad application design.

Based on the review of literature and design analysis, the drawbacks of current e-newspaper iPad application are summarized as follows:

1. The interactivity feature of electronic newspaper is not fully developed in the newspaper iPad application.
2. The navigation flow of some newspaper iPad applications is not fluent, which will cause trouble for readers during the reading process.
3. Compared to a newspaper website, the information provided by the newspaper iPad application is very limited.
4. The newspaper iPad application requires more steps to complete a specific task than a website.
5. In order to create a better reading experience, the iPad newspaper applications should provide users with more functions to customize its legibility.
6. E-newspaper iPad applications need to balance a diverse information format to assist readers in understanding news content better.

Through examining the advantages of e-newspaper website design and readers' expectations of electronic newspaper, the following suggestions will serve as solutions to improve e-newspaper application design.

First, according to the online survey results, the content interactivity and interpersonal interactivity are important advantages that are supported by the majority of the participants. The newspaper websites provide users with diverse functions to enable them to find information they are interested in through establishing an information network. The information-sharing function and "comment" section emphasize a social interactivity feature of e-newspaper as well. These functions can also be applied to news iPad applications.

Second, the newspaper iPad applications attempt to reduce the display space of navigation and other interaction elements through using pop-up windows and buttons. However, the display lacks visual cues to lead users' behavior. Some pop-up windows are hidden from the screen, which only appear when users hover over a specific area or tap a specific button. However, many buttons are displayed with small icons without any text label, so it is hard to notice the icons or may cause misunderstanding for users. It requires users to explore the interface for a while before they become familiar with it. Therefore, the newspaper iPad applications need to provide clear visual cues on their interface. Several possible solutions include punctuating important buttons, using text labels to clarify the icons, and keeping main navigation visible on the screen in the same location at all times.

Third, an e-newspaper needs to provide users with a moderate amount of information so that reader can scan a sufficient amount of information without turning pages. Due to the constrain of the iPad display dimension, a possible solution to display large quantities of information on a limited space is to divide the page into various sections and apply a simple swiping navigation separately to each section. In order to create a fluent navigation flow, it is important to maintain the same swiping gestures and direction throughout each section on the page.

Fourth, simplifying the steps to complete a specific task is critical for e-newspaper iPad applications. In Neilsen's study, he suggested iPad applications usually require more steps to complete a specific task than websites. This is also reflected on the newspaper iPad application design. For instance, the website keeps the navigation on every page, enabling readers to access any section by "one-click". But for some newspaper applications, users need to switch back and forth between the section homepage and news story page through using the pop-up menu. It repeats the article searching process that costs more time to change a news story article for readers. In addition, the "search" function of e-newspaper websites enables users to filter the information that they are interested in conveniently. The importance of a "search" function is also supported by the online survey results. However, this crucial function is lacking in some iPad applications. Providing the "search" function to "search-dominant" users is necessary for newspaper application design.

Fifth, the online survey results reveal that legibility is still an important factor that affects the reading experience of the electronic newspaper for readers. Even though the display technology has improved greatly, readers still have diverse needs for e-newspaper display. The current newspaper applications allow readers to adjust font sizes to fit their personal needs. However, other factors such as color contrast and light contrast also need to be considered in the newspaper application design. More customizable functions related to legibility need to be offered to readers.

Finally, as previous research indicates, the use of images assists readers to perceive information better, and some users are in favor of multimedia content. Therefore, the iPad news applications need to balance the display of text, images and multimedia information. The New York Times application that presents the news title and story summaries on the homepage. Comparatively, the Huffington Post presents news photos with story titles on the news list; this is a better way for readers to acquire information effectively. In Neilsen's case study about iPad magazine design, he suggested the page viewer that displays the thumbnail of articles would benefit readers navigate to a specific article. Therefore, displaying the photo rather than the story summary with the article title on the news story list will be a better way to communicate the general news information to readers.

5.5 Discussions and Future Work

The study compared the users' preference of digital format newspaper and printed newspaper, which supports the e-newspaper will have a promising future in the news publication industry. The design case studies and comparative analysis between the e-newspaper websites and iPad applications also discover the pros and cons of e-newspaper iPad applications, providing general guidelines to improve the current newspaper application design. However, the analysis is based on a personal observation and knowledge background, which may contain personal bias and be different from readers' actual reading behaviors. Further research about the reading process of readers who use iPad newspaper applications needs to be conducted to investigate the real reading experience of readers.

