CHAPTER 9

TECHNICAL INVESTIGATION:
VALUE ANALYSES OF EXISTING READING TECHNOLOGIES

Outside of a dog, a book is man's best friend. Inside of a dog, it's too dark to read.
— Groucho Marx (attributed)

This chapter describes the first of three technical investigations performed as part of this dissertation. In Value Sensitive Design, technical investigations can be conducted in several ways. One approach is to use an existing value-stakeholder framework to review existing technologies in terms of how well they address various value-related concerns. In this chapter, various technologies that support the reading process (i.e., reading widgets) are described and evaluated relative to the value-stakeholder framework from Chapter 6. First, the review process and how the reviews are presented is discussed. Next, the first technology reviewed is the traditional book and other forms of printed text. The next section overviews the currently available assistive technology. Several electronic reading devices are then evaluated. A discussion of the insights from the different reviews concludes the chapter.

1 The Value-Based Reviewing Process

In the following sections, multiple forms of technologies related to reading are reviewed. Each review begins with a description of the relevant reading widget or component under consideration. This description includes relevant features of the widget, how it is used, and both monetary and usage costs.

The technology is then evaluated in terms of how well it supports a set of seven key values: access, choice, empowerment\(^1\), fairness, literacy, normalcy, and privacy. For the reader’s convenience, definitions of these seven values are listed in Table 9.1. These values were selected from the interactive framework presented in Figures 6.3(a) and 6.3(b) in Chapter 6 (page 125), and each represents a key factor theme identified in the previous conceptual and empirical investigations that influences technology usage or reading disability management. Certain key values, such as identity and community, are not specifically included in this review as relevant elements of these values can be discussed within other values when the need arises. For
Table 9.1: Definitions of values used in the reviews of different reading technologies.

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>The ability of a person to use a system or service without experiencing barriers or difficulties.</td>
</tr>
<tr>
<td>Choice</td>
<td>The freedom and opportunity for a person to select among several options, including the option to choose none of them.</td>
</tr>
<tr>
<td>Empowerment</td>
<td>A person’s ability to freely plan, decide, and act as she deems best.</td>
</tr>
<tr>
<td>Fairness</td>
<td>All individuals should be treated favorably and without bias, dishonesty, or injustice. The belief that reasonable steps should be made to ensure that all persons have an opportunity to succeed in life.</td>
</tr>
<tr>
<td>Literacy</td>
<td>The ability to consume and produce information in a prescribed way (reading and writing). The expectation that a member of society has received an education and can read and write.</td>
</tr>
<tr>
<td>Normalcy</td>
<td>The degree to which a person conforms to the ideals of a society and the accompanying acceptance, rejection, and psychological impact received due to the degree of conformity. An individual’s conception of what the qualities and abilities (physical, mental, emotional, etc.) of other members of society are and how it compares to the individual’s own qualities and abilities.</td>
</tr>
<tr>
<td>Privacy</td>
<td>The rights to be left alone and to control how information about oneself is disseminated.</td>
</tr>
</tbody>
</table>

example, the role of community in influencing technology adoption and one’s sense of identity invoke values of normalcy and privacy.

When interpreting how well a widget supports the values, the viewpoints of different stakeholder groups are considered. Primarily, this view is that of the main direct stakeholder group: adults with RDs. Various other stakeholder groups are still relevant, of course, and are mentioned when applicable. In particular, the perspective of instructors in regards to the fairness of using the reviewed technology is of interest. As noted earlier, some college instructors have expressed doubt and distrust over providing accommodations to students with RDs/LDs (W. M. Williams & Ceci, 1999; Zirkel, 2000; Vickers, 2010). This vocal minority creates both a value tension and a value dam around issues of fairness (see Chapter 6, Section 4), as well as the need to evaluate how well any reading widget addresses potential fairness concerns.

2 The Book and Printed Text

To begin these technology reviews, the first reading widget under consideration might not be complex in terms of technology, but it has been refined and improved over the past centuries—printed text. Be it bound as a book, in a magazine, or several leafs of paper stapled together, printed text is typesetted text that is readily mass-produced (Knuth, 1999). One of the key attributes of this medium is that once it has printed, the text is essentially fixed in terms of its content and presentation. Other than through the use of external tools such a magnifying lens or a color overlay, no elements of the typography can be changed.
Moreover, printed text is not only about the content. How the text is presented is just as important (Bernhardt, 2004; Hill, 2004). Font choices, section headings, images, and even how text breaks across lines all shape the reading experience proffered by printed text (Tinker, 1963, 1965; Zachrisson, 1965; Frase & Schwartz, 1979; Santos Lonsdale et al., 2006). The differences in the usage experience of reading from a small paperback versus a heavy hardcover book are readily apparent. Printed text is both content and form, and both need to be considered when evaluating its support of the seven values in this review.