Moreover, the electronic newspaper is experiencing an evolution that merges

various news resources including newspaper, news magazine and news broadcasting into a flexible digital news media for readers. The development is so fast that it is hard to predict the future result of this evolution. However, the role of readers in the news communication process has become more and more important. Therefore, the user-centered design strategy must be the core of e-newspaper application design.

APPENDIX A. ONLINE SURVEY QUESTIONNAIRE

Informed Consent

This is an online survey about the general reading experience and preference about printed newspaper and digital format newspaper. Please take your time in deciding if you would like to participate.

INTRODUCTION
The objective of this study is to compare the general attitudes towards printed newspaper and digital format newspaper. Also it is to investigate the pros and cons of digital format newspaper. This survey aims to answer the following questions:
1). Which medium is more preferred between traditional newspaper and digital format news?
2). What are the advantages and disadvantages of the digital format news?

DESCRIPTION OF PROCEDURES
If you ages 18 and over and agree to participate in this survey, it will last for approximately 20 minutes. During the study you will be asked 20 questions about reading printed newspaper and digital format newspaper.

RISKS
There are no foreseeable risks in this study. However, you may leave the study at any time without penalty.

BENEFITS
Participants will not get direct benefits. However, this knowledge can be expected to ultimately provide significant opportunities to understand the pros and cons of digital format newspaper.

COSTS AND COMPENSATION
You will not have any costs from participating in this study. You may optionally provide your e-mail address in order to be entered into a drawing a $50 visa gift card. The drawing will be completed at the end of the study lifespan (at a time at which a present number of participants have completed the study), and participants who have been randomly selected via computer randomization will be notified directly via email of their winning.

PARTICIPANT RIGHTS
You are completely voluntary and you may refuse to participate or leave the study at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled. You can quit at anytime if you feel uncomfortable during the survey.

CONFIDENTIALITY
Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.
To ensure confidentiality to the extent permitted by law, the following measures will be taken.
The participant's identity will be anonymous all throughout the survey. Only the researcher will have access to the data.

QUESTIONS OR PROBLEMS
You are encouraged to ask questions at any time during this study. For further information about the study contact Lei Zhang, phone 515-509-6705, email lzhang@iastate.edu.

If you have any questions about the rights of research subjects or research-related injury, please contact IRB Administrator, (515) 294-4566, IRB@iastate.edu, or Director, Office for Responsible Research, (515) 294-3115, 1138 Pearson Hall, Ames, IA 50011.

1. Would you like to participate this survey?

If yes, please go to the next page to process the survey.

If no, please click the "Exit this survey" button at the top right corner to quit.

◯ Yes

◯ No

Demographic Information

2. Age:

3. Gender:

- ◯ Male
- ◯ Female

4. Native language

5. Profession

6. Education

7. Monthly Income

Questions for reading News

Please answer the questions about reading newspaper

8. What devices do you have or own? (Multiple choice)

- [ ] Desktop computer
- [ ] Laptop computer
- [ ] Tablet PC (iPad or other brands)
- [ ] Smart phone
- [ ] Regular phone
- [ ] E-book device
- [ ] iTouch

Other (please specify)

9. If you have an E-book device, what is the brand? (If your don't have one, please skip this question.)

- [ ] Kindle
- [ ] Barnes & Noble
- [ ] Sony Reader

Other (please specify)

10. How frequent do you use the devices listed in Question 7? Please range the frequency of using devices (high--low)

11. What devices do you usually use to read the news? (Multiple choice)

- [ ] Print newspaper
- [ ] Computer
- [ ] Mobile phone (via the internet)
- [ ] Mobile phone (via apps)
- [ ] iPad (via the internet)
- [ ] iPad (via apps)

Other (please specify)

12. How frequent do you access the news by the devices you selected in Q10? Please range the frequency of accessing news (high--low)

13. How often do you read news?

- ◯ Weekly
- ◯ Daily
- ◯ Twice per day (morning & night)
- ◯ Several times per day

Other (please specify)

14. Which media format do you prefer to access news?

- ☐ Text only
- ☐ Text & Image
- ☐ Video & Audio

Other (please specify)

Comparing digital newspaper (website, news apps, etc.) and printed newspape...