Foremost, the book/printed text is clearly supportive of the value of literacy. In many ways, the book is the symbolic embodiment of literacy, and separating the two is thereby difficult due to their shared history. The conventions of typography have shaped how people read, and how we read has similarly influenced how books are typeset. Typography began more as an art form, and the concept of the book as art is greatly exemplified in the illuminated tomes from the medieval ages (Knuth, 1999). Even after the printing press made mass production of books possible, great care was made in the design of typefaces and the laying out of each line of text (Sutherland, 1989; Knuth, 1999). These choices did not reflect only aesthetic goals, however, as readability and legibility were also desired. Centuries later, it would be determined by sensory psychologists like Tinker that their choices reflect the visual capabilities of the average reader (Tinker, 1963, 1965; Zachrisson, 1965; Sutherland, 1989).

Because both the book and the act of reading co-evolved, printed text also supports the notion of normalcy. Reading from a book, magazine, or stapled together pieces of paper will not make the user stand out in any particular way. Similarly, the privacy of a person with an RD is likely to be maintained when he or she reads silently from a book, even when in public. Only when reading has to be aloud or accomplished in a fast manner might there be some indications of deviance from normal on the part of a reading-disabled user. For example, reading a menu proved so challenging and distressing to one woman in the study by Tanner (2009) that she would insist on always eating at the same restaurant when dining with people who did not know about her RD.

This example also shows some of the limitations of printed text. Despite successfully supporting the values of literacy, normalcy, and privacy, printed text is not as supportive for the other values relevant to this review. For both empowerment and fairness, books are fairly neutral in their support of these values for the direct stakeholders. While the knowledge found in a book can empower the reader, this is true for any reader regardless of disability. Similarly, any concerns about fairness that an instructor may have about providing printed text to one student can be easily rectified by providing the same printed text to all students.

Access and choice, however, are negatively supported by printed text. Difficulties with access to printed text essentially create and define reading disability. Because text is the default state in which reading occurs, barriers to access are expected. Some texts are more accessible than others, however, such as large-print editions for readers with poor vision. Such large-print books are one of the few means by which the value of
choice is provided to the user. In general, printed text offers no freedom of choice to the user as the typography and content are fixed upon printing. Some choice can occur if different print formats are available, such as large-print editions or if the book is available from different publishers. However, this choice only exists at the time of purchase and only if multiple options are available to the consumer.

New options for printed text might change this scenario, however, in the form of personalized typesetting (Karow, 1998). Efforts like the Espresso Book Machine (On Demand Books, 2010) allow the consumer to purchase a book and have it printed using the purchaser’s personally selected typographic settings. Although the printed book will still be fixed in its format, the user at least has greater freedom of choice at the purchasing level. Personalized typesetting may also increase empowerment on behalf of those with RDs given the possible usage of personalized typography to improve reading performance (Dickinson et al., 2002; Gregor et al., 2003).

3 Assistive Reading Technologies

Given that printed text presents some access difficulties to those with reading disabilities, several forms of assistive reading devices have been developed. These range from simple tools like the color overlay to the more complex and technical text-to-speech systems. In this section, several types of these assistive reading technologies are evaluated.

3.1 Overlays and Windows

Among the simplest forms of assistive reading widgets are the text window and the color overlay. The text window (described in Chapter 3, Section 1.4) is a piece of cardboard or other stiff material with a small window cut into it in order to hide surrounding text, lessen visual distraction, and prevent line skipping. Color overlays (Chapter 3, Section 1.3) are transparent plastic sheets tinted to various colors that have been found to reduce the effects of visual stress. Both are used in the same way: placed on top of the text and moved as necessary.

One strength of these tools is their simplicity. Each is designed to address a specific reading difficulty and only that. Moreover, each can be readily constructed by anyone from materials at home or a local office supply store. This also negates the need to consult an AT specialist. This simplicity makes windows and overlays positively support several of the values. Both tools promote access, if only for a narrow range of difficulties. Empowerment is also readily encouraged as the user can act on his or her own in acquiring and configuring these tools. The simplicity of the reading intervention is unlikely to trigger fairness concerns as well.

Some degree of choice is also available with color overlays and text windows. The size of each is customizable. The two can be used separately or combined. However, the choice is inherently limited in terms of what is helpful. Not every color will help a person with visual stress. Too large of a window will fail to reduce the distraction of surrounding text, and too small of one will hinder reading.

Similarly, overlays and windows offer mixed support of the value of literacy. Both can improve reading
performance in the right user, so some positive support is there. However, because the window and the overlay are peripheral to printed text, their usage will interfere with the typical actions of reading. As mentioned in Chapter 2, Section 1.4, text windows may reduce comprehension due to obscuring the layout of text, which has been shown to affect recall and understanding (Frake & Schwartz, 1979; Wylie & McGuinness, 2004; Walker et al., 2005; Santos Lonsdale et al., 2006). Moreover, the action of reading is altered by usage of one of these widgets. Depending on its size, the window or overlay may have to be moved across a page. When the time comes to turn a page, extra steps are needed to remove and replace the widget. These interruptions, albeit minor, do interrupt the flow of reading.

The issue is that their usage deviates from the normal approach to reading. Because the vast majority of readers do not use windows or overlays, the use of one will be readily observed by those around. This usage may also suggest that the reader may be abnormal in some way. For example, in Britain, usage of color overlays for addressing dyslexia and related conditions is commonly known (Evans, 2001; D. Mills, 2005). At the same time, eye strain is common among people who must read frequently, so that reason could be given to explain using one. A text window or straightedge is sometimes recommended to improve pacing when skimming or speed reading. Thus, text windows and color overlays are limited in their support of the values of privacy and normalcy. Some negative implications of their usage exist due to associations with disabilities, but these negative aspects are ameliorated by the fact that more normal, more common reasons also exist for why they might be used.

3.2 Text-To-Speech Software

The next set of assistive reading widgets to evaluate are far more complex than the window and overlay. As described in Chapter 3, text-to-speech systems are the most common form of computer-based ATs for people with RDs. Multiple TTS software packages are available commercially, but for brevity, only two are evaluated here: Kurzweil 3000® and ReadPlease. These two systems represent the extremes in what is commercially available in text-to-speech for people with RDs in that the two are on opposite ends of the ranges for price and feature availability.

3.2.1 Kurzweil 3000

Kurzweil 3000 is one of the most popular TTS systems available today (Kurzweil Educational Systems, 2006; Laga et al., 2006). In addition to reading digital texts aloud, Kurzweil 3000 also comes with OCR software that allows a user to scan in any document of his choice. Documents can also be imported from files in several formats (e.g., PDF and Word). Additional tools to support the reading process include highlighting, magnification, a built-in dictionary, and pronunciation controls. The tools can be finely configured to meet the user’s needs. Individual software licenses for Kurzweil 3000 are priced between $1095 and $1495, with the primary price difference being if documents are imported or scanned in grayscale or color.
3.2.2 ReadPlease

ReadPlease (2005) is another popular TTS system. Much simpler than Kurzweil 3000, it has no scanning or import features. Users either copy and paste or type in the text they wish to be read aloud. ReadPlease contains some additional tools, such as word highlighting and speed adjustment, that can be configured to meet the user’s needs. ReadPlease is available as freeware, although a deluxe version is available for $50. The deluxe version adds some additional tools and features, though not as many as found in Kurzweil 3000.

3.2.3 Value Evaluation

As these two systems are assistive technologies, they should readily promote the value of access, and, to a degree, both do so. The key component in both, text-to-speech, has been identified as a helpful accommodation for most people with RDs (Elkind et al., 1996; Sands & Buchholz, 1997). Kurzweil goes further in promoting access, however, due to its greater recognition of the value of choice. By providing additional features beyond TTS, it can address other sources of reading disabilities better than the more limited ReadPlease.

Another aspect of access concerns getting the texts to be read by the systems. Manual entry by typing or copy/paste, as with ReadPlease, is cumbersome and scales poorly. Kurzweil’s scanning and file import features are clearly more efficient. Room for improvement still exists, though, as scanning is error-prone and can be a time-consuming, page by page process.