Please evaluate the Question 14~ 21 based on 1~5 scale (1/disagree—5/ agree)

15. The digital format is easier to find information compared with printed newspaper.

	disagree		neutral		agree
My attitude	◯	◯	◯	◯	◯

16. The digital format is easier to navigate me to the article I'm interested in compared with printed newspaper.

	disagree		neutral		agree
My attitude	◯	◯	◯	◯	◯

17. The digital format is more difficult to store useful information compared with printed newspaper.

	disagree		neutral		agree
My attitude	◯	◯	◯	◯	◯

18. The sound and video used in digital news is helpful to get information better

	disagree		neutral		agree
My attitude	◯	◯	◯	◯	◯

19. The digital format is easier to share and discuss news with other people compared with printed newspaper.

	disagree		neutral		agree
My attitude	◯	◯	◯	◯	◯

20. The digital format is more difficult to retrace old information compared with printed newspaper.

	disagree		neutral		agree
My attitude	◯	◯	◯	◯	◯

21. I feel more visual fatigue when I read digital news than printed news

	disagree		neutral		agree
My attitude	◯	◯	◯	◯	◯

22. Overall, I prefer to read digital format news than printed news

	disagree		neutral		agree
My attitude	◯	◯	◯	◯	◯

23. Compared with printed newspaper, what do you think the advantages of digital newspaper are? (Multiple choice)

- [ ] Portability
- [ ] Eco-friendly
- [ ] Quick update
- [ ] Easy navigation
- [ ] Multimedia (audio & video)
- [ ] Can compare information of difference presses

Other (please specify)

24. Compared with printed newspaper, what do you think the disadvantages of digital newspaper are? (Multiple choice)

- [ ] Hard to read
- [ ] Hard to use the device or interface
- [ ] Unable to mark or write
- [ ] Visual fatigue
- [ ] Expensive

Other (please specify)

Question about using an iPad

25. How often do you use iPad to read news?

- ◯ I don't have an iPad
- ◯ Weekly
- ◯ Daily
- ◯ Several times per day

26. Where do you usually use iPad to read news? (Multiple choice)

- ☐ I don't have an iPad
- ☐ Home
- ☐ Office
- ☐ Bus or Subway
- ☐ Airplane or Airport

Other (please specify)

27. If you use iPad News Apps, which app do you usually use? (Please specify)
If you don't have an iPad, please put N/A in the textbox.

28. If you use iPad to read news online, which website do you usually access? (Please specify)
If you don't have an iPad, please put N/A in the textbox.

APPENDIX B. IRB APPROVAL FORM

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Resear
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 1/23/2012

To: Lei Zhang
246 N Hyland
Ames, IA 50014

CC: Dr. Sunghyun Kang
282 Design
Debra Satterfield
277 College of Design

From: Office for Responsible Research

Title: Comparing the Reading Experiences between Traditional Newspaper and Digital Format Newspaper

IRB ID: 12-024

Study Review Date: 1/20/2012

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where
  - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
  - Any disclosure of the human subjects' responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.

The determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**

- **You must carry out the research as described in the IRB application.** Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

  Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

  Detailed information about requirements for submission of modifications can be found on the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. **Only the IRB or designees may make the determination of exemption**, even if you conduct a study in the future that is exactly like this study.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

IRB ID: 12-024

RECEIVED
JAN 13 2012
By IRB

INSTITUTIONAL REVIEW BOARD (IRB)
Exempt Study Review Form

Title of Project: Comparing the reading experiences between traditional newspaper and digital format newspaper		
Principal Investigator (PI): **Lei Zhang**		Degrees: Master of Fine Arts
University ID: **601507907**	Phone: 5155096705	Email Address: lzhang@iastate.edu
Correspondence Address: College of Design		
Department: Art & Design		College/Center/Institute: College of Design

PI Level: ☐ Tenured, Tenure-Eligible, & NTER Faculty ☐ Adjunct/Affiliate Faculty ☐ Collaborator Faculty ☐ Emeritus Faculty
☐ Visiting Faculty/Scientist ☐ Senior Lecturer/Clinician ☐ Lecturer/Clinician, Ph.D. or DVM ☐ P&S Employee, P37 & above
☐ Extension to Families/Youth Specialist ☐ Field Specialist III ☐ Postdoctoral Associate ☒ Graduate/Undergrad Student ☐ Other (specify:)

FOR STUDENT PROJECTS (*Required when the principal investigator is a student.*)		
Name of Major Professor/Supervising Faculty: Sunghyun Kang		
University ID: 601507907	Phone: 5152941669	Email Address: shrkang@iastate.edu
Campus Address: 146 College of Design		Department: Art & Design
Type of Project: (check all that apply) ☒ Thesis/Dissertation	☐ Class Project	☐ Other (specify:)