Similar to access are the systems’ support of the value of empowerment—the ability for a person to act for herself. Neither system limits what types of readings can be used. With Kurzweil 3000, less effort is needed to input documents than with ReadPlease. However, this easier usage comes at a high monetary cost. The high software price for Kurzweil 3000 is prohibitive for many users, especially university students who are dealing with other major expenses like tuition. Due to its high price, Kurzweil 3000 is mostly purchased by institutions rather than individuals. The software is made available on certain computers in certain labs. The limited locations and time available further hinders the ability of the user to work at her own discretion (Laga et al., 2006). With its far lower price tag, ReadPlease’s affordability promotes empowerment in its users but at the expense of greater difficulty with inputting documents to read. Moreover, since its basic version is free, it can be readily installed on any computer assuming the user has the appropriate administrative rights.

Unfortunately, both systems also further impair the user’s empowerment due to lack of access in the configuration menus. Neither ReadPlease nor Kurzweil 3000 incorporate TTS in the configuration menus, thus making any text within them potentially inaccessible. Customizing the software to one’s exact needs will be difficult and may require the help of another person. This is a particular concern for a feature-rich system like Kurzweil that may require the user to activate and adjust multiple software options. Kurzweil 3000 does at least incorporate TTS into the help menus, while ReadPlease does not.

Support of privacy is also problematic for the two software systems. Both require the user to wear
headphones or to have the text played aloud for all to hear. Playing the text aloud is likely to mark the user as having issues with reading. Headphones can solve this problem, but their usage is permissible and normal only in some situations. Thanks to the proliferation of MP3 players and iPods, headphones are frequently seen in libraries, computer labs, and many other public spaces. Wearing headphones in a lecture hall or while working with others is inappropriate, however. In these contexts, the user is forced to either not use the software or to relinquish her privacy around her RD.

Even without playing the speech aloud in public, TTS systems are still potential threats to the user’s sense of normalcy. The TTS software’s purpose is to provide assistance to people with reading difficulties. The presence of such an application on one’s computer is a direct reminder and symbol of having an RD. In the case of Kurzweil 3000, the software may only be installed on certain computers. If these computers are somehow marked as for use only by people with disabilities, then using those computers will also label the user as not normal. Moreover, using TTS to read is a deviation from the normal practice of reading. Although audiobooks have been available for quite some time now, is hearing a text read aloud equivalent to reading the text visually? Both ReadPlease and Kurzweil do show the text when it is being spoken aloud, but the user is by no means obligated to follow along.

Finally, the question of fairness can arise in the use of these tools in academic settings. As these are assistive technologies, the goal is for the software to try to level the playing field so that a person with an RD could perform just as well as a person with no disabilities. The concern is that an AT could go beyond equalizing and instead enhance performance. The on-demand dictionary in Kurzweil 3000 is a feature that could provide an unfair advantage. TTS addresses the phonological processing deficit, while the dictionary is primarily a convenient tool to aid comprehension.

A greater concern for fairness, however, is not in the software but the computer running it. Consider the situation in which a student with an RD uses TTS in his classes. On a test, he will be using his computer as per his accommodations. The expectation will be that the computer will be used only for text-to-speech, but the software provides no guarantees that he might access other information stored on the computer or through a network connection. Trust and respect are important mediators of this concern, but the threats to fairness are there and can feed and enlarge doubts about providing accommodations.

3.3 Reading Pens

While ReadPlease and Kurzweil 3000 are software solutions that require a computer to run them, reading widgets can also take the form of specialized hardware. For example, reading pens integrate scanning, OCR, and TTS into a single device (WizCom, 2010). Shaped like a writing utensil, reading pens have a small optical scanner on one end. The user can run this scanner over individual words or lines of text and hear them read aloud. Some reading pens also come with built-in dictionaries or pronunciation guides for use when single
words are scanned.

Because of their design and implementation as specialized hardware, reading pens balance out many of the access issues seen in the TTS software just discussed. Because of the built-in scanner and OCR, any text can readily be digitized. However, the pen is designed for scanning and reading aloud only small segments of text at a time. If the user needs extensive TTS support, the pen will be an inefficient means to scan the entire text. This limitation is tempered somewhat by the lower price (averaging about $250 (WizCom, 2010)) and device portability. Unlike the high expense of Kurzweil 3000, a person with an RD is more able to have a personal pen that is not restricted to usage in a particular computer lab. Thus, the user is offered a greater degree of empowerment by a reading pen.

As for supporting the other values, the reading pen performs similarly to the TTS software. As with Kurzweil 3000, the built-in dictionary may conflict with the value of fairness. Usage in public spaces also presents the user with the same challenges as text-to-speech in that playing the text out loud will disturb the user’s privacy. The user does have the choice of using only the definition and pronunciation features, but such usage in public is still likely to be noticed and commented upon. However, because the pen is used only when needed, any threats to normalcy can be limited. By using the pen only when necessary, the flow of reading is also less interrupted than when using a text window.

3.4 Intel Reader

In 2009, a new reading widget became available—the Intel Reader (Intel, 2010a). The Intel Reader is similar to the reading pen in that it is a specialized piece of portable hardware that combines OCR and TTS, but instead of scanning words or lines at a time, a camera is used to capture an entire page at a time. The imaged text is then displayed on a the device’s screen (10.9 cm diagonal) as it is read. Most importantly, text capture is not limited to just books, but can include restaurant menus, brochures, and any other printed materials one encounters on a daily basis. By making it possible to digitize and hear any text at any time, the Reader is designed to provide text access to people with print disabilities. This includes RDs as well as visual impairments.

At this time and to the best of my knowledge, no formal adoption/user studies of the Intel Reader have been published. There has been one informal field study (Intel, 2010b), however, in which Readers were provided to adolescents with dyslexia in U.S. middle and high schools over a six week period. Since the scope of the study involved a relatively short time period and that the students were given lots of secondary technical support, little to no information is available for prediction about the Reader’s adoptability by adults with RDs/LDs. However, using the value-stakeholder framework, a value evaluation can identify critical issues that will influence its rate of adoption among this primary direct stakeholder group.

Clearly, the Intel Reader succeeds in promoting the values of access and empowerment due to its combination of TTS and OCR. This support is similar to that provided by Kurzweil 3000, although the Intel
Reader does increase the portability of this approach as it can be used anywhere. The Reader also shares some of Kurzweil 3000’s difficulties with promoting these values. Capturing a book page-by-page is still a time-consuming process. Furthermore, the Intel Reader is priced at $1495 per device, making the expense out of reach for some consumers.

Because it is also based around text-to-speech, using the Intel Reader shares the same mixed support of literacy, normalcy, and privacy. Public usage will again require playing the TTS output aloud or using headphones. Moreover, since it is a specialized device, its novelty will also attract attention. Capturing text may involve a camera flash as well, further making the user stand out. Additionally, the Reader only captures the content of text; it does not maintain any of the formatting or layout of the captured text. Thus, the literacy experience using the Reader is considerably different than the original printed version.

The Reader also offers little support for the value of choice. It is only a TTS device and has no additional features like a built-in dictionary or notetaking tools like in Kurzweil 3000. Configuration options are limited to how the text is displayed on the screen: size and color. However, its text-capturing ability does allow the user complete freedom in whatever she wants to read.

Finally, since the Reader can store multiple documents at a time, it can raise some concerns about fairness in situations such as classroom usage and testing. Students will have to be trusted to only listen to appropriate, on-task materials. Similarly, accessing resources that could be construed as cheating is another concern. A more general concern may be the uniqueness of the reader. Unlike with a laptop or other portable computer device, most instructors will have little to no experience with the Reader. This unfamiliarity may breed distrust and concern regarding a student’s use of the technology.

4 Electronic Reading Devices

Supporting reading through computer technologies is not limited to only providing access for people with disabilities, however. Nowadays, not all text is necessarily printed onto paper. In today’s information society, more and more text is becoming available in digital formats. While printing onto paper is usually an option, reading can also take place from computer or other electronic displays.

The idea of reading from an electronic screen has been around for time and was predicted at least as early as 1945 (Bush). Empirical studies have explored the differences between reading from the screen and paper. While early studies suggested that reading from a screen was inferior to reading from paper, the ongoing evolution of display technologies and interface research has established the two as fairly equivalent mediums for reading (Mills & Weldon, 1987; Muter, 1996; Gujar et al., 1998; Price, Schilit, & Golovchinsky, 1998; B. L. Harrison, 2000; Dillon, 2004; Chen, Guimbretiere, Dixon, Lewis, & Agrawala, 2008). Differences still and will continue to exist between the two, however, due to the different affordances offered by the two
technologies. Texts printed on paper are easy to annotate, manipulate, and do not have a limited battery life. Digital texts allow the user to carry around a complete library in a condensed form. Moreover, search functions readily enable finding information in a text.