Alternate Contact Person: Debra Satterfield	Email Address: debra815@iastate.edu
Correspondence Address: 146 College of Design	Phone: 5152941669

ASSURANCE

- I certify that the information provided in this application is complete and accurate and consistent with any proposal(s) submitted to external funding agencies. Misrepresentation of the research described in this or any other IRB application may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.
- I agree to provide proper surveillance of this project to ensure that the rights and welfare of the human subjects are protected. I will report any problems to the IRB.
- I agree that modifications to the originally approved project will not take place without prior review and approval by the IRB.
- I agree that the research will not take place without the receipt of permission from any cooperating institutions, when applicable.
- I agree to obtain approval from other appropriate committees as needed for this project, such as the IACUC (if the research includes animals), the IBC (for research involving biohazards), the Radiation Safety Committee (for research involving x-rays or other radiation producing devices or procedures), etc.
- I agree that all activities will be performed in accordance with all applicable federal, state, local, and Iowa State University policies.

Lei Zhang 1/13/2012
Signature of Principal Investigator Date

Sunghyun Kang 1/13/2012
Signature of Major Professor/Supervising Faculty Date
(*Required when the principal investigator is a student.*)

- I have reviewed this application and determined that departmental requirements are met, the investigator(s) has/have adequate resources to conduct the research, and the research design is scientifically sound and has scientific merit.

Debra Satterfield 1/13/12
Signature of Department Chair Date

For IRB Use Only	☐ Not Research Per Federal Regulations	☐ No Human Participants	Review Date: January 20, 2012
	☒ Minimal Risk	EXEMPT Per 45 CFR 46.101(b): 2	
IRB Reviewer's Signature Kate Conard			

Exempt Study Information

Please provide *Yes* or *No* answers, except as specified. Incomplete forms will be returned without review.

Part A: Key Personnel

List all members and relevant qualifications of the project personnel. Key personnel includes the principal investigator, co-principal investigators, supervising faculty member, and any other individuals who will have contact with the participants or the participants' data (e.g., interviewers, transcribers, coders, etc.). This information is intended to inform the committee of the training and background related to the specific procedures that each person will perform on the project. For more information, please see Human Subjects - Persons Required to Obtain IRB Training.

NAME	Interpersonal contact or communication with subjects, or access to private identifiable data?	Involved in the consent process?	Contact with human blood, specimens, or other biohazardous materials?	Other Roles in Research	Qualifications (i.e., special training, degrees, certifications, coursework, etc.)	Human Subjects Training Date
Lei Zhang	☐	☒	☐		BA, MFA candidate	08/31/2010
Sunghyun Kang	☐	☐	☐		BFA, BA, MFA	08/08/2002
Debra Satterfield	☐	☐	☐		BS, MFA	01/21/2003
Fred Malven	☐	☐	☐		BS, MA, PhD	02/28/2008
	☐	☐	☐			
	☐	☐	☐			
	☐	☐	☐			
	☐	☐	☐			
	☐	☐	☐			
	☐	☐	☐			
	☐	☐	☐			
	☐	☐	☐			
	☐	☐	☐			
	☐	☐	☐			
	☐	☐	☐			
	☐	☐	☐			

Please complete additional pages of key personnel as necessary.

APPENDIX C. ELECTRONIC NESPAPER IPAD APPLICATION DESIGN EVALUATION MATRIXS

	Items	**Newspaper A**	**Newspaper B**	**Newspaper C**	…
Visual Presentation	Presentation style				
	Clarity of navigation				
Information Structure	Sections on the homepage				
	Number of news items on the homepage				
Information Accessing Immediacy	Windows to access news article content				
News Flow	Navigation flow				
	Information loading time				

BIBLIOGRAPHY

Ambrose, G. & Harris, P. (2011). *The Fundamentals of Typography.* Switzerland: AVA Publishing SA.

Bernard, L. M., Chaparro, S. B., Mills, M. M., & Halcomb, G. C. (2003). Comparing the effects of text size and format on the readability of computer-displayed Times New Roman and Arial text. *International Journal of Human-Computer Studies, 59(6), 823–835.*

Borchers, J., Deussen, O., Klingert, A., & Knorzer, C. (1996). Layout rules for graphical web documents. *Computer & Graphics, 20(3),* 415–426.

Bordewijk, J. L. & van Kaam, B. (1986). Towards a new classification of tele-information services. *Intermedia, 14,* 16–21.

Brown, J. G. (2001). Beyond print: reading digitally. *Library Hi Tech, 19(4),* 390-399.