From the perspective of assistive technologies and reading disabilities, electronic reading devices provide another opportunity and venue in which assistive tools could be deployed. Although these devices have not been deployed or explored as potential reading widgets, the value-stakeholder framework can be applied to them just as with the Intel Reader. Three types of electronic reading devices are considered: e-book readers, tablet computers, and PDAs/smartphones. Each is described, and then the three are evaluated.

4.1 Dedicated E-Book Readers

The first type of electronic reading technology is the dedicated e-book reader. These readers are portable digital devices consisting primarily of a large display, data storage, and text presentation software. Although these devices have been around since as early as 1998 (Gujar et al., 1998; Price et al., 1998), the technology has only recently become popular among consumers (Siegel & Gallaga, 2009). Improvements in the technologies and services associated with e-books are responsible for this change. For example, the Amazon Kindle uses an electronic ink/paper display that mimics papers and enables the screen to be read in a wide range of light levels, including sunlight (Kroeker, 2009; Amazon, 2010). With a battery life up to seven days, this encourages ongoing usage of the reader on daily commutes, at home, and on vacations. Moreover, the Amazon store is set up to make purchasing and downloading of new texts easy for the consumer.

At the time of the writing, several models of e-book readers are available, including the Amazon Kindle, the Barnes & Noble Nook, and the iRex Digital Reader (Amazon, 2010; Barnes & Noble, 2010; iRex, 2010). Aside from the electronic ink displays and extended use batteries, other features are sometimes found in these readers. Texts can be uploaded to the device through a direct connection with a computer or wirelessly through wi-fi, Bluetooth, or a cellular network connection. Some readers can accept different file formats, including the popular PDF format as well as the accessible DAISY and NIMAS standardized formats (NISO, 2005; National Center on Accessible Instructional Materials, 2006). Text can also be enlarged or changed to a different font typeface. A few readers also include reading tools like a built-in dictionary, TTS, or annotation tools. Additionally, most readers remember the last page that the user read, thus solving the misplaced bookmark problem.

4.2 Tablet Computers

Another common feature among e-book readers is that they are a dedicated piece of hardware and only support the act of reading. Portable computers can replicate the functionality of an e-book reader and offer additional functionality as well. Although the most common form of a portable computer is the laptop, tablet computers are also available (Willis & Miertschin, 2004). Tablets are a fully functional computer in the form factor of
a slate in which a large display (22–32 cm diagonal) is the prominent feature. Interaction with the computer is performed primarily through a touchscreen or a pen device/stylus. Not all tablets come with a keyboard, and those that do have the option of detaching or moving the keyboard out of the way. Importantly, because they are computers, tablets can run a variety of software that can include various reading applications. These applications may include any of the features available in e-book readers, including AT tools such as TTS.

The availability of tablets increased significantly in 2002 when Microsoft released a version of Windows XP with support for digital ink (Microsoft, 2002). Tablets running this operating system were essentially the same as a desktop or laptop running regular Windows XP, save for some additional features utilizing the digital ink. This meant that tablets software interfaces supported multitasking across different applications each housed in their own separate window. Interface controls such as menus and buttons that were designed for usage with a mouse interface were unchanged, sometimes causing difficulties for pen-based interactions.

This approach was the norm for tablet computers until the April 2010 release of Apple’s tablet—the iPad (Apple, 2010a). Emphasizing interaction through touchscreens, the iPad uses a specialized operating system, iOS, designed to facilitate working on a tablet. Functionality on the tablet is made extensible through the download of different applications. Multiple applications can be used at the same time, but only one application is viewable at a time. Interface controls have also been redesigned for easier use with a touchscreen or stylus. Although Apple was the first to produce touchscreen-based tablets using this approach, other companies have been developing similar products using the Android operating system with planned releases for late 2010/early 2011.