Budiu, R. & Nielsen, J. (2011). *Usability of iPad Apps and Websites.* http://www.nngroup.com/reports/mobile/ipad

Carter, R., Day, B., & Meggs, P. (2007). *Typographic Design: Form and Communication.* Hoboken: John Wiley & Sons, Inc.

Dillon, A., McKnight, C., &Richardson, J. (1988). Reading from paper versus reading from screen. *The Computer Journal, 31(5),* 457–464.

Dyson, C. M. & Kipping, J. G. (1997). The legibility of screen formats: are three columns better than one? *Computer & Graphics, 21(6),* 703–712.

Evans, H. (1973). *Newspaper design, book five.* New York: Watson-Guptill.

Fredin, E.S. & David, P. (1998). Browsing and the hypermedia interaction cycle: A model of self-efficacy and goal dynamics. *Journalism & mass Communication Quarterly, 75(1),* 35–54.

Friedland, L. A. & Webb, S. (1996). Incorporating online publishing into the curriculum. *Journalism & Mass Communication Educator, 51,* 54–65.

Gunter, B. (2003). *News and the Net.* Mahwah, New Jersey: Lawrence Erlbaum Associates.

Harrower, T. (1995). *The Newspaper Designer's Handbook.* Madison, Wisconsin: W.C.B., Brown & Benchmark Publishers.

Herther, K. N. (2009). Kindle DX: Amazon's latest ebook reader. *Information Today, 26(9),* 26(2).

Hvistendahl, J. K. & Mary R. K. (1975). Roman v. sans serif body type: Readability and reader preference. *ANPA News Research Report 2* (January).

Kang, Y. Y., Wang, J. M., & Lin, R. (2009). Usability evaluation of E-books. *Displays, 30(2),* 49–52.

Katz, E., Gurevitch, M., & Haas, H. (1973). On the use of the mass media for important things. *American Sociological Review, 38,* 164–181.

Kawamoto, K. (2003). *Digital Journalishm: Emerging Media and the Changing Horizons of Journalism.* Lanham: Rowman & Littlefield Publishers, Inc.

Klare, R. G. (2000). The measurement of readability: useful information for communicators. *ACM Journal of Computer Documentation, 24(3),* 107–121.

Krug, S. (2006). *Don't Make Me Think! A Common Sense Approach to Web Usability.* Berkeley, California: New Riders Publishing.

Lang, A. (2000). The limited capacity model of mediated message processing. *Journal of Communication, 50,* 46–70.

Lee, D. S., Ko, Y. H., Shen, I. H., & Chao, C. Y. (2011). Effect of light source, ambient illumination, character size and interline spacing on visual performance and visual fatigue with electronic paper displays. *Displays, 32(1),* 1–7.

Lee, D. S., Shieh, K. K., Jeng, S. C., & Shen, I.H. (2008). Effect of character size and lighting on legibility of electronic papers. *Displays, 29(1),* 10–17.

Leigh, J. H. (1991). Information processing differences among broadcast media: Review and suggestions for research. *Journal of Advertising, 20,* 71–75.

Li, X. (2006). *Internet Newspapers: The Marketing of a Mainstream Medium.* Mahwah, New Jersey: Lawrence Erlbaum Associates.

Li, X. Web page design and news retrieval efficiency: a content analysis of five U.S. Internet newspapers. In Li, X. (Eds.). (2006) *Internet Newspapers: The Marketing of a Mainstream Medium* (65–80). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Li, X. (1998). Web page design and graphic use of three U.S. newspapers. *Journalism & Mass Communication Quarterly, 75(2)*, 353–365.

Lin, P., Lin, Y., Hwang, S. L., Jeng, S. C., & Liao, C. (2008). Effect of anti-glare surface treatment, ambient illumination and bending curvature on legibility and visual fatigue of electronic papers. *Displays, 29(1),* 25–32.

Lin, Y.T., Hwang, S. L., Jeng, S. C., & Koubek, J. R. (2011). Minimum ambient illumination requirement for legible electronic-papers display. *Displays, 32(1),* 8–16.

Lonsdale, S. M., Dyson, C. M. & Reynolds, L. (2006). Reading in examination-type situations: the effects of text layout on performance. *Journal of Research in Reading, 29(4),* 433–453.

Lowrey, W. & Gade, J. P. (2011) Changing the News: The Forces Shaping Journalism in Uncertain Times. New York: Routledge.

Moen, R. D. (2000). *Newspaper Layout & Design: A Team Approach.* Ames: Iowa State University Press.