The iPad is particularly worth noting in this dissertation since as part of its success, the iPad has been receiving accolades as a platform for delivering assistive technologies (Hager, 2010; Harrell, 2010). The disabilities that have received this attention have primarily been severe cognitive disabilities such as autism or disabilities involving communication and the need for augmentative and alternative communication. Even though the iPad’s potential of supporting users RDs/LDs has not been explored, the reasons for its success with other disabilities are worth noting. One of the reasons given by these users or their caregivers is that the iPad is a cheaper option (prices start at $500 plus the cost of applications) than the specialized hardware options typical of most ATs. This is due in part to the economies of scale possible when manufacturing a product for the general population and not a small subset. Furthermore, the iPad offers additional functionality beyond the those specific to the assistive technology. Finally, the design of the hardware and software promotes an exploratory-style interface that greatly improves its usage learning curve.

4.3 PDAs and Smartphones

A third form factor of reading devices is distinguished by its smaller size. Unlike the vast majority of e-book readers and tablet computers, personal digital assistants (PDAs), and smartphones (cellular phones with
additional computing abilities) are small enough to fit into one’s palm or pocket. Their smaller size naturally means a reduced display screen, but their computational capabilities are not. PDAs and smartphones can access networks, play music, display and adjust text, and data can be entered via stylus input or touchscreen. As such, the difference between a PDA and a tablet computer is somewhat unclear, but smartphones are distinguished by their primary role as a cellular phone.

Although I am unaware of any implementations of assistive reading aids onto PDAs or smartphones, it is certainly within the realm of possibility. In the case of the smartphone the iPhone (Apple, 2010b), TTS has been implemented on the iPad which uses the same underlying operating system as the iPhone. Moreover, reading on mobile devices like the PDA has been previously studied (Waycott & Kukulska-Hulme, 2003; Mustonen, Olkkonen, & Hakkinen, 2004; Vadas, Patel, Lyons, Starner, & Jacko, 2006). The study by Waycott and Kukulska-Hulme (2003) is particularly worth mentioning as it reports on the experiences of Masters students in an information technology course in which the course text was provided only on PDAs.

4.4 Value Evaluation

Overall, the three types of electronic reading devices perform similarly in their support of the various values. For example, in all three cases, the consumer has a rich set of devices to choose among. This support of the value of choice comes from the larger consumer market involved in catering to the general population as opposed to only people with RDs/LDs. Similarly, the consumer also has many options for obtaining electronic text due to the recent grown in e-book availability. Since more and more books are available already in electronic form, the user is empowered in that she does not need to spend as much effort.

Unfortunately, this support of choice and empowerment does not carry over into promoting access, however. While it is true that the larger consumer market makes devices more accessible in terms of purchase costs, very few reading accommodations are offered on these devices. Text-to-speech is available on some, but not all, e-readers. Tablets have the option of installing TTS applications. Otherwise, the various devices only provide options for how text is formatted.

In regards to the value of literacy, the form factor of tablets and e-book readers reflect the form factor of books and the printed page. Size, dimensions, and font size are all replicated to some degree. PDAs and smartphones are limited, however, due to their inherently smaller sizes. More importantly, though, is how these devices fit into a larger shift in society’s perceptions of what literacy and reading entail. It is becoming more and more acceptable and normal for people to be seen reading from electronic devices like a Kindle or iPad. Because this is seen as normal, reading from one will not divulge the user as having a disability unless a noticeable reading accommodation like TTS is used. Privacy is thus promoted.

Despite the usage of these technologies becoming increasingly the norm, issues of fairness in their usage in scenarios like classrooms and testing are open questions. Time is needed for educators to react to the relatively
new technology. Since most of these devices can connect to networks, the specter of cheating does arise. This is particular true for smartphones due to concerns about their potential as tools for cheating (Campbell, 2006). However, policies will have to be developed due to the increasing rates of adoption of these technologies. As an example, if an instructor permits students to use their textbooks during exams, the eventual scenario in which some students use electronic versions of the textbook will force the instructor to address the fairness of using e-book readers.

5 Discussion

A summary of the value-based evaluations is presented in Table 9.2. These ratings are not absolute quantities but instead reflect the relative degree to which each technology promotes or detracts from the various values. For example, since printed text defines what is meant by literacy and normalcy in reading, printed text rates at the highest possible (+ + + +) for promoting these values.