Morineau, T., Blanche, C., Tobin, L., & Gueguen, N. (2005). The emergence of the contextual role of the e-book in cognitive processes through an ecological and functional analysis. *International Journal of Human-Computer Studies, 62(3), 329–348.*

Nguyen, B. & Chaparro, B. (2010). Survey results: iPad is best for reading, communicating, and gaming. *Usability News, 12(2).* http://www.surl.org/usabilitynews/122/ipadsurvey.asp

Nielsen, J. (2009). *Kindle 2 Usability Review.* http://www.useit.com/alertbox/kindle-usability-review.html

Nielsen, J. (2011). *Kindle Fire Usability Findings.* http://www.useit.com/alertbox/kindle-fire-usability.html

Paul, N. (1995). *Content: Are-visioning.* Paper presented to the conference on Interactive newspapers ’95. Available at: http://www.poynter.org/research/nm/nm_revision.html

PricewaterhouseCoopers (PwC), (2010). *Turning the Page: The Future of Ebooks.* http://www.pwc.com/gx/en/entertainment-media/publications/future-of ebooks.jhtml

Rebello, J. (2009). You're ready for the e-reader- but which one? *Massachusetts Lawyers Weekly, Nov 2.*

Rice, M. (2010). *USA Today iPad app: Behind the Scenes.*http://www.snd.org/2010/05/usa-today-ipad-app-behind-the-scenes/

Samara, T. (2002). *Making and Breaking the Grid.* Beverly: Pockport Publishers.

Severin, W.J. (1967). Pictures as retrieval cues in multi-channel communications. *Journalism Quarterly, 44,* 17–22, 52.

Vyas, S. R., Singh, N. P. & Bhabhra, S. (2007) Media displacement effect: investigating the impact of Internet on newspaper reading habits of consumers. *Vision–The Journal of Business Perspective, 11(2),* 29–40.

Shen, I. H., Shieh, K. K., Chao, C.Y., & Lee, D.S. (2009) Lighting, font style, and polarity on visual performance and visual fatigue with electronic paper displays. *Displays, 30(2),* 53–58.

Siegenthaler, E., Wurtz, P., Bergamin, P., & Groner, R. (2011). Comparing reading processes on e-ink displays and print. *Displays, 32(5),* 268–273.

Sunder, S. S. (1999). Exploring receivers' criteria for perception of print and online news. *Journalism & Mass Communication Quarterly, 76(2),* 373–386.

Tashman, C. & Edwards, W. K. (2011). Active reading and its discontents: the situations, problems and ideas of readers. *CHI 2011: Proceedings of the 2011 annual conference on Human factors in computing systems.* ACM Press.

Tinker, A. M. & Paterson, D. G. (1931) Studies of typographical factors influencing speed of reading: III. Length of line. *Journal of Applied Psychology, 15(3),* 241-247.

Whitbread, D. (2001). *The Design Manual.* Sydney, Australia : UNSW Press.

Wilson, R., Landoni, M., & Gibb, F. (2002). A user-centred approach to e-book design. *The Electronic Library, 20(4),* 322–330.

Wilson, R. & Landoni, M. (2003). Evaluating the usability of portable electronic books. *SAC '03: Proceedings of the 2003 ACM symposium on Applied computing.* ACM Press.

ACKNOWLEDGEMENTS

I would like to take this opportunity to express my thanks to those who helped me with various aspects of the research and writing of this thesis. First and foremost, I would like to thank my major professor Sunghyun Kang for her guidance throughout my research and writing; her insights into the field have been inspirational. I would also like to thank my committee members, Debra J. Satterfield and Frederic C. Malven, for their inspiring ideas through their unique research areas of specialization, which had enabled me to look in new directions. With the knowledge I have gained throughout this study, I hope to avidly continue my research in news media design in my future academic career.

Additionally, I must thank Nora Ladjahasan, Research Scientist with Iowa State Institute for Design Research and Outreach, for her work on the statistical analysis of the survey about readers' attitudes toward digital format newspaper and the feedback she gave me along the way.

I would also like to thank Beverly Krumm, the lecture of Graphic Design at Iowa State University, and Kayla Nielsen, a recent graduate of Psychology at Iowa State University, for their assistance and helpful recommendations regarding proofreading and polishing the language of my thesis.

Finally, I would like to thank all my friends and colleagues who accompanied me during the past three years. I really appreciate their help and encouragements during the time I studied graphic design at Iowa State University.