In looking at Table 9.2, several patterns are readily noticed. As is to be expected, the assistive reading devices do a better job at promoting access than the other technologies, although the electronic reading devices do put in some effort as well. Similarly, the reading technologies all promote literacy to some degree. Due to their relative newness, the various reading technologies also raise concerns about fairness.

Perhaps most telling is the dynamic between access, normalcy, and privacy. While the assistive reading technologies in Section 3 do a good job at promoting access, their specific focus on disabilities and accommodations detracts from the values of normalcy and privacy. Conversely, the electronic reading devices in Section 4 offer far less access support for users with RDs/LDs, but their emphasis on the general population

<table>
<thead>
<tr>
<th>Table 9.2: Summary of value-based reviews of existings reading technologies. Relative rating are represented as series of up to 4 minus signs (negative support) or 4 plus signs (positive support).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Printed Text</strong></td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Printed Text</td>
</tr>
<tr>
<td>Text Window</td>
</tr>
<tr>
<td>Color Overlay</td>
</tr>
<tr>
<td>Kurzweil 3000</td>
</tr>
<tr>
<td>ReadPlease</td>
</tr>
<tr>
<td>Reading Pen</td>
</tr>
<tr>
<td>Intel Reader</td>
</tr>
<tr>
<td>E-Book Readers</td>
</tr>
<tr>
<td>Tablet Computers</td>
</tr>
<tr>
<td>PDAs / Smartphones</td>
</tr>
</tbody>
</table>
Chapter 9

makes their usage achieve better promotion of normalcy and the privacy of one’s disability.

These reviews suggest several directions on how to build a reading widget that better supports these values. Clearly, policies or technical features that better support the fairness concerns associated with these technologies need to be developed. To address the mixed support of access, normalcy, and privacy, one approach may be to simply integrate assistive reading tools into e-book readers and tablet computers. While this would improve electronic reading devices’ promotion of access for users with RDs/LDs, their support of privacy and normalcy may actually turn negative. The problem with systems like ReadPlease and Kurzweil 3000 are not the computers they are installed on but the visibility and resulting stigma risk of the accommodations they provide. Implementing a full TTS system like Kurzweil 3000 on an iPad or Kindle will not negate the value-based usage concerns.

This idea is not without merit, however, and a more refined approach at incorporating assistive reading tools into general electronic reading devices is detailed in Chapter 11. Before exploring that direction, the next chapter takes the findings from these reviews as well as previous chapters to formulate several design guidelines. These guidelines provide general recommendations for design goals, features, and tasks that should be considered when planning and implementing a reading widget for adults with RDs/LDs.

6 Chapter Summary

This chapter presented a technical investigation in which the value-stakeholder framework was used as a basis for evaluating existing reading technologies. Reviews were performed on printed text, various ATs for RDs, and computer-based reading devices. Support of several values were found to be lacking, including a failure to address fairness concerns and an inverse relationship between support of access and normalcy / privacy.
NOTES TO CHAPTER 9

1 Although empowerment was not discussed in great detail in Chapter 6, it is included in these technical reviews. One of the key goals of any assistive technology is the empowerment of its user to be able to live more independently with less difficulty and fewer barriers (King, 1999; Ladner, 2008). Thus, any assistive reading widget should clearly support the value of empowerment.

2 In the case of a color overlay, the user might be able to select a helpful tint on one’s own. However, some studies have found that the wrong color may actually decrease reading performance (Jeanes et al., 1997; Dickinson et al., 2002). Moreover, studies have shown that to guarantee that a person can find a color that benefits reading, the set of available colors needs to sufficiently cover color space (Smith & Wilkins, 2007). If the user can only procure a small number of colored overlays, he may fail at finding one that benefits his reading. Overlay kits, such as the Intuitive Overlays (Smith & Wilkins, 2007), thus offer upwards of 30 color options in order to fine-tune the color to the user. The color transparencies available from a local office supply store may not offer the same range of options.

3 The complexity of configuring Kurzweil 3000’s many features is also a source of concern for the validity and generalizability of studies of its effectiveness. In studies like Hecker et al. (2002), the study participants are given professional, customized advice and support in the installation and configuration of the system. Study results are therefore reflective of the best-case usage scenario. Real-life usage might involve a less-optimal configuration for the software, thereby lessening any benefits to reading. This concern suggests a need to replicate effectiveness studies in which the participants receive a lesser degree of technical support.